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“LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS OF HUMAN LIFE ENRICHED ”



ENCYCLOPÆDIA BRITANNICA

A New Survey of Universal Knowledge

Volume 7

DAMASCUS to EDUCATION IN ANIMALS

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Volume 7

DAMASCUS to EDUCATION IN ANIMALS

DAMASCUS, capital of the Syrian republic and chief city of the province of Damascus, 57 mi. S E of Beirut, in lat. $33^{\circ} 30'$ N and long. $36^{\circ} 18'$ E. Population (1947 census), 310,246.

Situated under the eastward slopes of the Anti-Lebanon, at the edge of the Syrian desert, Damascus owes its existence to the river Barada, which breaks through the Anti-Lebanon at this point and whose waters are distributed by an ingenious system of canals to irrigate an extensive fan-shaped tract of land, known as the Ghutah. Orchards of fruit trees (olives, apricots, figs, pomegranates, pistachios and almonds) are intermingled with fields of wheat, barley and maize and groves of poplar and walnut, seen from a point of vantage (as from the northern suburb of Sahhiyah, on the slope of Mount Kasiyun), the white minarets of the city rising above the mass of verdure leave an ineffaceable impression. The city stands on the main channel of the Barada, at the northwestern edge of this oasis. The ancient town, roughly rectangular, was huddled on the south bank and protected by a wall, of which portions still remain. The modern city is spoon-shaped, the long handle to the south along the Mecca road forming the quarter known as the Medan. A suburb, Suk Sarouja, was built on the northern bank, and farther toward the northwest is another suburb, Sahhiyah, both of these were greatly expanded and connected by newer suburbs. The old city was divided into quarters, the Jewish quarter being at the southeastern angle and the Christian at the northeastern.

The city is supplied with water from the Barada by an extensive system of canals and conduits. Its streets are for the most part narrow and protected overhead, and the high walls which conceal private dwellings belie the magnificence to be found within. Its public buildings—mosques, schools and khans—present many fine examples of Arabian art. To a partial extent sheltered by hills to the north, west and south, the city lies open to the east and its trying and prevalent winds. It suffers a great variation in temperature in the course of the year. In winter frost and snow are not unknown, and summer temperatures are high, but the nights are always cool. Fever, dysentery and ophthalmia caused by the climatic conditions are prevalent.

In modern, as in earlier times, the development of the city has been affected by great outbreaks of fire. The Great mosque was

guttled in 1893, and in 1912 a conflagration destroyed a considerable tract of bazaars. It is said that Damascus has 240 mosques, mostly dilapidated, of which 70 were still in use at mid 20th century. Catholic and Protestant missions support several educational institutions and hospitals. Damascus is also the seat of the Syrian university.

Antiquities—The ground plan of the city may be said to have remained unaltered since the Mohammedan occupation at least, and a conflagration such as reduced the city to ashes in 1401 merely cleared the site for fresh building. Material and facilities for archaeological study are consequently less than might have been expected. The hand of the Roman workman is visible in what is left of the city walls and gates, in the area of the Great mosque, in the Darb al Mustakim or "Straight street," which was probably colonnaded, and in an aqueduct in the western quarter. The Great mosque (or Omayyad mosque) was originally the church of St. John Baptist, begun by the emperor Theodosius (375) and completed by Arcadius (395-408). It occupied the site of an earlier temple, probably that of Rimmon (*c.* II Kings v, 18). The Omayyad caliph al Walid deprived the Christians of their building (705) and destroyed it in great part before erecting it as a mosque. It was burned down in 1069, pillaged by Timur (1400) and badly damaged by fire in 1893. The citadel in the northwestern angle of the city was built under the Seljuk occupation, rebuilt after 1206 as a royal residence, refortified by



GENERAL VIEW OF THE CITY OF DAMASCUS SHOWING IN THE DISTANCE THE COVERED STREET WHICH IS CALLED STRAIGHT

Sultan Bibars (1262) and maintained by the Ottoman Turks. An inscription of Mohammedan architecture and art was established by the French, as well as a school of Arabic decorative art to revive the work in glass and wood and the colouring of stucco. A Syrian national museum was also instituted.

Commerce—The economic importance of Damascus derives from its agricultural wealth in relation to the trade routes of the Syrian steppe-land, and from the earliest times it has been the market of the desert. For westward trade, on the other hand, it long suffered from lack of easy access to the sea. Ezekiel (xvii, 18) mentions its "wine of Helbon" and its wool, and in classical times it had a reputation for its Chalybeian wine (see of Helbon, modern Halun, 13 mi N N W of Damascus). Its dried fruits (*prunus et cottana* Juvenal ii, 83), still a local specialty, were valued present, and its linens, cloths and cushions were famous. For centuries the "Damascene blade" earned far afield the reputation of the city's armourers. Diocletian promoted this industry but it perished when Timur carried off the smiths in 1401. The silk looms are less important now than formerly, but modern industries such as leather work, the filigree work of gold and silver-smiths and inlaid work in wood and metal (brass, copper) survived. Damascus was hard hit by World War I, and industry revived slowly. The textile industry suffers from foreign competition, and dyeing has declined accordingly. Railway connection with Hauran (1894), Beirut (1895) and Haifa (1905) diminished the caravan trade. Damascus was tending more and more to become a centre for imported foreign goods as well as local produce. (E. Ro., X.)

History—The origin of Damascus is unknown, and the belief that it is the oldest city in the world still inhabited has much to recommend it. It is mentioned in the account of the battle of the four kings against five, in the book of Genesis (ch. xiv), where Abram (Abraham) is reported to have pursued the routed kings to Hobab, north of Damascus (verse 15). In the period of the Egyptian suzerainty over Palestine in the 18th dynasty Damascus (whose name appears in the Tell el-Amarna tablets as Dimashka) was capital of the province of Ubi. Toward the end of that period the overrunning of Palestine and Syria by the Khabiru and Sutu evidently changed the conditions, language and government of the country, and the Aramaean form, Damesek, appears in an inscription of Rameses III. Damascus soon reached such strength that though Tiglath-Pileser I reduced the whole of northern Syria, he did not venture to attack Kadesh and Damascus, so that this kingdom acted as a buffer between Assyria and the rising kingdom of Israel.

David made an expedition (II Sam. viii) against Damascus as a reprisal for the assistance the city had given his enemy Haddadezer, king of Zobah. The Israelite possession of Syria did not last long. A subordinate of Haddadezer named Rezon (Rasun) succeeded in founding a dynasty there, and throughout Solomon's reign he was a constant enemy to Israel (I Kings xi, 23 seq.).

It is inferred from I Kings xv, 19 that Abijah, son of Rehoboam, king of Judah, made a league with Tabrimmon of Damascus to assist him in his wars against Israel, and that afterward Tabrimmon's son Ben-hadad came to terms with the second successor of Jeroboam, Baasha. Asa, son of Abijah, followed his father's policy and bought the aid of Syria, whereby he was enabled to destroy the border fort that Baasha had erected (I Kings xv, 22). Hostilities continued between Israel and Syria. Syria established a quarter for Syrian merchants in Samaria (I Kings xx, 34). A Syrian defeat at Aphek, when the king of Israel acted too leniently, was the cause of a prophetic denunciation (I Kings xx, 42). According to the Assyrian records Ahab fought as Ben-hadad's ally at the battle of Karkar against Shalmaneser III in 835 B.C. This seems to indicate the vassalage of Ahab, of which no direct record remains, and it was perhaps in the attempt to throw this off that he met his death in battle (I Kings xxii, 34-40). In the reign of Joram, Naaman, the Syrian general, came and was cleansed by the prophet Elisha of leprosy (II Kings v).

In 842 Hazael assassinated Ben-hadad and made himself king of Damascus. The states which Ben-hadad had brought together into a coalition against the advancing power of Assyria all re-

volted, and Shalmaneser, king of Assyria, took advantage of this and attacked Syria (842). He wasted the country, but could not take the capital. Jehu, king of Israel, paid tribute to Assyria, for which Hazael afterward revenged himself, during the time when Shalmaneser was distracted by his Armenian wars, by attacking the borders of Israel (II King x, 32).

Adad-nir III invaded Syria and besieged Damascus, c. 805-802, and Jehoahaz, king of Israel, seizing the opportunity, recovered the cities that his father had lost to Hazael. In 735 Ahab of Judah was attacked by Rezon (Rasun, Rezin), king of Damascus at the same time the Edomites and the Philistines revolted. The king of Assyria, Tiglath-Pileser III was besought to help invading Syria, he reduced Damascus in 733.

Except for the abortive rising under Sargon II in 720, we hear nothing more of Damascus for a long period. In 333 B.C., after the battle of Issus, it was delivered over by treachery to Ptolemy, the general of Alexander the Great. It had a chequered history in the wars of the successors of Alexander, being occasionally in Egyptian hands. In 112 B.C. the empire of Syria was divided by Antiochus Grypus and Antiochus Cyrenicus, the city of Damascus fell to the share of the latter. Hyrcanus took advantage of the disputes of these rulers to advance his own kingdom. Demetrius Eucerus, successor of Cyrenicus, invaded Palestine in 88 B.C. and defeated Alexander Jannaeus at Shechem. On his dethronement and captivity by the Partians, Antiochus Dionysus, his brother, succeeded him, but was slain in battle by the Nabataean king Haritha (Aretas). Haritha yielded to Tigranes, king of Armenia, who in his turn was driven out by Q. Caecilius Metellus. In 63 B.C. Syria was made a Roman province, but Damascus remained under the government of the Nabataeans.

In the New Testament Damascus appears only in connection with Acts ix, xxii, xxvi, II Cor. xi and Gal. i. In A.D. 106, under Trajan, Damascus became a Roman provincial city. Under the Romans the city was largely reconstructed and the canalization replanned. On the establishment of Christianity Damascus became the seat of a bishop who ranked next to a Christian church.

In 635 Damascus was captured by the Moslem Arabs under Khalid ibn al-Walid. After the murder of 'Abd, the fourth caliph, in 661 his successor Mu'awiyah transferred the seat of the caliphate to Damascus. With him began the great dynasty of the Omayyads.



THE COVERED STREET CALLED STRAIGHT WHICH RUNS FROM THE EASTERN TO THE WESTERN GATE OF DAMASCUS

yads, whose rule extended from the Atlantic to India. Ninety years later it was supplanted by that of the Abbasids, who moved the seat of empire to Mesopotamia, and Damascus fell to the rank of a provincial capital. After the decline of the Abbasids in the middle of the 9th century, it was generally held by the rulers of Egypt (with intervals of Bedouin incursion and military revolt) until the Seljuk conquest in 1076.

With its occupation by Nureddin in 1154 and under his successor Saladin (q.v.), Damascus became the headquarters of the Moslem forces in the wars with the Franks and regained or surpassed its former prosperity. In spite of the wars between Saladin's suc-

cessors, the Ayyubid kings of Egypt and Syria, the city continued to expand and to develop as a centre of commerce and Moslem civilisation. After a brief occupation by the Mongols in 1260 it was recaptured by the Mameluke Kotuz and became the principal of the six governments in Syria under the Mameluke sultans of Egypt. In Dec. 1400 it was devastated by Timur (Tamerlane) and never fully recovered. In 1516 it passed into the possession of the Ottoman sultans of Constantinople, under whom Syria was divided into four pashaliks, of which that of Damascus was the highest. The city continued to enjoy a fair degree of prosperity, particularly on account of its position as the headquarters of the Turkish pilgrim caravan to Meccah, to which the expansion of its southern suburb, the Medan was due. During the 19th century new suburbs grew up to the north and west, a development greatly accelerated following World War I. Among the more notable incidents in its 19th-century history may be mentioned the massacre of July 1860, when the Christian quarter was burned and thousands of Christians slaughtered.

During World War I, Damascus served as the headquarters of the Turkish and German forces which, under Gen. Otto Liman von Sanders, tried to attack the Suez canal and to oppose the British advance into Palestine. The Egyptian expeditionary force under Gen. E. H. H. Allenby and the Arab army commanded by the Emir Faisal ibn Husain entered Damascus on Oct. 1, 1918. Faisal made his formal entry on Oct. 3 and proceeded to establish the government for an independent Syria, with Damascus as the capital. In the hope of forestalling the proposals for French and British mandates in Syria and Palestine, a Syrian national congress, meeting in Damascus, offered, on March 11, 1920, the royal crown of Syria to Faisal and unanimously adopted on July 3 a democratic constitution for a united Syria, including the Lebanon and Palestine. This was followed by an ultimatum from the French high commissioner in Beirut, Gen. Henri Gouraud, on July 19, demanding unconditional recognition of the French mandate. An Arab army, under Yusuf al Akm, the minister of war, met the French at Khan Messalun on July 24 and was defeated, Damascus was occupied by the French and the short lived kingdom brought to an end.

Under the French administration Syria was partitioned into a number of states, and part of the former province of Damascus was annexed to the new state of greater Lebanon. At first, Damascus remained only the capital of one relatively small administrative area, but in 1924 Gen. Maxime Weygand reunited Aleppo and Damascus in the state of Syria and made Damascus the capital. The policy pursued by the French met with vigorous opposition from the Syrian leaders, supported by the population of Damascus. Mass demonstrations on the visit of the American Charles Crane, on April 1, 1922, led to severe repression by the government, and similar demonstrations occurred in April 1925, when Lord Balfour visited Damascus, in protest against Zionism and the separation of Palestine from Syria. A constitution granted on Dec. 5, 1924, provided for a Syrian state with an elected president, a ministry appointed by him and an elected legislative council, but no real power was given to the newly created native authorities. Syrian discontent continued.

Rebellion began in the mountains of the Druse state in July 1925. After the first successes under Sultan Fasha al Atrash, Damascus joined in the revolt. A provisional government was constituted, and for months the thickly populated oasis of Damascus formed a battleground. Nor did the city itself escape from Oct. 18 to 20 violent encounters took place in its streets, while the French army bombarded the centre of the city from the neighbouring hills. The revolt was not put down until 1927. Damascus was bombarded a second time by French artillery and aircraft on May 7, 1926, when the greater part of the Medan quarter was damaged.

From 1928 a more conciliatory policy was adopted and a new Syrian constitution was promulgated by an elected national assembly in Damascus on May 14, 1930. Negotiations for a treaty between France and Syria were opened, the first proposals were rejected in Nov. 1933 by the Syrians as unsatisfactory, and a second draft treaty in 1936, though accepted by the Syrians, was



KHAN SULEIMAN PASHA. AN OLD ROOFLESS BUILDING NAMED AFTER THE GREAT SULTAN OF TURKEY WHICH WAS FORMERLY AN INN BUT BECAME A THRIVING BAZAAR.

never ratified by the French. At the opening of World War II, Franco-Syrian relations were thus still unregulated, and after the fall of France in June 1940, the danger of the Germans' exploiting Syria as a centre of axis propaganda and strategy in the middle east led to the occupation of Syria and Lebanon by Allied forces, British, Australian and Free French, in June 1941.

On Sept. 28, 1941, the Free French authority proclaimed the independence of Syria with Damascus as its capital, and Sheikh Taj al Din al Hasan became first president of the new republic. But tension continued between the Syrian government and the French military authorities. After the war, in retaliation for a series of violent outbreaks, French troops again bombarded Damascus on May 31, 1945, but were immediately withdrawn on British intervention. (See also SYRIA.)

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DAMASK, the technical term applied to certain distinct types of fabric. The term owes its origin to the ornamental silk fabrics of Damascus, fabrics which were elaborately woven in colours, sometimes with the addition of gold and other metallic threads. At the present day it denotes a linen texture richly figured in the weaving with flowers, fruit, forms of animal life and other types of ornament. "China, no doubt," says Rock (*Catalogue of Textile Fabrics*, Victoria and Albert Museum), "was the first country to ornament its silken webs with a pattern. India, Persia and Syria, then Byzantine Greece followed, but long intervals between, in China's footsteps. Stuff so brought with them to the West the name 'daspron' or 'dasprun'."

bestowed upon them at Constantinople. But about the 12th century the city of Damascus, even then long celebrated for its looms, so far outstripped all other places for beauty of design, that her silken textiles were in demand everywhere, and thus, as often happens, traders fastened the name of damascene or damask upon every silken fabric richly wrought and curiously designed, no matter whether it came or not from Damascus."

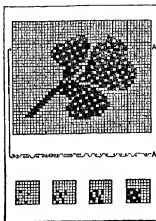
The term is perhaps now best known in reference to damask tablecloths, a species of figured cloth usually of flax or tow yarns, but sometimes made partly of cotton. The finer qualities are made of the best linen yarn, and, although the latter is of a brownish colour during the weaving processes, the ultimate fabric is pure white. The high lights in these cloths are obtained by long floats of warp and weft, and, as these are set at right angles, they reflect the light differently according to the angle of the rays of light, the effect changes also with the position of the observer. Subdued effects are produced by shorter floats of yarn, and sometimes by special weaves. Any subject, however intricate, can be copied by this method of weaving, provided that expense is no object. The finest results are obtained when the so called double damask weaves are used. These weaves are shown under DIZ, and it will be seen that each weave gives a maximum float of seven threads. (In some special cases a weave is used which gives a float of nine.)

The small figure here shown to illustrate a small section of a damask design is composed of the two single damask weaves, these give a maximum float of four threads or picks. No shading is shown in the design, and thus for two reasons (1) the single damask weaves do not permit of elaborate shading, although some very good effects are obtainable, (2) the available space is not sufficiently large to show the method to advantage. The different single damask weaves used in the shading of these cloths appear, however, at the bottom of the figure, while between these and the design proper there is an illustration of the 31st pick interweaving with all the 48 threads.

The principal British centres for fine damasks are Belfast and Dunfermline, while the medium qualities are made in several places in Ireland, in a few places in England, and in the counties of Fife, Forfar and Perth in Scotland. Cotton damasks, which are made in Paisley, Glasgow, and several places in Lancashire, are used for toilet covers, tablecloths and similar purposes. They are often ornamented with colours and sent to the Indian and West Indian markets. Silk damasks for curtains and upholstery decorations are made in the silk-weaving centres.

DAMASKINOS (1891-1949), a Greek archbishop, was born Dimitrios Papandreu on March 3, 1891, at Dobritza in Thessaly, Greece. He studied law and theology at the University of Athens, served in the Greek army as a private during the Balkan Wars in 1912 and took his holy vows as a priest in the Greek Orthodox Church in 1917. In 1922 he was elected bishop of Corinth, and later was raised to the rank of a metropolitan. In 1938 his election as archbishop of Athens and all Greece was voided by Premier Ioann Metaxas because of his opposition to the regime, and Bishop Chrysanthos of Trebizond was appointed to that office. Damaskinos was exiled to a mountain monastery, but was recalled by the Holy Synod in 1947 to replace Bishop Chrysanthos who had refused to swear in 1947 to proams premier, George Tsolakoglou. Damaskinos opposed the German occupation policy and went so far as to urge orthodox Greeks to conceal Jews to prevent them from falling into Nazi hands.

In 1944 during the civil war between the royalists and the



DETAILS OF A DAMASK DESIGN

The name "damask" originally given to the woven silks of Damascus to day signifies a linen texture elaborately designed in the weaving.

Communists and Communist controlled groups in Greece, Arch-bishop Damaskinos was selected to serve as regent of Greece. In the following 16 months he appointed no fewer than five premiers in an effort to solve the political crisis and even formed an interim cabinet himself in Oct. 1945. In Sept. 1945 it was decided that before a plebiscite to determine whether Greece should be a monarchy or a republic, a general election should be held. The election, held March 31, 1946, resulted in a decisive royalist victory which was confirmed by the plebiscite of Sept. 1, 1946, and King George returned to the country on Sept. 27. Meanwhile, Damaskinos had resigned as regent on Sept. 5, and he thereafter took no direct part in political life.

DAMASK STEEL or **DAMASCUS STEEL**, a steel with a peculiar watered or streaked appearance, as seen in the blades of fine swords and other weapons of oriental manufacture. One way of producing this appearance is to twist together strips of iron and steel of different quality and then weld them into a solid mass. A similar but inferior result may be obtained by etching with acid the surface of a metal, parts of which are protected by some greasy substance in such a way as to give the watered pattern desired. The art of producing damask steel has been generally practised in oriental countries from a remote period, the most famous blades having come from Isfahan, Khurasan and Shiraz in Persia.

DAMASUS, the name of two popes

DAMASUS I, Saint, was pope from 366 to 384. As a deacon he protested against the banishment of Pope Liberius (355), but when the emperor Constantius sent to Rome the antipope Felix II, Damasus, with the other clergy, rallied to his cause. When Liberius returned from exile and Felix was expelled, Damasus again supported Liberius. On the death of Liberius (366) he was nominated successor, but the irreconcilables of the party of Liberius set up against him another deacon, Ursinus. A serious conflict ensued which quickly led to rioting. The prefect of Rome recognized the claims of Damasus, and Ursinus and his supporters were expelled. They, however, persisted obstinately in their opposition to Damasus, combating him first by riots, and then by calumnious lawsuits, such as that instituted by one Isaac, a converted and released Jew.

To the official support, which never failed him, Damasus endeavoured to join the popular sympathy. From before his election he had been in high favour with the Roman aristocracy. At that period the urban masses, but recently converted to Christianity, sought in the worship of the martyrs a sort of substitute for polytheism. Damasus showed great zeal in discovering the tombs of martyrs, adorning them with precious marbles and monumental inscriptions. The inscriptions he composed himself, in mediocre verse, full of Virgilian reminiscences. Several have come down to us on the original marbles, entire or in fragments, others are known from old copies. In the interior of Rome he erected or embellished the church which still bears his name (S. Lorenzo in Damaso).

The west was recovering gradually from the effects of the Arian crisis, and Damasus endeavoured to eliminate from Italy and Illyria the last champions of the council of Rimini. The bishops of the east, however, under the direction of St. Basil, were involved in a struggle with the emperor Valens, whose policy was favourable to the council of Rimini. Damasus, to whom they appealed for help, was unable to be of much service because that episcopal group, viewed askance by St. Athanasius and his successor Peter, was necessarily combated at the papal court by the hatred of Alexandria. The eastern bishops triumphed in the end under Theodosius, at the council of Constantinople (381), in which the western church took no part. They were invited to a council at Rome in 382, but few attended.

This council had brought to Rome the learned monk Jerome, for whom Damasus showed great esteem. To him Damasus entrusted the revision of the Latin text of the Bible. A short time before the pope had received a visit from the Priscillianists after their condemnation in Spain and had dismissed them. Damasus died on Dec. 11, 384.

His writings are printed in Migne, *Patrol. Lat.* XIII. See also

Duchesne, *Liber Pontificalis* 1, 212, J. Witig, *Papst Damasus I* (Kome, 1902) and *Die Friedenspolitik des Papstes Damasus I* (Breslau, 1912)

DAMASUS II, pope from July 17 to Aug 9, 1048, was the ephemeral successor of Clement II. His original name was Poppo, and he was bishop of Brixen when the emperor Henry III raised him to the papacy.

DAME, properly a name of respect or a title equivalent to "lady," now surviving in English as the legal designation of the wife or widow of a baronet or knight, or of a dame of the Order of the British Empire, it is prefixed to the Christian name and surname. It has also been used in modern times by certain societies or orders, e.g., the Primrose league, as the name of a certain rank among the lady members, answering to the male rank of knight. The ordinary use of the word by itself is for an old woman. As meaning "mistress," i.e., teacher, "dame" was used of the female keepers of schools for young children, which have become obsolete since the advance of public elementary education. At Eton college boardinghouses kept by persons other than members of the teaching staff of the school were known as "Dames' Houses," though the head might not necessarily be a lady. As a term of address to ladies of all ranks, from the sovereign down, "Madam," shortened to "ma'am," represents the French *madame*, my lady.

"Damsel," a young girl or maiden, now only used as a literary word, is taken from the O Fr *dameſeile*, formed from *dame*, and parallel with the popular *daneſeile* or *donceſeile* from the M Lat *domicella* or *domnicella*, diminutive of *domnus*. The French *dameſelle* and *dameſelle* are later formations which developed merely to the title of a young unmarried lady, the *mademoiselle* of modern usage, the English "miss." At the court of France, after the 17th century, *Mademoiselle*, without the name of the lady, was a courtesy title given to the eldest daughter of the eldest brother of the king, known as *Monsieur Anne Marie Louise* is known to history as *La Grande Mademoiselle*. The English literary form "damsel" was another importation from France in the 15th century. In the early middle ages *dameſeau*, M Lat *domicellus*, *dameſeile*, *dameſelle*, *domicella*, were used as titles of honour for the unmarried sons and daughters of royal persons and lords (*seigneurs*). Later the *dameſeau* (in the south *donzel*, in Bearn *domengar*) was specifically a young man of gentle birth who aspired to knighthood, equivalent to écuyer, esquire (q.v.) or valet.

DAME'S VIOLET, the name for *Hesperis matronalis*, a biennial herb belonging to the family Cruciferae, and closely allied to the wallflower and stock, called also dame's rocket. It has an erect, stout, leafy stem, 2 to 3 ft high, with irregularly toothed, short stalked leaves and white or lilac flowers, $\frac{1}{2}$ in across, which give off a scent in the evening. The slender pods are constricted between the seeds. The plant is a native of Europe and temperate Asia, and is found in Great Britain and in the eastern United States and Canada as an escape from gardens.

DAMGHAN, town, Iran, in $36^{\circ} 10' N$, $54^{\circ} 20' E$, 216 mi from Tehran, on the high road to Khurasan, elevation 3,737 feet. Pop 5,000. Damghan was an important city in the middle ages. Fath Ali Shah was born there in 1772. There is considerable trade in pistachios and almonds, the latter with very thin shells, for which Damghan is famous. The oldest mosque in Persia, the Tarik Khaneh (c. 775) and four fine towers (11th and 12th centuries) are still standing. Important archaeological excavations disclosed cultures ranging from 3500 B.C. to A.D. 500.

DAMIANI, PIETRO, SAINT (c. 1007-1072), celebrated ecclesiastic, was born at Ravenna, and after some years of teaching about 1035 entered the hermitage of Fonte Avellana, near Gubbio, where he became superior some eight years later. He entered into communication with the emperor Henry III, addressed to Pope Leo IX in 1049 his *Liber Gomorrhianus* denouncing the vices of the clergy, and soon became associated with Hildebrand in the work of reform. As a trusted counsellor of successive popes he was made cardinal bishop of Ostia in 1057, and presided over a council at Milan in 1059. He assisted Alexander II

in his struggle with the anti-pope, Honorius II, and having served the papacy as legate to France and to Florence, was allowed to resign his bishopric in 1067. After a period of retirement at Fonte Avellana, he proceeded in 1069 as papal legate to Germany, and persuaded the emperor Henry IV to give up his intention of divorcing his wife Bertha. He died at Faenza on Feb. 22, 1072. Damiani was a determined foe of simony and clerical marriage, and a vigorous controversialist.

His works published by Cardinal Cajetan, 4 vols. (Rome, 1606-15) are reprinted in Migne, *Patrol. Lat.* v, 144 and 145. See F. Neukirch, *Das Leben des Petri Damiani* (Göttingen, 1875), Klemmerts, *Der heilige Petrus Damiani* (Steyl, 1882), R. Biron, *St Pierre Damien* (1908), J. A. Endres, *Petrus Damiani und die weltliche Wissenschaft* (Münster, 1910).

DAMIEN, FATHER, the name in religion of JOSEPH DE VEUSTER (1840-1889), Belgian missionary, born at Tremeloo near Louvain, on Jan. 3, 1840. In 1858, he joined the Society of the Sacred Heart of Jesus and Mary (also known as the Pious Congregation), and while still in minor orders, in 1863 went as a missionary to the Pacific islands, taking the place of his brother, who had been prevented by illness. On reaching Honolulu he was ordained priest in 1864. Struck with the sad condition of the lepers, whom the Hawaiian government deported to Molokai Island, in 1873 he volunteered to take spiritual charge of the settlement. Besides attending to the spiritual needs of the lepers, he managed, by the labour of his own hands and by appeals to the Hawaiian government, to improve the water supply, the dwellings, and the victualling of the settlement, and after five years received assistance from other resident priests. He succumbed to leprosy on April 15, 1889. Some ill considered imputations upon Father Damien by a Presbyterian minister produced a memorable tract by Robert Louis Stevenson (*An Open Letter to the Rev Dr Hyde*, 1890).

See *Life and Letters of Fr. Damien*, ed. by his brother, Fr. Pamphile (London, 1889) and M. Quinlan, *Damien of Molokai* (London, 1909), which reproduces Stevenson's letter.

DAMIENS, ROBERT FRANÇOIS (1715-1757), a Frenchman who made an attempt on the life of Louis XV on Jan. 5, 1757. As the king was entering his carriage, he rushed forward and stabbed him with a knife, inflicting only a slight wound. His mind seems to have been unhinged by the ecclesiastical controverted of the moment. He was condemned as a regicide, and sentenced to be torn in pieces by horses in the Place de Grève. Before being put to death he was barbarously tortured.

See *Procès originaux et procédures du procès fait à Robert François Damien* (Paris, 1757).

DAMIETTA, a town of Lower Egypt, on the eastern (Damietta or Phatnitic) branch of the Nile, a few miles above its mouth and 125 mi NNE of Cairo by rail. Pop (1937) 40,332. Area 89 sq mi. The town is built on the east bank of the river between it and Lake Menzala. Though ill built and partly ruinous, the town possesses some fine mosques, with lofty minarets, public baths and busy bazaars. Along the river front are many substantial houses with terraces and steps leading to the water. Their wooden lattices of sawwork are very graceful. Once the third town in Egypt, it enjoys little more than a coasting trade, and ships of over 6 ft draught must anchor in the offing.

Damietta is a Levantine corruption of the Coptic name *Tamiat*, Arabic *Dumyāt*. The original town was 4 mi nearer the sea than the modern city. Under the Saracens it had great wealth and commerce, and, as the eastern bulwark of Egypt, was frequently attacked by the crusaders. In June 1249, Louis IX of France occupied Damietta without opposition, but being defeated near Mansura in the February following, and compelled (April 6) to surrender himself prisoner, Damietta was restored to the Muslims as part of the ransom exacted. To prevent further attacks from the sea the Mameluke sultan Bibars blocked up the Phatnitic mouth of the Nile (about 1260), razed old Damietta to the ground, and transferred the inhabitants to the site of the modern town. Damietta gives its name to dimity, a kind of striped cloth for which the place was at one time famous. Cotton and silk goods are still manufactured there and there is some trade in rice and salted fish.

DAMIRI, the common name of KAMAR UD DIN MUHAMMAD IBN MUSÄ UD DAMIRI (1344-1405) Arabian writer on canon law and natural history, he belonged to one of two towns called Damir near Dimettra and spent his life in Egypt. Of the Shihite school of law, he became professor of tradition in the *Ruknuya* at Cairo and also at the mosque el Azhar, in connection with this work he wrote a commentary on the *Almujal ul Lahib* of Nawäwi. He is, however, better known in the history of literature for his *Life of Animals* (*Hayat ul Hayawanin*), which treats in alphabetical order of 931 animals mentioned in the Koran, the traditions and the poetical and proverbial literature of the Arabs.

The use of the animals in medicine, their lawfulness or unlawfulness as food, their position in folk lore are the main subjects treated, while occasionally long irrelevant sections on political history are introduced.

Several editions have been made at various times of extracts, among them the poetical one by Suyuti (q.v.), which was translated into Latin by A. Echclensis (1607). Bochartus in his *Hierozoicon* (1653) used Damir's work. There is a translation of the whole into English by Lieutenant-Colonel Jaykar (Bombay, 1900-1908).

DAMJANICH, JANOS (1804-1849), Hungarian soldier, was born at Siasa in the Banat. On the outbreak of the Hungarian war of independence he was promoted to be a major of the third Honvéd regiment at Szeged, for although he was an orthodox Serb, he was from the first a devoted adherent of the Magyar Liberals. At the beginning of 1849 he was appointed commander of the 3rd army corps in the middle Theiss on account of his reputation for ability and valour. He fought battle after battle, so that after the battle of Isaszeg, Kossuth, at the ensuing review at Godollo, expressed the sentiments of the whole nation when he doffed his hat as Damjanich's battalions passed by. Always a fiery democrat, Damjanich uncompromisingly supported the extreme views of Kossuth, and was appointed commander of one of the three divisions which, under Gorgei, entered Vác in April 1849. After the catastrophe of Vilagos, Damjanich surrendered to the Russians, by whom he was handed over to the Austrians.

DAMMAR · DAMILR

It is readily soluble in ether, benzol and chloroform, and with oil of turpentine it forms a fine transparent varnish which dries clear, smooth and hard. The allied kauri gum, or dammar of New Zealand (Australan dammar), is produced by *Agathis australis*, or kauri pine, the wood of which is used for wood paving. Much of the New Zealand resin is found fossil in circumstances analogous to the conditions under which the fossil copal of Zanzibar is obtained. Dammar is besides a generic Indian name for various other resins, which, however, are little known in western commerce. Of these the principal are black dammar, yielded by *Canarium strictum* (family Burseraceae) and white dammar, Indian copal, or piney varnish, the produce of *Vateria indica* (family Dip-

entaceae), the common name of Dammartin, made himself master of the town in the 10th century. His dynasty was replaced by another family in the 11th century. Revnald I (Reynald), count of Dammartin (d. 1227), who was one of the coalition crushed by Philip Augustus at the battle of Bouvines (1214) left two co-heiresses, of whom the elder, Maud (Matilda or Mahaut), married Philip Hurepel, son of Philip Augustus, and the second, Alix married Jean de Thie in whose line the countship was reunited after the death of Philip Hurepel's son Albeic. In the 15th century the countship was acquired by Antoine de Chibannes (d. 1488) by his marriage with Marguerite, heiress of Revnald V of Nanteuil Aci and Marie of Dammartin. Antoine de Chibannes fought under the standard of Joan of Arc, became a leader of the *Ecorcheurs*, took part in the war of the public weal against Louis XI, and then fought for him against the Burgundians. The collegiate church at Dammartin was founded by him in 1480, and his tomb and effigy are in the chancel. His son, Jean de Chibannes, left three heiresses, of whom the second left a daughter who brought the countship to Philippe de Boulainvilliers, by whose heirs it was sold in 1554 to the dukes of Montmorency. In 1632 the countship was confiscated by Louis XIII and bestowed on the princes of Conde.

DAMME, a decayed city of Belgium (pop. [1939] 1,135), 4½ m. N.E. of Bruges, once so important as a commercial port that it had its own maritime law, the *Zeerecht van Damme*. It is on the canal from Bruges to Sluys (Ecluse), but in the middle ages a navigable channel called the Zwyn connected it with the North sea, the battle of Sluys, in which Edward III. destroyed the French fleet, was fought in 1340 at its mouth. In 1490 a treaty was signed at Damme between the people of Bruges and the archduke Maximilian, and very soon after the channel became completely silted up, and the foreign merchant gilds or "nations" removed to Antwerp. The marriage of Charles the Bold and Margaret of York, sister of Edward IV., was celebrated at Damme on July 2, 1468. The town, although long neglected, preserves some remains of its former prosperity. The tower of Our Lady, dating from 1180, is a landmark across the dunes, and the church, although a shell, merits inspection, out of a portion of the ancient markets a town hall has been constructed, and in the hospital of St. Jan are a few pictures, and in the Place is a statue (1860) to Jacob Van Maerlant, the Flemish poet, who was clerk to the magistrates of Damme in the late 13th century.

DAMOCLES, one of the courtiers of the elder Dionysius of Syracuse. When he spoke in extravagant terms of the happiness of his sovereign, Dionysius is said to have invited him to a sumptuous banquet, at which he found himself seated under a naked sword suspended by a single hair (Cicero *Tusc.* v. 21, Horace *Odes*, iii. 1, 17, Persius iii. 40).

DAMOH, a town and district of British India, in the Jubulpore division of the Central Provinces. The town of Damoh is situated on the railway from Katni to Bina, a branch of the GIP railway, 48 m. E. of Saugor. It has small local industries and a large cattle market, and is a distributing and collecting centre for the district. Being situated below rocky hills it is decidedly hot. In pre-railway days its population was about 8,000, which had increased to 17,000 in 1911. In 1921, owing to an epidemic, population fell to 15,296 but was 26,795 in 1941. Damoh was looted by mutineers from Jubulpore in 1857 and the district office was burnt.

The DISTRICT OF DAMOH is one of the smallest in the Central Provinces, having an area of 2,818 sq. m. and a population of 305,568. It is one of the Vindhyan districts and on the north and north-east borders Bundelkhand. It is drained by the Sonar and

been taken. Dyeing, weaving, pottery and the manufacture of bell metal utensils are the chief industries. Cattle slaughtering for the export of dried meat, bones, hides, horns and hoofs has been established near Damoh, the old and infirm cattle from long distances being brought in for slaughtering. Except for a little iron ore and sandstone for building, there is no mineral wealth in the district. There are notable temples at Bandakpur and Kundalpur and there are old Hindu and Jain remains at Nohta.

DAMON AND PHINTIAS (not Pythias), Syracusan Pythagoreans devoted friends. Condemned to death by Dionysius of Syracuse, Phintias begged a short respite that he might arrange his affairs. Damon pledged his life for the return of his friend, and Phintias returned in time. The tyrant released both and begged to be admitted to their friendship (Diod. Sic. 4, Cicero, *De Off.* 11, 45, cp. Hyginus, *Job* 257).

DAMOPHON, a Greek sculptor of Messene, who executed many statues for the people of Messene, Megalopolis, Aegum, and other cities of Peloponnesus. Considerable fragments, including three colossal heads from a group by him representing Demeter, Persephone, Artemis, and the giant Anytus, have been found on the site of Lycovura in Arcadia where there was a temple of the goddess called 'The Mistress'. They are preserved in part in the museum at Athens and partly on the spot. Hence there arose controversy as to the date of the artist, who was assigned to various periods, from the 4th century B.C. to the 2nd A.D. G. Dickens, however, by the help of inscriptions proved the date to be the 2nd century B.C.

See G. Dickens, *Annual of the British School at Athens* (xii and xiii).

DAMP, vapour or mist, and hence moisture. In the vocabulary of coal miners 'firedamp' is marsh gas, which, when mixed with air and exploded, produces 'choke damp,' 'after damp' or 'suffocating damp' (carbon dioxide). 'Bluck damp' consists of accumulations of irrespirable gases, mostly nitrogen, which cause the lights to burn dimly, and the term 'white damp' is sometimes applied to carbon monoxide. As a verb, the word means to stifle or check, hence damped vibrations or oscillations are those which have been reduced or stopped, instead of being allowed to die out naturally, the 'dampers' of the piano are small pieces of felt covered wood which fall upon the strings and stop their vibrations as the keys rise, and the 'damper' of a chimney or flue, by restricting the draught, lessens the rate of combustion.

DAMPIER, WILLIAM (1652-1715), English buccaneer, navigator and hydrographer, was born at East Coker, Somersetshire, in 1652. Having early become an orphan, he was placed with the master of a ship at Weymouth, in which he made a voyage to Newfoundland. On his return he sailed to Bantam in the East Indies. He served in 1673 in the Dutch War under Sir Edward Sprague, and was present at two engagements (May 28, June 4), but then fell sick and was put ashore. In 1674 he became an under-manager of a Jamaica estate, but continued only a short time in this situation. He afterwards engaged in the coasting trade, and thus acquired an accurate knowledge of all the ports and bays of the island. He made two voyages to the Bay of Campeachy (1675-76), and remained for some time with the logwood cutters, varying this occupation with buccaneering. In 1678 he returned to England, again visiting Jamaica in 1679 and joining a party of buccaneers, with whom he crossed the Isthmus of Darien, spent the year 1680 on the Peruvian coast, and sacking, plundering and burning, made his way down to Juan Fernandez island. After serving with another privateering expedition in the Spanish Main, he went to Virginia and engaged with a captain named Cock for a privateering voyage against the Spaniards in the South Seas. They sailed in Aug. 1683, touched at the Guinea coast, and then proceeded round Cape Horn into the Pacific. Having touched at Juan Fernandez, they made the coast of South America, cruising along Chile and Peru. They took some prizes, and with these they proceeded to the Galapagos islands and to Mexico, falling in with the latter near Cape Blanco. While they lay here Captain Cock died, and the command devolved on Captain Davis, who, with several other pirate vessels, English and French, raided the west

American shores for the next year, attacking Guayaquil, Puchla, Nova, etc. At last Dampier, leaving Davis, went on board Swin's ship, and proceeded with him along the northern parts of Mexico as far as southern California. Swin then proposed, as the expedition met with 'bad success' on the Mexican coast, to run across the Pacific and return by the East Indies. They started from Cape Corrientes on March 31, 1686, and reached Guam in the Ladrone on May 20, the men, having come almost to an end of their rations, had decided to kill and eat their leaders next, beginning with the 'lustiest and fleshy' Swin. After six months' drunkenness and debauchery in the Philippines, the majority of the crew, including Dampier, left Swin and thirty six others behind in Manila, crossed (1687-1688) from Manila to Pulo Condore, from the latter to China and from China to the Spice Islands and New Holland (the Australian mainland). In March 1688 they were off Sumatra, and in May off the Nicobars, where Dampier was marooned (it was his own request, as he declares, for the purpose of establishing a trade in ambergris) with two other Englishmen, a Portuguese and some Malays. He and his companions contrived to navigate a canoe to Achin in Sumatra, but the fatigues and distress of the voyage proved fatal to several and nearly carried off Dampier himself. After making several voyages to different places of the East Indies (Tongking, Madras, etc.), he acted for some time, and apparently somewhat unwillingly, as gunner to the English fort of Benkulen. Thence he ultimately contrived to return to England in 1691.

In 1699 he was sent out by the English Admiralty in command of the 'Roebuck,' especially designed for discovery in and around Australia. He sailed from the Downs on Jan. 14, with twenty months' provisions, touched at the Canaries, Cape Verde and Bahia, and ran from Brazil round the Cape of Good Hope direct to Australia, whose west coast he reached on July 26, in about 26° S. Anchoring in Shark's Bay, he began a careful exploration of the neighbouring shore lands, but found no good harbour or estuary, no fresh water or provisions. In September, accordingly, he left Australia, recruited and refitted at Timor, and thence made for New Guinea, where he arrived on Dec. 3. By sailing along to its easternmost extremity, he discovered that it was terminated by an island, which he named New Britain (now New Pommern), whose north, south and east coasts he surveyed. That St. George's bay was really St. George's channel, dividing the island into two, was not perceived by Dampier; it was the discovery of his successor, Philip Carteret. Nor did Dampier visit the west coast of New Britain or realize its small extent on that side. He was prevented from prosecuting his discoveries by the discontent of his men and the state of his ship. In May 1700 he was again at Timor, and thence he proceeded homeward by Batavia (July 4-Oct. 17) and the Cape of Good Hope. In February 1701 he arrived off Ascension island, when the vessel foundered (Feb. 21-24), the crew reaching land and staying in the island till April 3, when they were conveyed to England by some East Indian men and warships bound for home. In 1703-1707 Dampier commanded two Government privateers on an expedition to the South Seas with grievous unsuccess, better fortune attended him on his last voyage, as pilot to Woodes Rogers in the circumnavigation of 1708-1711. On the former venture Alexander Selkirk, the master of one of the vessels, was marooned at Juan Fernandez, on the latter Selkirk was rescued and a profit of nearly £200,000 was made. But four years before the prize money was paid Dampier died (March 1715) in St. Stephen's parish, Coleman street, London. Dampier's accounts of his voyages are famous. He had a genius for observation, especially of the scientific phenomena affecting a seaman's life, his style is usually admirable—easy, clear and manly. His knowledge of natural history, though not scientific, appears surprisingly accurate and trustworthy. (C. R. B.)

See Dampier's *New Voyage Round the World* (1697), his *Voyages and Descriptions* (1699), a work supplementary to the *New Voyage*, his *Voyage to New Holland in 1690* (1703, 1709), *Dampier's Voyages* (ed. J. Massie, 1906), W. C. Russell, *William Dampier* ("English Men of Action," 1880), also Funnell's *Narrative of the Voyage of 1703-1707*, Dampier's *Vindication of his Voyage* (1707), Welbe's *Answer to Captain Dampier's Vindication*, Woodes Rogers, *Cruising Voyage Round the World* (1712).

DAMROSCH, LEOPOLD (1832-1885) German American musician and conductor, born in Posen, Prussia Oct. 2, 1832. In early life a physician, he became *Konzertmeister* at Weimar, then conductor of the Philharmonic society at Breslau, he went to the United States as conductor at the Metropolitan Opera house and founded the Oratorio society, New York city, 1874, the New York Symphony society, 1878, etc.

His son, **WALTER JOHANNES DAMROSCH** (1862-1950), U.S. musician and conductor, was born at Breslau, Ger., Jan. 30, 1862. He went to the U.S. in 1871, and ten years later began his career as conductor in Newark, N.J. On the death of his father in 1885 he was appointed conductor of the Metropolitan Opera house, the New York Symphony society and the Oratorio society.

In 1894 he founded the Damrosch Opera company for producing Wagner and in 1896 produced Wagner's *Parsifal* in concert form for the first time in the United States. In 1903 he was appointed director of the New York Symphony orchestra, remaining conductor until Feb. 1927. He was then appointed musical adviser to the National Broadcasting company, informal lectures on Wagner with music having developed into lecture recitals over the radio. He also founded the NBC "Music Appreciation Hour."

His compositions include *The Scarlet Letter* (1894), *Cyano* (1913), *The Man without a Country* (1936) and *The Opera Cloak* (1942)—all operas, also music for Euripides' *Medea* and *Iphigenia in Aulis* (Berkeley, 1915) and Sophocles' *Electra* (1917). He wrote an autobiography, *My Musical Life* (1923).

Walter Damrosch, who was elected president of the American Academy of Arts and Letters in 1940, died at New York city Dec. 22, 1950.

Another son of Leopold Damrosch, **FRANK HEINO DAMROSCH** (1859-1937), was born at Breslau. He became in 1905 director of the Institute of Musical Art, New York city, and wrote a *Popular Method of Sight Singing and Some Essentials in the Teaching of Music*.

DAMS. Dams are barriers built across a stream for the purpose of diverting the flow, of creating a head of water for the development of power or for storing water. Storage may be used to create a constant-level pond to be used for recreation and other purposes, or to store water during periods of excess flow to be drawn out later for power, irrigation or domestic use during times of insufficient natural flow, or to store flood waters in order to reduce the flood hazard in populated places below the dam.

From immemorial times dams have been constructed of earth and masonry for the purpose of forming reservoirs for the storage of water to ensure regular supplies to communities for domestic purposes and for irrigation. There are records of a huge earthen dam on the Nigris and a large masonry dam on the river Nile, built almost in prehistoric times, which remained in service for incredibly long periods, and the Romans built numerous massive masonry dams in Italy and northern Africa. All the early masonry dams were characterized by excessive width of base, usually three to four times the height.

The production of hydroelectric energy and the application of irrigation on a large scale—two forms of development which expanded very rapidly in the 20th century in countries having the

requisite conditions and resources—in many cases involved enormously greater storage of water than that required for even the largest towns.

The progress in scientific design and in magnitude of dam structures was correspondingly extensive and new types of structures were introduced to meet the call for greater economy in a class of work which had seldom been cheap.

TYPES OF DAMS

The principal types are

- 1 Earth dams
- 2 Rock fill dams
- 3 Solid masonry gravity dams
- 4 Hollow masonry gravity dams
- 5 Steel dams
- 6 Timber dams
- 7 Arch dams

While the first three types have been used from antiquity, the others are products of the 19th and 20th centuries. The type and height of a dam, which is adapted to a particular site, depends upon the geology and configuration of the site, the purpose for which it is to be used and its relative cost as affected by, among other things, the availability of construction materials. All types except steel and timber are considered permanent if well constructed, requiring practically no maintenance.

Earth Dams.—This type consists of an embankment composed entirely of earth, brought in and compacted or sluiced into position. It is adaptable to places where ample suitable earth materials are available and where a place is convenient to provide a spillway to pass flood waters. It is also adaptable to sites where the foundation is not suitable for a high masonry dam.

Security for earth dams depends on the following:

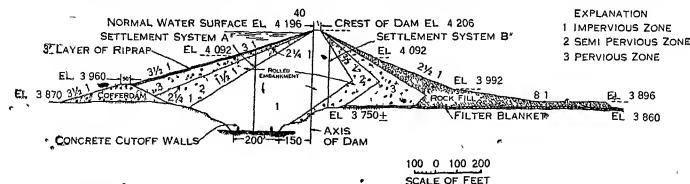
1 Ample spillway capacity is essential because much water, passing over the top of an earth dam, will invariably scour a passage sufficiently large to empty the reservoir quickly. Spillways consist of chutes constructed adjacent to the dam to lower flood waters harmlessly to the lower river level.

2 Leakage, through or under the dam, must be reduced to an amount which will not move the materials of which the dam or foundation is composed. If watertightness is not inherent in the materials of the dam and foundation, a continuous impervious earth core, extended to impervious foundation, is provided. Cores of concrete were not used to any extent after about 1920. Drains under the dam consisting of filter blankets or other means are used frequently to collect and dispose of leakage harmlessly.

3 The slopes of the dam must be flat enough to prevent sloughing of the dam or overstepping the foundation. The required slopes depend entirely upon the nature of the materials, the weaker materials requiring the flatter slopes.

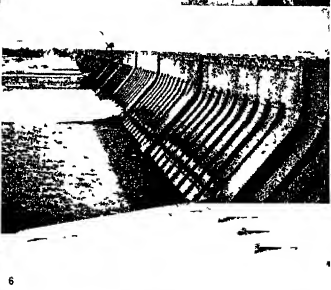
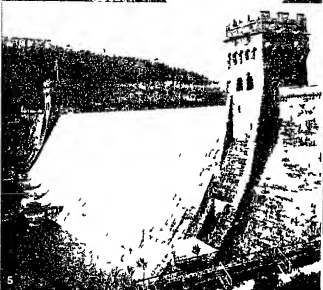
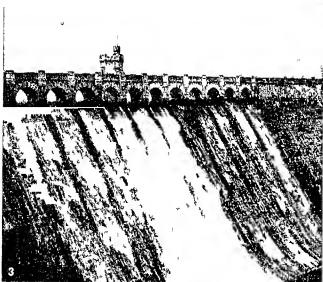
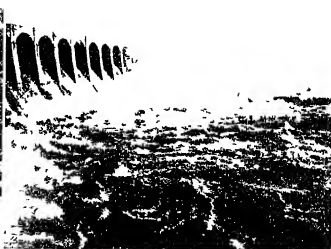
4 The downstream slope must be protected from rainwash and the upstream slope from damage by waves. Grass or gravel is used on the downstream slope and a layer of rock fragments, called "riprap," or a slab of concrete is used on the upstream slope.

Earth dams are constructed either by the rolled fill or the hydraulic-fill methods. For the former, the material is placed in



COURTESY OF ENGINEER'S NEWS-RECORD

3 1—CROSS SECTION OF ANDERSON RANCH DAM, IDAHO, SHOWING ZONING OF EARTH FILL MATERIALS TO PRODUCE AN IMPERVIOUS CORE SUPPORTED STABLE FREE DRAINING SECTIONS

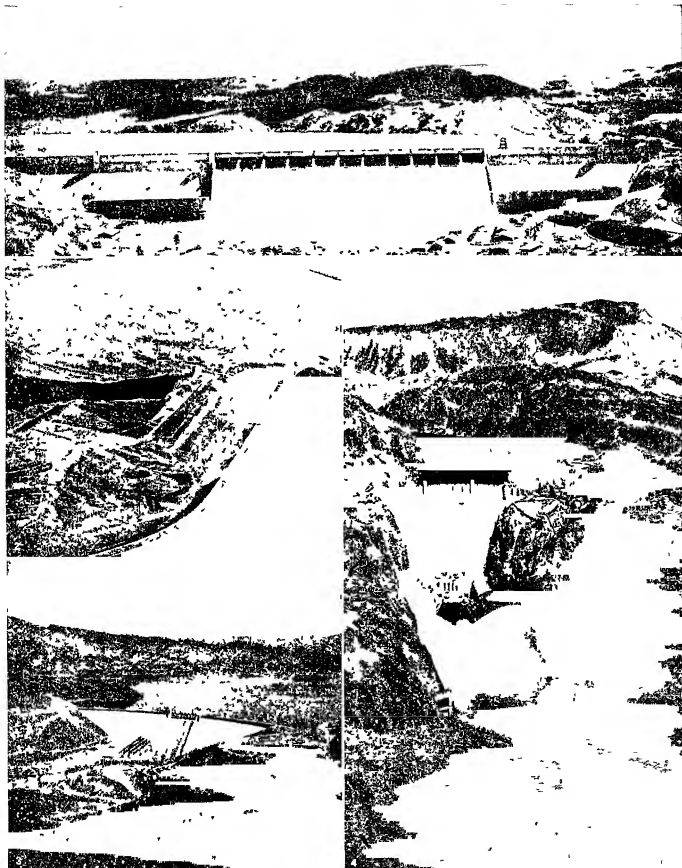


BY COURTESY OF (1) THE BOARD OF WATER SUPPLY OF THE CITY OF NEW YORK (2) THE U.S. CORPS OF ENGINEERS (3) THE GRADFORD WATER PURVEY (4) TVA (5) THE DORSETT VALLEY WATER BOARD (6) RANILTON WRIGHT

SOLID MASONRY GRAVITY DAMS

- 1 Kensico gravity dam New York city water supply system
- 2 Overflow gravity type Wilson dam Tennessee river
- 3 Face of Angram dam, Yorkshire, England masonry spillways

- 4 Downstream face of Norris dam near Knoxville Tenn
- 5 Stone spillway of Howden dam Dorset valley, England
- 6 Downstream face of Aswan dam Egypt



BY COURTESY OF (1, 3, 4) U.S. BUREAU OF RECLAMATION (2) MISSOURI RIVER DIVISION U.S. CORPS OF ENGINEERS DEPARTMENT OF DEFENSE

AMONG THE WORLD'S LARGEST DAMS

1 Grand Coulee dam, Columbia river Washington, gravity type masonry dam

2 Fort Peck dam, Missouri river Montana, hydraulic-fill type earth dam

3 Shasta dam, Sacramento river California, gravity type curved concrete dam

4 Hoover dam, Colorado river on the border of Arizona and Nevada,

the dam in layers, each layer being well compacted by special rollers, for the latter, the material is hauled or sluiced to the dam and washed into place, the fires depositing in the centre

Fig 1 shows a cross section of the Anderson Ranch rolled fill earth dam in Idaho

The Fort Peck hydraulic fill earth dam, on the Missouri river in Montana, was still the largest dam in the world at mid 20th century, containing 109,000,000 cu yd of earth. Four large dredges were built at the dam for purposes of dredging material from the valley bottom and pumping it into place on the dam through steel pipe lines 28 in in diameter and 5 mi long at certain stages of construction

When more than 95% of the fill was completed, a considerable movement of the material in the upstream face of the dam occurred near the east abutment, involving approximately 5,000,000 cu yd of fill. The damaged portion was entirely removed and rebuilt, causing a delay of more than a year in completion of the structure

Fort Peck's storage of 19,500,000 ac ft of water was exceeded at mid century only by Lake Mead, the storage reservoir created by Hoover dam in Nevada and Arizona

Rock Fill Dams—Rock fill dams are embankments composed of rock fragments of quarry run sizes up to as large as can be economically handled and dumped into place. Large quantities of water are applied during the dumping operations to ensure necessary initial settlement and compaction

For the same reason given for earth dams, a separate spillway is required. It is usually cut into the rock formation alongside the rock fill and the stone from its excavation used in the dam. Rock fill dams compete with earth dams only if rock is available close by

Watertightness may be obtained by a thin central core of impervious earth, by an upstream impervious earth blanket or by a reinforced concrete slab placed on the upstream face. The concrete slab must be well built to withstand settlement, as it sometimes cracks from that cause

Compared with an earth dam, the slopes of rock fill dams are much steeper. When an upstream earth blanket or a concrete slab is used, the slopes are usually those which the material will take when dumped into place, which is about 1:3 to 1:4 horizontally to 1 vertically. When a central earth core is used, the downstream slope is slightly flatter. The upstream impervious blanket is designed with a slope as prescribed for earth dams, or if steeper, it must be supported by additional rock fill upstream from it

The foundation for a rock fill dam must be free from possible settlement and, in addition, if a concrete slab is used for watertightness, must be resistant to scour from possible considerable leakage caused by cracks

Requirements for stability are practically the same as those described below for sliding of gravity dams

Fig 2 is a cross section of the 345 ft Salt Springs dam in California, the highest of its type yet constructed at mid-20th century. The concrete slab was placed on a layer of, hand or derrick-placed dry rubble to provide greater support

In spite of this provision, some cracking of the concrete occurred requiring emptying of the reservoir for repairs which were successful

Solid Masonry Gravity Dams—Masonry dams built in the first half of the 20th century

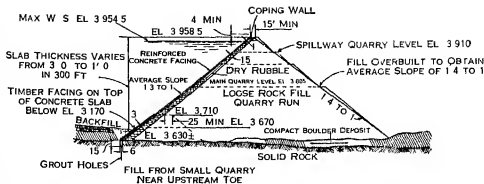


FIG 2—CROSS SECTION OF SALT SPRINGS DAM, CALIFORNIA

were almost invariably composed of plain concrete masonry with out steel reinforcement. A typical cross section is shown in fig 3. These dams have a vertical or very slightly battered upstream face. The forces tending to move the dam are water pressure, silt pressure in the reservoir against the dam, ice pressure from surface ice on the reservoir, earthquake and the buoyant effect of water seeping through the dam and its foundation

They rely for stability on their weight, plus the vertical component of water pressure on the upstream face, to resist overturning or sliding, although the strength and roughness of the foundation also have an important influence on stability. The bases of excessively high dams must be spread to keep the compressive stresses within safe limits

Though dams of massive masonry had been used for thousands of years it was not until the 19th century that a proper scientific basis for design was developed by W. J. M. Rankine and others so that the width could be reduced from three to four times the height to something less than the height

This type of dam is adaptable to most any site, except that it requires a rock foundation for heights above about 65 ft

A grout curtain, consisting of holes drilled in the foundation at the upstream side of the dam and filled with grout under pressure, is used for high dams to prevent too much leakage through the foundation and to reduce the uplift pressure on the base. In order to reduce the uplift pressure further, drainage holes are then drilled just downstream from the grout curtain

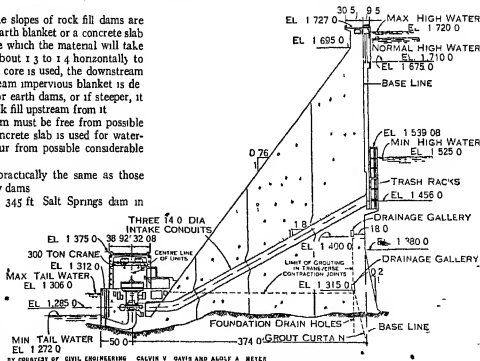


FIG 3—CROSS SECTION OF FONTANA DAM, NORTH CAROLINA

The requirements for stability are as follows:

1. There shall be no tension in any horizontal plane. This requires that the resultant of all forces at and above the plane must intersect the plane within the middle third.
2. The frictional and shearing resistance shall be sufficient to prevent sliding.
3. The compressive stresses shall be within safe limits.

To reduce the tendency of concrete in large dams to crack because of shrinkage when cooling, modern practice requires (1) the least amount of cement in the concrete consistent with required strength and durability, (2) construction lifts not in excess of about four or five feet, and (3) cooling the concrete to reduce the temperature after placement.

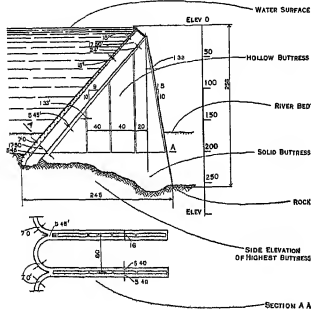
The concrete may be cooled before or after it is placed in the dam.

Flood waters are allowed to pass over the top of gravity dams, the spillway portion being at a lower elevation and shaped to allow the water to pass over it with the least disturbance.

Stilling basins are frequently provided at the bottom of high spillways of all types in order to reduce the amount of scour of the foundation.

Sometimes dams of this type are arched upstream in plan in order to fit the contours of the site, but, because of their rigidity, very little of the load can be carried by arch action (see *Arch Dams*, below), except possibly after incipient failure has occurred. The highest dam of this type at mid 20th century was the Hoover dam, towering 726 ft above the canyon floor, and the highest dam of any type in the world yet constructed. Originally proposed as a concrete horizontal arch, the dam was finally built as a solid concrete gravity type, curved in plan. Its crest length is 1,282 ft. Built for flood control, irrigation and power development, it creates storage of more than 30,000,000 ac ft of water and will produce about 4,330,000,000 kw hr of firm power annually.

The Grand Coulee dam in Washington, although only 550 ft high, contains 10,885,000 cu yd of concrete and was the largest



BY COURTESY OF F. A. ROETZLI

FIG. 4.—PLAN OF LAKE PLEASANT ARIZONA MULTIPLE ARCH DAM SHOWING ABOVE ELEVATION OF HIGHEST BUTTRESS AND BELOW A SECTION THROUGH THE ARCHES AND HOLLOW BUTTRESSES

masonry structure in the world at mid century. It contains more than seven times as much masonry as the great Cheops pyramid in Egypt. Its spillway is capable of passing a flood of 1,000,000 cu ft per second, which would create a fall of water five times the average flow of Niagara falls and three times as high. Assisting materially in flood control and river regulation, Grand Coulee dam creates a storage capacity of 9,610,000 ac ft, to produce more than 8,100,000,000 kw hr of firm power annually.

Hollow Masonry Gravity Dams—Dams of this type are composed of multiple concrete buttresses (some are stone masonry in Europe) to which the water load is carried by a deck composed of either reinforced concrete slabs or arches in the upstream face, as shown in fig. 4. The former type is sometimes called the "Ambrusen" dam and its buttresses are spaced from 18 ft to 30 ft centres. The latter type is called the "multiple arch" dam, and its buttresses have been spaced from 20 ft to 110 ft centres. Another type, called the "round head buttress" dam, has buttresses very closely spaced and expanded on the upstream side an amount sufficient to contact adjacent buttresses, requiring no deck.

Where such dams are used for spillways, a reinforced concrete slab is placed also on the downstream face to support the spilling

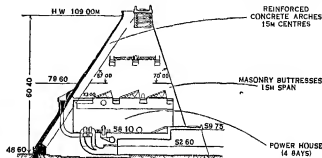


FIG. 5.—CROSS SECTION OF THE TIRSO DAM SARDINIA

water. Hydroelectric plants are sometimes placed within hollow dams.

This type of dam is designed under the same theories as those described for solid masonry gravity dams, but they contain only about 35% to 40% as much concrete. The upstream face is inclined usually about 45° and therefore provides a much larger vertical component of water pressure to assist stability than does the solid concrete type. For this reason, less weight of masonry is required.

However, because they require steel reinforcement, more form work and more skilled labour in their construction, they are more expensive per cubic yard of content. They have an advantage over solid masonry gravity dams only where the ingredients for concrete are expensive and where lumber for forms and skilled labour are relatively cheap.

The Bartlett dam in Arizona, 287 ft high, was the highest of this type in the world at mid-20th century. This dam has one unique feature in that the buttresses are of cellular construction, with double walls, to increase their stiffness.

Fig. 5 shows a cross section of the Tirso dam in Sardinia, 200 ft high, the highest hollow dam in Europe at mid century. Its unique features are stone masonry buttresses and a hydroelectric plant between buttresses.

Steel and Timber Dams—Mention should be made of the relatively less important dams of steel and timber, both of which are designed as previously described for hollow dams. The steel dam is in general similar to the buttressed hollow dams, but the deck is steel plate and the buttresses are steel frames.

Few steel dams have been built, probably because of lack of confidence in their permanence. Three large steel dams were constructed about 1900, but after one of these failed, although its destruction was attributed to a foundation failure and not in any way connected with the fact that it was built of steel, it was replaced by a concrete dam.

Timber dams are usually of the same shape but are frequently composed of rock-filled cribs with timber decks. They are numerous but usually quite small because, although they may last more than 50 years, they require very considerable maintenance and are seldom very tight after a few years of use. They are used frequently as cofferdams to unwater construction work.

Arch Dams—The arch dam does not rely upon its weight for stability, but is designed to carry the water load directly to the abutments by horizontal arch action. However, that part of the

dam which is in contact with the bottom of the gorge alters this tendency, and put of the water load is resisted by vertical cantilever action. This combined action produces stresses which are exceedingly complicated and can be computed only by the "trial load" method of analysis. However, that method requires the work of several men for a number of weeks to complete and, for that reason, is used only for the most important projects. Others are designed by shorter and more conservative methods.

Arch dams are relatively rare because sites at which the length of the dam would be small in proportion to its height, and are therefore adaptable to their use, are not frequently available. They are usually the cheapest type of dam where the site is suitable for their use. The Matijiri dam in California is an example of this type of dam.

The highest dam of this type at mid 20th century, constructed in 1934, was the Sautet dam on the Drac river, a tributary of the Rhone river, with a maximum height of 414 ft, thickness varying irregularly from 8 ft at the top to 56 ft at the bottom and radius of the water face varying from 230 ft at the top to about 85 ft at the bottom.

FLOOD GATES

Special circumstances arise in regard to dams on large rivers, whether installed for purposes of irrigation or for the generation of hydroelectric power. It is generally necessary to control within close limits the flood and backing up height above the dam, so that provision must be made for passing very large volumes of flood water. The circumstances are accentuated where a large part of the wet season flow of a river carrying much silt has to be stored to give a regulated supply during the dry season. For all such cases movable openings are necessary on a scale commensurate with the flood or maximum flow conditions, and where close regulation is essential a series of large steel gates, usually of such weight as must be operated by machinery, are most commonly used. The Aswan dam on the Nile has a length across the river of 6,400 ft with a maximum height of 175 ft and forms an irrigation storage reservoir with a capacity of more than 4,000,000 ac ft.

The Dneprostroi dam on the Dnieper river, built for the soviet government, was at mid century the largest low head dam in the world constructed for hydroelectric power purposes. Gate and spillway arrangements were provided on a scale sufficient to pass a flood of 1,250,000 cu ft per second. Power can be developed up to 560,000 kw.

For the extreme case of a river transporting great quantities of silt where the dam must not be allowed to become a trap for the settlement and accumulation of large quantities of material brought down during high floods, a continuous series of gates is used extending from bank to bank and having their sills at the river bed. The gates are separated by piers, usually of concrete, which must be capable of supporting the maximum water load from a panel of the dam as well as the erections and machinery for operating the gates. The gates are fully opened to pass the first part of the wet season flood and scour the reservoir bed clean, and closed in time to conserve the later and cleaner part of the flow.

The Vaal river dam, U. of S. A., is an interesting example of this type of dam, on a river whose annual silt burden is estimated at 1,200,000 tons and maximum flood flow 187,000 cu ft per second.

BIBLIOGRAPHY—National Resources Committee, *Low Dams* (1938), W. P. Ciesielski, J. D. Justin and Julian Hinds, *Engineering for Dams*, (1945), F. W. Hanna and R. C. Kennedy, *Design of Dams*, 2nd ed (1938), (W. P. C., B. O. M.)

DAN, a tribe of Israel named after a son of Jacob and Bilhah, the maid of Rachel. The earlier home of the tribe was to the west of Judah, where it seems that they occupied the sea coast, covering the caravan routes, where the weakness of the later kings of the Egyptian 18th dynasty made it possible for them freely to plunder travellers (Judges v 17, Gen xix). The Philistine settlements naturally came into contact first with this tribe, and in the days of Samson their territory was reduced to small compass, embracing only the neighbouring villages of Zorah and Eshtalot. The story of Samson gives us traditions of the struggle which ended in the

expulsion of the Danites. In Judges xvii 5-9 we have the narrative of their migration to a new site in the far north. Thus was their home during the whole period of the northern monarchy, and their settlement centred round one of the most famous sanctuaries in Israel. The fact that several of the famous Israelite artists (especially in metal) are connected with the tribe of Dan (cf e.g., Exodus xxxi 6, II Chron i 21, 5-9) has suggested that early tradition connected Dan with the Canaanites and Kenites.

In the monarchic period the importance of Dan is almost entirely religious. It was a home of bull worship, and tradition ascribes the introduction of this cult to Jeroboam I (I Ki xii 28-30), but the shrine is far older, and its priesthood traced its descent from Moses himself (Judges xviii 30). Dan was subsequently either regarded as the embodiment of wickedness or entirely ignored (the list of the redeemed in Rev vii 5-8 omits the tribe of Dan altogether). Late speculation that the Antichrist should spring from it appears to be based upon an interpretation of Gen. xlix 17.

DAN, a light-skinned tribal people (formerly cannibal) sometimes known as the Juti cannibals, on the French Ivory coast and in Liberia in the basin of the upper Kavalley. The villages are independent. Family property is joint with individual ownership of person or possessions. They practise husbandry and arboriculture (millet, yam, kola, coco nut oil and rubber). They are animists and practise ordeal by poison and by boiling oil.

See M. S. Vendere, "Ethnographie du Cercle de Man, Côte d'Ivoire," *Revue Ethn et Trad* 1914.

DAN, a town which marked the northern limit of Palestine reckoned "from Dan to Beersheba." It is now identified with Tell el-Kadi, a mound 4 m west of Banias, in a jungle of rank vegetation. From its western base issues a mighty fountain (Leddai), the largest of the sources of the Jordan. Laish, or Leshem (Judges xviii), was its name prior to its conquest by migrating Danites and it formed, seemingly, a colony or dependence of Sidon. Here the Danites set up Micah's graven image (Judges xviii 30f.), and Jeroboam erected one of his golden calves (I Ki xii 29). Its name disappears from history with its capture by Ben Hadad of Damascus (I Ki xv 20). An attempt has been made to locate Dan at Banias based on a direct statement of Theodore and a vague allusion of the Jerusalem Talmud, but it has against it the definite testimony of Josephus (*Juag.* i 10 1 etc.) and that of Eusebius and Jerome (*Onom. Sac.*) as well as the evidence from the survival of the name (both Dan and Kadhi signify judge). Tell el-Kadi is now in British Mandated Territory. A preliminary survey of the mound for excavation purposes has been made since the World War.

DANA, CHARLES ANDERSON (1819-1897), American journalist, was born in Hinsdale, N.H., on Aug. 8, 1819. In 1839 he entered Harvard, but the impairment of his eyesight in 1841 forced him to leave college. From Sept. 1841 until March 1846 he lived at Brook Farm (q.v.), where he was made one of the trustees. He had previously written for the *Harbinger*, the Brook Farm organ, and had written as early as 1844 for the Boston *Chronotype*. In 1847 he joined the staff of the New York *Tribune*, and in 1848 he wrote from Europe letters to it on the revolutionary movements of that year. Returning to the *Tribune* in 1849, he became its managing editor, and in this capacity actively promoted the anti-slavery cause. In 1866 his resignation was asked for, apparently because of wide temperamental differences between him and Greeley. Secretary of war Seward immediately made him a special investigating agent of the war department, in this capacity Dana spent much time at the front, and sent to Stanton frequent reports. He went through the Vicksburg campaign and was at Chickamauga and Chattanooga, and urged the placing of Gen. Grant in supreme command of all the armies in the field. In 1864-65 Dana was second assistant secretary of war. He became the editor and part owner of the New York *Sun* in 1868, and remained in control of it until his death. Under Dana's control the *Sun* opposed the impeachment of President Johnson, it supported Grant for the presidency in 1868, it was a sharp critic of Grant as president, and in 1872 took part in the Liberal Republic

revolt and urged Greeley's nomination. It favoured Tilden, the Democratic candidate for the presidency, in 1876, opposed the Electoral Commission and continually referred to Hayes as the 'fraud president'. In 1884 it supported Benjamin F. Butler, the candidate of Greenback Labor and Anti Monopolist parties, for the presidency, and opposed Blaine (Republican) and even more bitterly Cleveland (Democrat), it supported Cleveland and opposed Harrison in 1888, and in 1890, on the free silver issue, it opposed Bryan, the Democratic candidate for the presidency. Dana's literary style came to be the style of the *Sun*—simple, strong, clear, "boiled down" *The Art of Newspaper Making*, containing lectures which he wrote on journalism, was published in 1900. With George Ripley he edited *The New American Cyclopaedia* (1857-63), reissued as the *American Cyclopaedia* in 1873-76. He edited an anthology, *The Household Book of Poetry* (1857). Dana's *Reminiscences of the Civil War* was published in 1898, as was his *Eastern Journeys, Notes of Travel*. He died at Glen Cove, Long Island, N.Y., on Oct. 17, 1897.

See James Wilson, *The Life of Charles A. Dana* (1907), and Frank M. O'Brien, *The Story of the "Sun"*, New York, 1833-1918 (1918).

DANA, FRANCIS (1743-1821), American jurist, was born in Charlestown (Mass.), June 13, 1743. He graduated at Harvard in 1760, was admitted to the bar in 1767, became a leader of the Sons of Liberty, and in 1774 was a member of the first provincial congress of Massachusetts. He was a member of the Massachusetts Executive Council (1776-80) and a delegate to the Continental Congress (1776-78). In the autumn of 1779 he was appointed secretary to John Adams, who had been selected as minister plenipotentiary to negotiate treaties of peace and commerce with Great Britain, and in Dec. 1780 he was appointed diplomatic representative to the Russian Government. He remained at St. Petersburg from 1781 to 1783, but was never formally received by the empress Catherine. In 1784 he was again chosen a delegate to Congress, and in 1785 he became a justice of the Massachusetts supreme court, over which he presided (1792-1806) with ability and distinction. He was an earnest advocate of the adoption of the Federal constitution, was a member of the Massachusetts convention which ratified that instrument and was one of the most influential advisers of the leaders of the Federalist party. He died at Cambridge (Mass.), April 25, 1821.

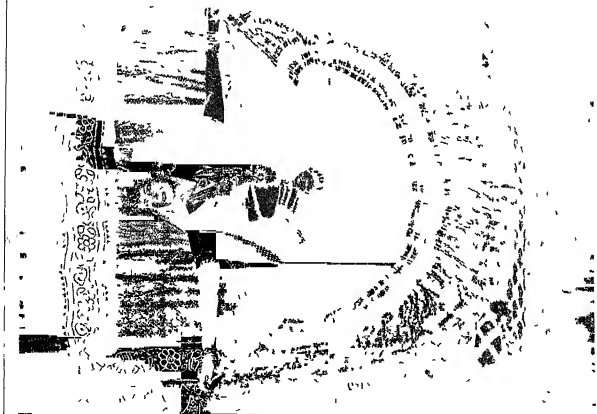
His son, **RICHARD HENRY DANA** (1787-1879), was born in Cambridge (Mass.), Nov. 15, 1787. After graduation from Harvard in 1808 he was admitted to the bar, but literature was his absorbing interest. From 1815 until 1821 he was associated with Jared Sparks and Edward T. Channing in the editorial control of the *North American Review*, and in 1821-22 he put forth a miscellany, *The Idle Man*. He published his first volume of *Poems* in 1827, and in 1833 appeared his *Poems and Prose Writings*, republished in 1850 in two volumes. An English edition, *The Buccaneer and Other Poems*, was issued in 1844. Dana died in Boston, Feb. 2, 1879.

RICHARD HENRY DANA (1815-1882), son of the last mentioned, was born in Cambridge (Mass.), Aug. 1, 1815. He entered Harvard in the class of 1835, but an illness affecting his sight necessitated a suspension of his college work, and in Aug. 1834 he shipped before the mast for California, returning in Sept. 1836. This voyage was really a turning point in his career, renewing his health, turning him into a self-reliant, energetic man with broad interests and keen sympathies, and giving him the material for his *Two Years before the Mast* (1840), one of the best American books on the sea. Not only is this still widely read at home and abroad, but it also has historic significance. It created interest in California prior to the gold rush, with Melville's *White Jacket* (1850) it led to reforms in the treatment of sailors, and it vividly preserves a bygone epoch. Before the publication of his book, Dana had completed his legal training at Harvard, and he now began the practice of law, his former experience immediately bringing him a large number of maritime cases. In 1841 he published *The Seaman's Friend*, republished in England as *The Seaman's Manual*, a useful and readable book. In spite of the ostracism and danger

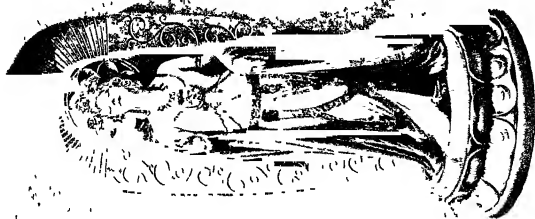
it involved, Dana became prominently associated in 1843, with the Free Soil movement and volunteered his services for negroes seized under the Fugitive Slave Act. In 1857 he became a regular attendant at the meetings of the famous Boston Saturday club, to the members of which he dedicated his account of a vacation trip, *To Cuba and Back* (1859). He returned to America from a trip round the world in time to participate in the presidential campaign of 1860 and after Lincoln's inauguration he was appointed United States district attorney for Massachusetts. In this office in 1863 he won before the Supreme Court of the United States the famous prize case of the "Amy Warwick," on the decision in which depended the right of the Government to blockade the Confederate ports without giving the Confederate States an international status as belligerents. He brought out in 1865 an edition of Wheaton's *International Law*, his notes constituting a most learned and valuable authority on this subject and its bearings on American history and diplomacy, but Dana was charged by the editor of two earlier editions, William Bench Lawrence, with infringing his copyright, and was involved in litigation for 13 years. Dana's political aspirations were largely frustrated. He declined the position of United States district judge, but he became a member of the Massachusetts house of representatives (1867-68), and in 1867 was returned, with William M. Everts, to prosecute Jefferson Davis, whose admission to bail he counselled. Although the Senate refused to ratify Grant's nomination of him for minister to England, he was, in 1877, one of the counsel for the United States before the commission that met at Halifax, N.S., to arbitrate the fisheries question between the United States and Great Britain. In 1878 he gave up his law practice, and he devoted the rest of his life to study and travel. He died in Rome, Italy, Jan. 6, 1882.

For the elder Richard Henry Dana, see J. G. Wilson, *Bryant and His Friends* (1885). For the younger, see C. F. Adams, *Richard Henry Dana: a Biography* (1890) and *Exercises: Celebrating the One Hundredth Anniversary of the Birth of Richard Henry Dana* (Cambridge, 1916).

DANA, JAMES DWIGHT (1813-1895), American geologist, mineralogist and zoologist, born in Utica, New York, on the 12th of February 1813. He early displayed a taste for science, which had been fostered by Fay Edgerton, a teacher in the Utica high school, and in 1830 he entered Yale College, in order to study under Benjamin Silliman the elder. Graduating in 1833, for the next two years he was teacher of mathematics to midshipmen in the navy, and sailed to the Mediterranean while engaged in his duties. In 1836-37 he was assistant to Professor Silliman in the chemical laboratory at Yale, and then, for four years, acted as mineralogist and geologist of a United States exploring expedition, commanded by Captain Charles Wilkes, in the Pacific ocean (see WILKES, CHARLES). His labours in preparing the reports of his explorations occupied parts of thirteen years after his return to America in 1842. In 1844 he again became a resident of New Haven, married the daughter of Professor Silliman, and in 1850, on the resignation of the latter, was appointed Silliman Professor of Natural History and Geology in Yale College, a position which he held till 1892. In 1846 he became joint editor and during the later years of his life he was chief editor of the *American Journal of Science and Arts* (founded in 1818 by Benjamin Silliman), to which he was a constant contributor, principally of articles on geology and mineralogy. A bibliographical list of his writings shows 214 titles of books and papers, beginning in 1835 with a paper on the conditions of Vesuvius in 1834, and ending with the fourth revised edition (finished in February 1895) of his *Manual of Geology*. His reports on *Zoophytes*, on the *Geology of the Pacific Area*, and on *Crustacea*, summarizing his work on the Wilkes expedition, appeared in 1846, 1849 and 1853-1854, in quarto volumes, with copiously illustrated atlases, but as these were issued in small numbers, his reputation more largely rests upon his *System of Mineralogy* (1837 and subsequent editions), *Manual of Geology* (1862, 4th ed. 1895), *Manual of Mineralogy* (1848), afterward entitled *Manual of Mineralogy and Lithology* (4th ed. 1887), and *Coral and Coral Islands* (1872, 2nd ed. 1890). In 1887 Dana revisited the Hawaiian Islands, and the results of his further investigations were pub-



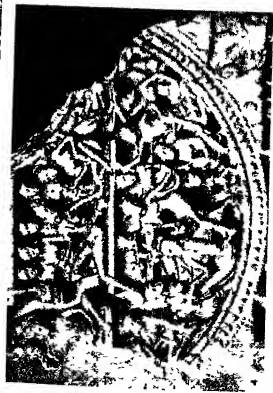
1. Ruth St. Denis in one of her interpretations of the Nautch dance of India



2. The sun dancer in a pose similar to the ancient Chinese carvings representing Kwan Yin

FROM PHOTOGRAPHS IN COLLAGE PHOTO, SPECIALLY FOR THE ENCYCLOPEDIA BRITANNICA

WESTERN INTERPRETATIONS OF FAR EASTERN DANCES



The first of the three photographs shows a person sitting on a low, patterned rug in a room with a doorway. The second photograph shows a person sitting on a low, patterned rug in a room with a doorway. The third photograph shows a person sitting on a low, patterned rug in a room with a doorway.



BY COURTESY OF (1) 2) 3) ASTORIA MURRAY (4) ACNE NEWSPHOTOS INC

STEPS IN MODERN BALLROOM DANCING

1 and 2 Arthur Murray and partners showing two views of the correct positions in dancing

3 Son commonly known as the Rhumba
4 The French Tango posed by Maurice and Cordeba



BY COURTESY OF (1) PARAMOUNT PRODUCTIONS INC. (2) DE MIZIAN STUDIO (3) ARTHUR MURRAY (4) RKO RADIO PICTURES INC. (5) METRO-GOLDWYN-MAYER CORP.

BALLROOM AND EXHIBITION DANCES

- 1 The "East of Wall" originated by Vernon and Irene Castle. This dance is a variation of the one step and was popular from 1913 to 1915. It consisted of long walking steps on one's toes moving up and down after circling the heel.
- 2 The Argentine Tango was popular between 1914 and 1916 but was later repudiated by the French. Photograph shows Ricardo Cortez and Dolores Del Rio.
- 3 The Maxie had a brief popularity as a ballroom dance in 1914. For a year afterwards it was used only as an exhibition dance danced by Ramon and Renita.
- 4 The Lula Fado, Tolo Polka, Braziliano had a brief vogue between 1914 and 1916. Photograph shows Arthur Murray and partner in the Chinese Tolo.
- 5 There was a lull in dancing after the hectic craze which died down in 1917 until 1926 when the Charleston became popular. Photograph shows Fred Astaire and Ginger Rogers in a characteristic step of the Charleston.
- 6 Tap Dancing Eleanor Powell in a characteristic pose.

lished in a quarto volume in 1899, entitled *Characteristics of Volcanoes*. He was awarded the Copley medal in 1877 by the Royal Society of London, and the Wollaston medal in 1872 by the Geological Society. He was one of the 50 original members of the National Academy of Sciences. He also took an active part in the affairs of Yale college, particularly in the development of the Sheffield Scientific school. He died April 14, 1895.

His son EDWARD SALISBURY DANA, born at New Haven on Nov. 16, 1849, was the author of *A Textbook of Mineralogy* (1877, 4th ed., 1932) and a *Text Book of Elementary Mechanics* (1881). In 1879-80 he was professor of natural philosophy and then was professor of physics at Yale. He died June 17, 1935.

See *Life of J. D. Dana*, by Daniel C. Gilman (1899).

DANAE (Gr. *da nā* ā anglicized *dan'-a-ē*), in Greek legend, daughter of Acrisius, king of Argos. According to the myth, her father, having been warned by an oracle that she would bear a son by whom he would be slain, confined Danae in a brazen tower. But Zeus descended to her in a shower of gold, and she gave birth to Perseus, whereupon Acrisius placed her and her infant in a wooden box and threw them into the sea. They were finally driven ashore on the island of Serphus, where they were picked up and brought to Polydectes, king of the island. For her subsequent adventures see PERSEUS.

DANAGLA, see BARABRA.

DANAO, a municipality (with administrative centre and 30 *barrios* or districts) of the province and island of Cebu, Philippine islands, on the east coast, at the mouth of the Danao river, 17 mi. NNE of Cebu, the provincial capital. Pop. (1948) 26,461.

Danao is in the centre of a rich agricultural region producing rice, corn, sugar, copra and cacao. Coal is mined in the vicinity.

According to the census of 1939, there were 3,100 farms in Danao, 1,289 of which were farmed by the owners, 907 by part owners, 903 by share tenants and one cash tenant. The vernacular is Cebuano.

DANAEUS, in Greek legend, son of Belus, king of Egypt, and twin brother of Aegyptus. He was born at Chemmis (Panopolis) in Egypt, but having been driven out by his brother he fled with his 50 daughters to Argos, the home of his ancestress Io. The 50 sons of Aegyptus arrived in Argos, and Danaus was obliged to consent to their marriage with his daughters. But to each of these he gave a knife with injunctions to slay her husband on the marriage night. They all obeyed except Hypermestra, who spared Lynceus. She was brought to trial by her father, acquitted and afterward married to her lover. Being unable to find suitors for the other daughters, Danaus offered them in marriage to the youths of the district who proved themselves victorious in racing contests (Pindar, *Pythia*, ix. 117).

According to another story Lynceus slew Danaus and his daughters and seized the throne of Argos (schol. on Euripides, *Hecuba*, 886). In the other world the Danaides were condemned to the endless task of filling with water a vessel which had no bottom. Crime and punishment alike have been variously explained by mythologists.

See articles in Pauly-Wissowa's *Realencyklopädie* and W. H. Roscher's *Lexikon der Mythologie*, Campbell Bonner, in *Harvard Studies*, xiii (1902).

DANBURITE, a rare mineral species consisting of calcium and boron orthosilicate, $\text{CaB}_2(\text{SiO}_4)_2$, crystallizing in the orthorhombic system and discovered in 1839 at Danbury, Conn., whence its name, and where it occurs embedded in dolomite. The crystals are transparent to translucent, and colourless to pale yellow, they are prismatic in habit, and closely resemble topaz in form and interfacial angles. There is an imperfect cleavage parallel to the basal plane, hardness 7, specific gravity 3.0. Splendid crystals have been found in Japan.

DANBURY, a city of southwestern Connecticut, 65 mi. NNE of New York city, on the Still river, one of the county seats of Fairfield county. It is served by the New York, New Haven and Hartford railroad. The population was 32,067 in 1950 and 24,339 in 1940 by the federal census.

The city lies in a broad plain, surrounded by the foothills of the

Berkshires, and retains much of the delightful aspect of a New England village. It is the seat of a state teachers college, opened 1904. The predominant industry is the manufacture of felt hats begun in 1780. Other important manufactures are hatmaking machinery, silverplated ware, surgical instruments, silk braid, thread, ball and roller bearings, aluminum foil, heating units, electronic instruments, precision tools and artists' brushes. An agricultural fair is an annual event.

Danbury was settled in 1684. The borough was chartered in 1812 and became a city in 1889. In 1776 a depot of military supplies was established there, which in April 1777 was raided by Gov. William Tryon of New York. In his retreat he was attacked at Ridgefield (9 mi. S) by the Americans under Gen. David Wooster, who was fatally wounded in the conflict. Several books about Danbury were written by James Montgomery Bailey (1841-94), founder and for many years proprietor of the *Danbury News*, whose humorous sketches in the *News* made him self and the paper famous.

The "Danbury Hatters' Case" a suit for damages brought by a manufacturing firm against 186 hatters of Danbury in 1902 on the ground that their boycott was a violation of the Sherman Act, is important in the annals of organized labour in America. Damages were awarded to the plaintiff and his contention was upheld by a decision of the U.S. supreme court in 1908.

DANBY, FRANCIS (1793-1861), landscape painter was born at Common, near Wexford, Ire., and died at Exmouth, Devon. On being elected A.R.A. in 1825 he settled in London. In 1839, however, he quarrelled with the academy and till 1841 lived by the lake of Geneva. His elder son and pupil, JAMES FRANCIS DANBY (1816-75), specialized in sunrises and sunsets in his father's Turner coat Martin style, the younger, THOMAS DANBY (1817?-86), tried in his Welsh landscapes to imitate Claude Lorrain.

DANBY, THOMAS OSBORNE, EARL OF, see LLEDS, THOMAS OSBORNE, 1ST DUKE OF.

DANCE, the name of an English family distinguished in architecture, art and the drama. GEORGE DANCE, the elder (1700-68), obtained the appointment of architect to the City of London and designed the Mansion house (1739), the churches of St. Botolph, Aldgate (1741), St. Luke's, Old street, St. Leonard, Shoreditch, the old excise office, Broad street, and other public works of importance. His eldest son, JAMES DANCE (1722-74) was educated at the Merchant Taylors' school and St. John's college, Oxford. He took the name of Love and became an actor and playwright connected for 12 years with Drury Lane theatre. He wrote a number of comedies—the earliest *Pamela* (1742).

George Dance's third son, SIR NATHANIEL DANCE HOLLAND BART (1735-1811), studied art under Francis Hayman in Italy, where he formed a hopeless attachment for Angelica Kauffmann. From Rome he sent home "Dido and Aeneas" (1763). On his return to England he took up portrait painting with great success and contributed to the first exhibition of the Royal Academy, of which he was a foundation member, full length portraits of George III and his queen. These, and his portraits of Capt. James Cook and of Garrick as Richard III, engraved by Dixon, are his best known works. In 1790 he became M.P. for East Grinstead taking the additional name of Holland. He was made a baronet in 1800. George Dance's fifth and youngest son, GEORGE DANCE the younger (1741-1825), succeeded his father as City surveyor and architect in 1768. He had spent several years abroad chiefly in Italy, and had already distinguished himself by designs for Blackfriars bridge. His first important public work was the rebuilding of Newgate prison in 1770. He was a foundation member of the Royal Academy and the "revelled master" of Sir John Soane. His son, CHARLES DANCE (1794-1863), was for 30 years registrar, taxing officer and chief clerk of the insolvent debtors court. In collaboration with J. R. Planche and others, or alone, he wrote a great number of extravaganza, farces and comedies. He was one of the first of the burlesque writers, and was the author of those produced so successfully by Madame Vestris for years at the Olympic.

DANCE. Dancing consists in the rhythmical movement of any or all parts of the body in accordance with some scheme of

individual or concerted action which is expressive of emotions or ideas. Amongst primitive peoples it always has some accompaniment by means of which the rhythm is emphasized. In its simplest form this consists in clapping the hands, or beating a drum to mark the time, more elaborate is the accompaniment composed of several drums each with its own rhythm, or of an orchestra of different instruments. Frequently every dance has its own song which is sung by the performers themselves or by the onlookers.

Among primitive peoples the range of movements employed in dancing is very wide. All parts of the body are used, head, back, hips, arms, fingers and even the facial muscles are brought into play as well as the feet. Some performances demand great physical exertion, with leaping and many bodily contortions, as in the war *haka* of the Maori.¹ In others the dancers confine themselves to a monotonous movement of the hands and feet. Many observers have commented on the swiftness and lack of beauty in savage dances but such a condemnation is based upon the misconception that they are performed primarily for the pleasure of the spectator. Spectacular dances are not unknown, but generally the satisfaction of the dancers is of first importance.

Much has been written of the obscenity of primitive dancing and it has even been said that it is primarily sexual in intent. Evidence from many parts of the world does not bear this out. To a certain extent all dancing is sexually stimulating, but, except in courtship dances, this stimulus may be regarded as a by-product. Nor is it true that all primitive dance movements are mimetic. Some are undoubtedly so, as the totemic dances in Australia (see TOTEMISM), but in the Andaman Islands there is no trace of any such significance. Often the movements seem to be artistic renderings of spontaneous actions resulting from some emotional state.

As a rule a dance is performed by a group or groups of people all of whom move in the same way. Solo dances are rare, though not infrequently there is a dance leader who has a special part to play. All the able bodied adults of the community are expected to take part. Usually the sexes are segregated, though this is by no means universal, but the close embrace, customary in European round dances, is seldom countenanced. Sometimes certain dances are restricted to one sex. Unless the dance forms part of a secret ceremony, that section of the community which is not dancing acts as audience, and often performs the accompaniment. Children are seldom allowed to join their elders, but have dances and singing games among themselves.

Under certain conditions some individuals, such as those who are in mourning or in seclusion at puberty, are not allowed to dance. They are in an abnormal state and temporarily cut off from society, and are therefore excluded from dancing, which is essentially a social occupation. It is for this reason too that a dance is so



with a pair of the ceremony which terminates a period of isolation, by joining in its performance the individual re-establishes his membership of the group.

"The individual shouts and jumps for joy, the society turns the jump into a dance, the shout into a song." Dancing is a general means of enjoyment, often of rejoicing. But, as indicated above, it is more than this. Consciously or unconsciously it is a means of reaffirming social unity and occurs on all occasions which are so usually important at the close of *Passage Rites* (*q.v.*)—especially those of puberty and death, at the initiation and close of group

¹ Ellis, *The Maori*, vol. II, pp. 102-103

activities such as fighting or the building of a communal house, or during inter group activities such as the tribal corroboree in Australia or the peace-making of the Andromans. The food supply is all-important to the community and thus among agricultural people, for instance, seed and harvest time have social significance, and are therefore times of dancing.

But except on such occasions is the dance meetings of local groups and the peace making ceremonies of the Andromans the sense of social unity is felt as a pleasurable accompaniment to dancing rather than as its conscious purpose.



BY COURTESY OF Y. W. C. A.
CHINESE BOY IN COS-
TUME FOR DEVIL DANCE

would detract from the efficacy of the dance. Accuracy of movement like accuracy of words is essential to the success of magical rites. From the way in which a dance is performed omens are frequently taken, any mistake or want of spirit being accounted evil. The border line between magic and religion is notoriously difficult to draw, but among some people dancing seems definitely to be a form of religious exercise akin to prayer.

Dancing as an incident in courtship is found among many species of birds and animals. In all dancing there is an opportunity for pleasurable exercise, but some dances are designed to create sexual excitement in both performers and onlookers. Thus in Torres Straits, the unmarried girls watch the bachelors dancing, and then each taps on the shoulder the one whom she has chosen, and in Australia the occasional periods of organized sexual licence are led up to by dancing.

Auto intoxication is induced either intentionally or incidentally by dancing, the best known examples of this being the wild excesses of the bacchanals and of the shamans of Siberia, who use dancing as a means of becoming inspired by their tutelary spirit. Similar "possession" is induced by priests among savage peoples, and the power to do this is often a *sine qua non* of priesthood. In a war dance the condition produced is not so extreme, but is akin to this. The warriors work themselves into a frenzy of hatred, and they feel themselves exalted. Though many war dances may have a supposed magical effect on the enemy, this exaltation, this sense of heightened valour, is often one if not the only reason for their performance.

Nothing will survive in any human society unless it has a functional value. Within every individual in a community there is a conflict of desires. On the one hand there is a wish to be outstanding, on the other the longing for a sense of group fellowship. To both these desires dancing at once provides satisfaction. The dancer can display himself to the best advantage and can do so in harmony with others. On certain occasions one or other of these two aspects may be stressed, as, for instance, the individual aspect in dances of courtship, the group aspect in war or peace dances, but, to a greater or less extent, both aspects are always present. Therefore, because dancing is entirely satisfying emotionally, it survives in the savage and civilized world when beliefs in its magical or religious efficacy have passed away.

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HISTORY

The term "dancing" in its widest sense includes three things — (1) the spontaneous activity of the muscles under the influence of some strong emotion, such as social joy or religious exultation, (2) definite combinations of graceful movements performed for the sake of the pleasure which the exercise affords to the dancer or to the spectator, (3) carefully trained movements which are meant by the dancer vividly to represent the actions and passions of other people. In the highest sense it seems to be for prose gesture what song is for the instinctive exclamations of feeling. At a Mexican feast to the god Huitzilopochtli the noblemen and women danced tied together at the hands, and embracing one another the arms being thrown over the neck. This resembles the dance variously known as the Greek Bracelet or Brawl, *Oppos*, or Bearsfeet, but all of them probably are to a certain extent symbolical of the relations between the sexes. In a very old Peruvian dance of ceremony before the Inca, several hundreds of men formed a chain, each taking hold of the hand of the man beyond his immediate neighbour, and the whole body moving forwards and backwards three steps at a time as they approached the throne.

The rude imitative dances of early civilization are of extreme interest. In the same way the dances of the Otyak tribes (Northern Asia) imitate the habitual sports of the chase and the gambols of the wolf and the bear and other wild beasts, the dancing consisting mainly of sudden leaps and violent turns which exhaust the muscular powers of the whole body. The Kamchadales, too, in dancing, imitate bears, dogs and birds. The *Kru* dances of the Coast Negroes represent hunting scenes, and on the Congo, before the hunters start, they go through a dance imitating the habits of the gorilla and its movements when attacked. The Damara dance is a mimic representation of the movements of oxen and sheep, four men stooping with their heads in contact and uttering harsh cries. The center of the baboon is the humorous part of the ceremony. The Bushmen dance in long irregular jumps, which they compare to the leaping of a herd of calves, and the Hottentots not only go on all fours to counterfeit the baboon, but they have a dance in which the buzzing of a swarm of bees is represented. The Kennowits in Borneo introduce the mias and the deer for the same purpose. The Australians and Tasmanians in their dances called *corrobories* imitate the frog and the kangaroo (both leaping animals). The hunt of the emu is also performed, a number of men passing slowly round the fire and throwing their arrows about so as to imitate the movements of the animal's head while feeding. The Gonds are fond of dancing the bison hunt, one man with skin and horns taking the part of the animal. Closely allied to these are the mimic fights, almost universal among tribes to which war is one of the great interests of life. The Bravery dance of the Dahomans and the Hoolee of the Bihl tribe in the Vindhya Hills are illustrations. The latter seems to have been reduced to an amusement conducted by professionals who go from village to village,—the battle being engaged in by women with long poles on the one side, and men with short cudgels on the other. There is here an element of comedy, which also appears in the Fiji club dance. This, although no doubt originally suggested by war, is enlivened by the presence of a clown covered with leaves and wearing a mask. The monotonous song accompanying the club dance is by way of commentary or explanation. So, also, in Guatemala there is a public *baile* or dance, in which all the performers, wearing the skins and heads of beasts, go through a mock battle, which always ends in the victory of those wearing the deer's head. At the end the victors truce in the sand with a pole the figure of some animal, and this exhibition is supposed to have some historical reference. But nearly all savage tribes have a regular war dance, in which they appear in fighting costume, handle their weapons, and go through the movements of challenge, conflict, pursuit or defeat. The women generally supply the stimulus of music. There is one very picturesque dance of the Natal Kafirs, which probably refers to the departure of the warriors for the battle. The women appeal plaintively to the men, who slowly withdraw, stamping on the

ground and darting their short spears or *assegais* towards the sky. In Madagascar, when the men are absent on war, the women dance for a great part of the day, believing that this inspires their husbands with courage. In this, however, there may be some religious significance. These war dances are totally distinct from the institution of military drill, which belongs to a later period, when social life has become less impulsive and more reflective. (The Greek *kaptraia* represented the surprise by robbers of a warrior ploughing a field. The gymnopaediæ dances imitated the sterner sports of the palaestra.) There can be little doubt that some of the characteristic movements of these primitive hunting and war dances survive in the smooth and ceremonious dances of the present day. But the truly mimetic dance was not confined to these two subjects, it embraced the other great events of savage life—the drama of courtship and marriage, the funeral dance, the consecration of labour, the celebration of harvest or vintage, sometimes, too, purely fictitious scenes of dramatic interest, while other dances degenerated into games. (The Greek *Lenaxa* and *Dionysia* had a distinct reference to the seasons.) For instance, in Yucatan one man danced in a cowering attitude round a circle, while another followed hurling at him *bohordos* or cunes, which were adroitly caught on a small stick. Again in Tasmanian, the dances of the women describe their "clamber for the opossum, diving for shell fish, digging for roots, nursing children and quarrelling with husbands." Another dance, in which a woman by gesture punts a thief on with cowardice, gives him an opportunity of coming forward and recounting his courageous deeds in dance. The funeral dance of the Todas (another Indian hill tribe) consists in walking backwards and forwards, without variation, to a howling tune of "hoo! hoo!" The meaning of this is obscure, but it can scarcely be solely an outburst of grief. In Dahomey the blacksmiths, carpenters, hunters, braves and bards, with their various tools and instruments, join in a dramatic dance. We may add here a form of dance which is almost precisely equivalent to the spoken incantation. It is used by the professional devil-dancer of the wild Veddahs for the cure of diseases. An offering of eatables is put on a tripod of sticks, and the dancer, decorated with green leaves, goes into a paroxysm of dancing in the midst of which he receives the required information. This, however, rather belongs to the subject of religious dances.

It is impossible here to enumerate either the names or the forms of the sacred dances which formed so prominent a part of the worship of antiquity. After the middle of the 18th century there were still traces of religious dancing in the cathedrals of Spain, Portugal and Roussillon—especially in the Mozarabic Mass of Toledo.

HISTORIC DANCES, 15TH-19TH CENTURY

France and Italy.—Italy, in the 15th century, saw the renaissance of dancing, and France may be said to have been the nursery of the modern art, though comparatively few modern dances are really French in origin. The national dances of other countries were brought to France, studied systematically, and made perfect there. An English or a Bohemian dance, practised only amongst peasants, would be taken to France polished and perfected, and would at last find its way back to its own country, no more recognizable than a piece of elegant cloth when it returns from the printer to the piece from which as "grey" material it was sent. The fact that the terminology of dancing is almost entirely French is a sufficient indication of the origin of the rules that govern it.

The earliest dances that bear any relation to the modern art are probably the *dances basses* and *dances hautes* of the 16th century. The *dance basse* was the dance of the court of Charles IX. and of good society, the steps being very grave and dignified, not to say solemn, and the accompaniment a psalm tune. The *dances hautes* or *baladines* had a skipping step, and were practised only by clowns and country people. More lively dances, such as the *Gaillarde* and *Volta* were introduced into France from Italy by Catherine de' Medici, but even in these the interest was chiefly spectacular. Other dances of the same period were the *Bransle* (afterwards corrupted to *Braule*, and known in England

as the Brawle)—a kind of generic dance which was capable of an almost infinite amount of variety. Thus there were imitative dances—*Bransles mimés*, such as the *Bransles des Ermites*, *Bransles des flambeaux* and the *Bransles des lavandières*. The *Bransle* in its original form had steps like the *All-monde*.

Perhaps the most famous and stately dance of this period was the *Pavane* (of Spanish origin), which is very fully described in Tabouret's *Orchédographie*, the earliest work in which a dance is found minutely described. The *Pavane*, which was really more a procession than a dance, must have been a very gorgeous and noble sight, and it was perfectly suited to the dress of the period, the stiff brocades of the ladies and the swords and heavily plumed hats of the gentlemen being displayed in its simple and dignified measures to great advantage.

In the *Pavane* and *Bransle*, and in nearly all the dances of the 17th and 18th centuries, the practice of kissing formed a not unimportant part, and seems to have added greatly to the popularity of the pastime. Another extremely popular dance was the *Sara band*, which, however, died out after the 17th century. It was originally a Spanish dance but enjoyed an enormous success for a time in France. Every dance at that time had its own tune or tunes, which were called by its own name, and of the *Saraband* the chevalier de Grammont wrote that "it either charmed or annoyed everyone, for all the guitarists of the court began to learn it, and God only knows the universal twanging that followed." Vauquelin des Yvetours, in his 80th year, desired to die to the tune of the *Saraband*, "so that his soul might pass away sweetly."

The *Courante* was a court dance performed on tiptoe with slightly jumping steps and many bows and curtsies. The minuet and the waltz were both in some degree derived from it, and it had much in common with the famous *Seguidilla* of Spain. It was a favourite dance of Louis XIV., who was an adept in the art, and it was regarded in his time as of such importance that a noble man's education could hardly have been said to be begun until he had mastered the *Courante*.

The dance which the French brought to the greatest perfection—which many, indeed, regard as the fine flower of art—was the *Minuet*. Its origin, as a rustic dance, is not less antique than that of the other dances from which the modern art has been evolved. It was originally a *bransle* of Poitou, derived from the *Courante*. It came to Paris in 1650 and was first set to music by Lully. It was at first a gay and lively dance, but on being brought to court it soon lost its sportive character and became grave and dignified. It is mentioned by Beauchamps, the father of dancing-masters, who flourished in Louis XIV.'s reign, and also by Blondy, his pupil, but it was Pecour who really gave the minuet its popularity, and although it was improved and made perfect by Dauberval, Gardel, Marcel and Vestris, it was in Louis XV.'s reign that it saw its golden age. It was then a dance for two in moderate triple time, and was generally followed by the gavotte. Afterwards the minuet was considerably developed, and with the gavotte became chiefly a stage dance and a means of display, but it should be remembered that the minuetts which are now danced on the stage are generally highly elaborated with a view to their spectacular effect, and have imported into them steps and figures which do not belong to the minuet at all, but are borrowed from all kinds of other dances. The original court minuet was a grave and simple dance, although it did not retain its simplicity for long. But when it became elaborated it was glorified and moulded into a perfect expression of an age in which deportment was most sedulously cultivated and most brilliantly polished. The "linguishing" eye and smiling mouth had their due effect in the minuet, it was graceful movements and curtsies, the pauses which had to be filled by neatly turned compliments, the beauty and bravery of attire—all were eloquent of graces and outward refinements which we cannot boast now. The fact that the measure of the minuet has become incorporated in the structure of the symphony shows how important was its place in the polite world.

The *Gavotte*, which was often danced as a pendant to the minuet, was also originally a peasant's dance, a *danse des Gavots*, and consisted chiefly of kissing and capering. It also became stiff and

artificial, and in the later and more prudish half of the 18th century the ladies received bouquets instead of kisses in dancing the gavotte. It rapidly became a stage dance, and it has never been restored to the ballroom. Gretry attempted to revive it, but his arrangement never became popular.

Other dances which were naturalized in France were the *Ecos saise*, popular in 1760, the *Cotton*, fashionable under Charles X., derived from the peasant *bransles* and danced by ladies in short skirts, the *Galop*, imported from Germany, the *Lancers*, invented by Laborde in 1836, the *Polka*, brought by a dancing master from Prague in 1840, the *Schottische*, also Bohemian, first introduced in 1844, the *Bourree*, or French clog dance, the *Quadrille*, known in the 18th century as the *Contre danse*, and the *Waltz*, which was danced as a *volte* by Henry III. of France, but only became popular in the beginning of the 19th century. We shall return to the history of some of these later dances in discussing the dances at present in use.

Spain—If France has been the nursery and school of the art of dancing, Spain is its true home. There it is part of the national life, the inevitable expression of the gay, contented, irresponsible, sunburnt nature of the people. The form of Spanish dances has hardly changed, some of them are of great antiquity, and may be traced back with hardly a break to the performances in ancient Rome of the famous dancing-girls of Cadiz. The connection is lost during the period of the Arab invasion, but the art was not neglected, and Jovellanos suggests that it took refuge in Asturias. At any rate, dances of the 10th and 12th centuries have been preserved uncorrupted. The earliest dances known were the *Turdion*, the *Gibdana*, the *Pié de-gibao*, and (later) the *Madama Orleans*, the *Alemána* and the *Pavana*. Under Philip IV. theatrical dancing was in high popularity, and ballets were organized with extraordinary magnificence of decoration and costume. They supplanted the national dances, and the *Zarabanda* and *Chacona* were practically extinct in the 18th century. It is at this period that the famous modern Spanish dances, the *Bolero*, *Seguidilla* and the *Fandango*, first appear.

Of these the *Fandango* is the most important. It is danced by two people in 6-8 time, beginning slowly and tenderly, the rhythm marked by the click of castanets, the snapping of the fingers and the stamping of feet, and the speed gradually increasing until a whirl of exaltation is reached. A feature of the *Fandango* and also of the *Seguidilla* is a sudden pause of the music towards the end of each measure, upon which the dancers stand rigid in the attitudes in which the stopping of the music found them, and only move again when the music is resumed. M. Vuillier, in his *History of Dancing*, gives the following description of the *Fandango*:—"Like an electric shock, the notes of the *Fandango* animate all hearts. Men and women, young and old, acknowledge the power of this air over the ears and soul of every Spaniard. The young men spring to their places, rattling castanets or imitating their sound by snapping their fingers. The girls are remarkable for the willowy languor and lightness of their movements, the voluptuousness of their attitudes—beating the exactest time with tapping heels. Partners tense and entreat and pursue each other by turns. Suddenly the music stops, and each dancer shows his skill by remaining absolutely motionless, bounding again into the full life of the *Fandango* as the orchestra strikes up. The sound of the guitar, the violin, the rapid tic-tac of heels (*tacomeos*), the crack of fingers and castanets, the supple swaying of the dancers, fill the spectator with ecstasy. The measure whirls along in a rapid triple time. Spangles glitter, the sharp clank of ivory and ebony castanets beats out the cadence of strange, throbbing, deepening notes—assonances unknown to music, but curiously characteristic, effective and intoxicating. Amidst the rustle of silks, smiles gleam over white teeth, dark eyes sparkle and droop and flash up again in flame. All is flutter and glitter, grace and animation—quivering, sonorous, passionate, seductive."

The *Bolero* is a comparatively modern dance, having been invented by Sebastian Cerezo, a celebrated dancer of the time of King Charles III. It is remarkable for the free use made in it of the arms, and is said to be derived from the ancient *Zarabanda*, a violent and licentious dance, which has entirely disappeared,

and with which the later Saraband has practically nothing in common. The step of the *Bolero* is low and gliding but well marked. It is danced by one or more couples. The *Segundilla* is hardly less ancient than the *Fandango*, which it resembles. Every province in Spain has its own *Segundilla*, and the dance is accompanied by *coplas*, or verses, which are sung either to traditional melodies or to the tunes of local composers, indeed, the national music of Spain consists largely of these coplas.

The *Jota* is the national dance of Aragon, a lively and splendid, but badly dignified and reticent, dance derived from the 16th century *Pasacalle*. It is still used as a religious dance. The *Cachucha* is a light and graceful dance in triple time. It is performed by a single dancer of either sex. The head and shoulders play an important part in the movements of this dance. Other provincial dances now in existence are the *Jaleo de Jerez*, a whirling measure performed by gipsies, the *Paloté*, the *Polo*, the *Gallegada*, the *Muyneria*, the *Habas Verdes*, the *Zapatado*, the *Zorongo*, the *Vito*, the *Tirano* and the *Tripola Trapola*. Most of these dances are named either after the places where they are danced or after the composers who have invented tunes for them. Many of them are but slight variations from the *Fandango* and *Segundilla*.

Great Britain.—The history of court dancing in Great Britain is practically the same as that of France, and need not occupy much of our attention here. But there are strictly national dances still in existence which are quite peculiar to the country, and may be traced back to the dances and games of the Saxon gleemen. The *Egg dance* and the *Carole* were both Saxon dances, the *Carole* being a Yule-tide festivity, of which the present day Christmas carol is a remnant.

The oldest dances which remain unchanged in England are the *Morris dances*, which were introduced in the time of Edward III. (See MORRIS DANCE.)

Dancing practically disappeared during the Puritan regime, but with the Restoration it again became popular. It underwent no considerable developments, however, until the reign of Queen Anne, when the glories of Bath were revived in the beginning of the 18th century, and Beau Nash drew up his famous codes of rules for the regulation of dress and manners, and founded the balls in which the polite French dances completely eclipsed the simpler English ones.

The only true national dances of Scotland are reels, strathspeys and flings, while in Ireland there is but one dance—the jig, which is there, however, found in many varieties and expressive of many shades of emotion, from the maddest gaiety to the wildest lament. Curiously enough, although the Welsh dance often, they have no strictly national dances.

Popular Dances of Universal Importance.—The *Waltz* is no doubt the most popular of the 19th century dances. Its origin is a much-debated subject, the French, Italians and Bavarians each claiming for their respective countries the honour of having given birth to it. As a matter of fact the waltz, as it is now danced, comes from Germany, but it is equally true that its real origin is French, since it is a development of the *Volte*, which in its turn came from the *Lavolta* of Provence, one of the most ancient of French dances. The *Lavolta* was fashionable in the 16th century and was the delight of the Valois court. The *Volte* danced by Henry III. was really a *Valse à deux pas*, and Castil-Blaze says that "the waltz which we took again from the Germans in 1795 had been a French dance for four hundred years." The change, it is true, came upon it during its visit to Germany, hence the theory of its German origin. The first German waltz tune is dated 1770—"Achl du lieber Augustin." It was first danced at the Paris opera in 1793, in Gardel's ballet *La Danse-mante*. It was introduced to English ballrooms in 1812, when it roused a storm of ridicule and opposition, but it became popular when danced at Almack's by the emperor Alexander in 1816. The waltz *à trois temps* has a sliding step in which the movements of the knees play an important part. The tempo is moderate, so as to allow three distinct movements on the three beats of each bar, and the waltz is written in 3-4 time and in eight-bar sentences. Walking up and down the room and occasionally breaking into the

step of the dance is not true waltzing, and the habit of pushing one's partner backwards along the room is an entirely English one. But the dancer must be able to waltz equally well in all directions, pivoting and crossing the feet when necessary in the reverse turn. It need hardly be said that the feet should never leave the floor in the true waltz. Gungl, Waldteufel and the Strauss family may be said to have moulded the modern waltz to its present form by their rhythmic and agreeable compositions. There are variations which include hopping and lurching steps, these are degradations, and foreign to the spirit of the true waltz.

The *Quadrille* is of some antiquity, and a dance of this kind was first brought to England from Normandy by William the Conqueror, and was common all over Europe in the 16th and 17th centuries. The term quadrille means a kind of card game, and the dance is supposed to be in some way connected with the game. A species of quadrille appeared in a French ballet in 1745, and since that time the dance has gone by that name. It then consisted of very elaborate steps, which in England have been simplified until the degenerate practice has become common of walking through the dance. The quadrille, properly danced, has many of the graces of the minuet. It is often stated that the square dance is of modern French origin. This is incorrect, and probably arises from a mistaken identification of the terms quadrille and square dance. "Dull Sir John" and "Taine I would," were square dances popular in England 300 years ago.

An account of the country dance, with the names of some of the old dance tunes, has been given above. The word is not, as has been supposed, an adaptation of the French *contre danse*, neither is the dance itself French in origin. According to the *New English Dictionary*, *contre danse* is a corruption of "country dance," possibly due to a peculiar feature of many of such dances, like Sir Roger de Coverley, where the partners are drawn up in lines opposite to each other. The English "country dances" were introduced into France in the early part of the 18th century and became popular, later French modifications were brought back to England under the French form of the name, and this, no doubt, caused the long-accepted but confused derivation.

The *Lancers* were invented by Laborde in Paris in 1836. They were brought over to England in 1850, and were made fashionable by Madame Sacré at her classes in Hanover Square Rooms.

The *Polka*, the chief of the Bohemian national dances, was adopted by society in 1835 at Prague. Josef Neruda had seen a peasant girl dancing and singing the polka, and had noted down the tune and the steps. From Prague it readily spread to Vienna, and was introduced to Paris by Cellarius, a dancing-master, who gave it at the Odéon in 1840. It took the public by storm, and spread like an infection through England and America. Everything was named after the polka, from public houses to articles of dress. Mr Punch exerted his wit on the subject weekly, and even *The Times* complained that its French correspondence was interrupted, since the polka had taken the place of politics in Paris. The true polka has three slightly jumping steps, danced on the first three beats of a four quarter bar, the last beat of which is employed as a rest while the toe of the unemployed foot is drawn up against the heel of the other.

The *Galop* is strictly speaking a Hungarian dance, which became popular in Paris in 1830. But some kind of a dance corresponding to the galop was always indulged in after *Voltes* and *Contre-dances*, as a relief from their constrained measures.

The *Barn dance* is no doubt of American origin, its height of popularity being toward the end of the 19th century. It was customary for the farmer who wished to build a new barn to call in his neighbours for a "working" and finish the job within a short time, after which a dance was "thrown." The dance is still very popular in certain rural sections, and does not necessarily confine itself to new or empty barns. The square dance, or some form of group dancing, is executed to the accompaniment of a two- or three-piece string band or the neighbouring fiddle.

The *Paul Jones* is one of the many "sets" that are evening of barn-dancing. A number of couples are at the performance as well as a "caller" who gives direct action of each couple.

The *Washington Post* belongs to America.

The *Polka Mazurka* is extremely popular in Vienna and Budapest, and is a favourite theme with Hungarian composers. The six movements of this dance occupy two bars of 3-4 time, and consist of a mazurka step joined to the polka. It is of Polish origin.

The *Polonaise* and *Mazurka* are both Polish dances and are still fashionable in Russia and Poland. Every State ball in Russia is opened with the ceremonious Polonaise.

The *Schottische*, a kind of modified polka, was "created" by Maikowski, who was the proprietor of a famous dancing academy in 1850. The *Highland Schottische* is a fling. The Fling and Reel are Celtic dances, and form the national dances of Scotland and Denmark. They are complicated measures of a studied and classical order, in which free use is made of the arms and of cries and stampings. The *Siratspey* is a slow and grandiose modification of the Reel.

Mr Roger de Coverley is the only one of the old English social dances which has survived to the present day, and it is frequently danced at the conclusion of the less formal sort of balls. It is a merry and lively game in which all the company take part, men and women facing each other in two long rows. The dancers are constantly changing places in such a way that if the dance is carried to its conclusion everyone will have danced with everyone else. The music was first printed in 1685, and is sometimes written in 2-4 time, sometimes in 6-8 time, and sometimes in 3-9 time.

The *Cotillon* is a modern development of the French dance of the same name referred to above. It is an extremely elaborate dance, in which a great many toys and accessories are employed, hundreds of figures may be contrived for it, in which presents, toys, lighted tapers, biscuits, air balloons and hurdles are used.

Ballet—The modern ballet (*q.v.*) would seem to have been first produced on a considerable scale in 1489 at Tortona, before Duke Galeazzo of Milan. It soon became a common amusement on great occasions at the European courts. The ordinary length was five acts, each containing several *entrées*, and each *entrée* containing several quadrilles.

BIBLIOGRAPHY—For the old division of the *Ars Gymnastica* into *paedastica* and *saltatoria*, and of the latter into *cubistica*, *sphaeristica* and *archistica*, see the learned work of Hieronymus Mercatorius, *De arte Gymnastica* (Amsterdam, 1572). Cubistic was the art of throwing somersaults, and is described minutely by Tuccaro in his *Tractatus Dialogues* (Paris, 1599). Sphaeristic included several complex games at ball and tilting—the Greek *σφαίρις* and the Roman *trigonalis* and *paganica*. Orchestic, divided by Plutarch into *latius*, *figura* and *indicatio*, was really imitative dancing, the "silent poetry" of Simonides. The importance of the *χορονομία* or hand-movement is indicated by Ovid—"Si vox est, cantu, si mollia brachia, salta." For further information as to modern dancing, see Rameau's *Le maître à danser* (1726), Querou's *Le triomphe des grâces* (1774), Cahouse's *La danse ancienne et moderne* (1754), Vuillier, *History of Dancing* (Eng. trans., 1897), Giraudet, *Traité de la danse* (1900).

(A B F Y)

JAPAN

The dance in Japan has its origin in her mythical age. According to the 8th century *Kojiki*, when Amaterasu, the sun-goddess, retired in high dudgeon to a cavern, Ama no Uzumeno mikoto danced at the cavern's mouth to lure her out. *Kagura*, the sacred dance of today, is traced back to this incident by the native literati. Records speak of the emperor Inkō playing on a *wa gon* (Japanese native *hoto*) and the empress dancing at the imperial banquet given in 419 on the completion of their new palace building. In the Orient the dance is as old as history, and when some 7,000 Chinese families emigrated to Japan in 540 it is not to be doubted that they brought with them their cherished national custom. In 552 a Korean monarch sent a Buddhist mission to Japan and the dance formed a part of their religious ceremony. The old picturesque dance of China and Korea is still executed semi-annually, to the sound of flutes and waving of feathers in worship by the followers of Confucius. The dance became definitely established as a Japanese institution by the Ashikaga Shōgun (1367-1395). Yoshimitsu's school for dancing, and the Shōgun incorporated many historical themes of China into dramatic dances. With the invention of the *Nō* play by Kwanami utojūn (1406) and its development by his equally famous son, Ōno Motochika, the dance became closely associated with the

national theatre. In the 16th century the fame of the beautiful Okuni popularized the dance among all classes of society. But the tridition begun by her was interrupted in 1615 when for reasons of public morality, women were forbidden to appear upon the stage, male actors and the priests of Buddha continued the ancient custom of Korea and China. Western billroom dances such as waltzes and two steps were introduced to Japan in the last quarter of the 19th century and became a fashion for a time, but were soon dropped, and then revived again. (A K)

Visitors to Japan generally return deeply impressed with the beauty of cherry blossoms and the charming grace of the *geisha* girl dance. The dance is performed not only by the *geisha* and other dancing professionals, but is given in connection with the classical *Nō* drama, and it plays an important part in the old style of acting known as *kabuki* for, as an eminent actor of the old school has said, "an actor without ability to dance is like a wrestler without strength." Sacred dances called *kagura*, very simple in character, are given by maidens at some shrines, while Buddhist dances, such as *Nembutsu odori*, may be seen in connection with some religious observances.

Speaking of the native dance of Japan, three terms are used *mai*, *odori* and *furi* or *shosa*, all meaning dance, though technically differentiated. The first has been used to designate the older style of dancing which has been in vogue among the upper class and come to be performed by professionals. It is likened to the graceful movements of the crane at sunrise. The second, which does not appear in literature before the 15th century, has been applied to the dance that was born and has become a fashion among the common people. It means the spontaneous expression of joy with gesture of hands and feet common to all people. The third designates the dance woven into the acting on the stage. *Mai* may be said to designate a classical, *odori* a popular and *furi* a dramatic dance. However, the first may also be classified into two classical and popular. The classical *mai* is preserved in the imperial court in connection with traditional observances or in Shinto shrines as *kagura*, or in *Nō* drama, while the popular *mai* is practically the same as *odori* but called *mai* according to the custom peculiar to certain localities. It is generally maintained that in *mai* the attitude is characterized by solemnity, the gesture by elegance and refinement, and the movement by an easy and natural flow, while in *odori* the dance is more natural and free in attitude and movement, and the gesture more active and subtle, with a greater freedom for variation, allowing even a comical or a rustic element to creep in. *Furi* is enriched with dramatic quality. However, in many instances the distinction is hard, or even impossible, to draw. Moreover, the three terms may be said to represent different essential elements in the dance, rather than its kinds.

The dance of Japan may generally be divided into two classes: the popular and the special or professional. The former is for the pleasure of the mass of people who may acquire the art in several days or weeks, and it includes such dances as *Ise odori* (time-honoured dance in the province of Ise), *Tanabata odori* (for the festival of the star Vega) and others connected with popular festivals, as well as such religious dances as *Bon-odori* (held in summer in memory of the dead), *Nembutsu odori* (with Buddhist prayers), etc. The professional dances are acquired only by patient and laborious practice, requiring at least several years to master them. Some of these dances consist purely of graceful movements, while others are enlivened with dramatic elements. Those with dramatic elements try to narrate a story in rhythmic movements or to reveal feelings of joy, anger, sorrow, love, hatred, etc., either expressed or suggested in the songs or music played in accompaniment. The songs so used are of different styles, such as *naga uta*, *tokuwazu* and *kyōmoto*, all rendered to the accompaniment of *samisen*, the three strung musical instrument, and some with drums and flutes in addition. The songs are descriptive of scenery, narrative of historical or traditional events, accounts of heroes, of love or madness, sometimes they deal with ghosts of men and women, or with the spirit of a bon or of a spider, etc., an effort being often made to transport the observer to the realm of dreams.

The dramatic dance was originally taught by actors themselves until about the beginning of the 18th century, when it became an independent profession. The pioneers of that profession in Tokyo were Dajiro Shigayama, who was originally an actor, Kwambet Fujima and Senzo Nishikawa, the founder of his own school or style, followed by other masters who formulated styles of their own, each with a number of followers. The most influential styles of dancing in Tokyo are *Fujima ryu*, *Hanayagi ryu*, and *Wakayagi ryu* (ryu meaning style or school). Those of Kyoto are *Inouye ryu* and *Shimozaki ryu*, those of Osaka are *Nishikawa ryu*, *Yamamura ryu* and *Uemoto ryu*, while Nagoya is dominated by *Nishikawa ryu*. Broadly speaking, the dances in vogue in Tokyo are those with a dramatic element, being bold and active, cheerful and witty in style, more fitting to be performed by men on the stage than in a room, while those of Nagoya, Kyoto and Osaka, which lay great stress upon the grace and charm of movement, are more appropriate to be seen in a room than on the stage, and performed by female rather than male dancers.

According to a rule, the dancer begins at a point one step behind the centre of the stage, and brings the dance to a close at the centre with a stamp of the foot. The first step is to be taken with an "active" effect and the last with a "passive" feeling. Generally the dancer, in the course of the performance, describes a shape of a folding fan, which symbolizes prosperity as it spreads out toward the end. In pose, the face or the head of the dancer is considered to stand for heaven, the shoulders for the earth, and the waist for the man, indicating the three most important points to be considered in the dancing, and suggesting the relation of the one towards the others in the order of the universe. However, all parts of the body are used to make the dance well balanced, graceful and effective. While limbs, chiefly arms and hands in an endless variety of graceful sweeps and powerful flourishes, are mainly relied upon for the rhythmic movement, the waist keeps the equilibrium. A fan or a *tengu* (scarf) is often used in dancing, being manipulated to suggest all sorts of things as the occasion may require. To give a few examples in common practice, an open fan raised gradually in front signifies the rising sun, used in a drinking attitude it may represent a wine cup, a closed fan may be used to suggest a stick, a bow, an arrow, or a gun, etc., a scarf may be doubled and thrust into the sash to indicate long and short swords worn by a samurai, when redoubled and held on the palm in a smoking attitude it may serve as a pipe, or it may be made to describe running water by holding one end of it and giving it a quick succession of jerks from one side to the other.

It has been the ideal of some great master dancers of Japan to give the dance dignity, refinement and charm by investing it with idealistic, rather than realistic, quality, to make it suggestive, rather than merely explanatory, to create an interesting design, rather than a conglomeration of decorations. The dance of Japan is unique in many respects, and rich in beauty and tradition as the cherry blossoms that adorn the country in spring. (See THEATRE, NŌ DRAMA, JAPANESE ARCHITECTURE, PANTOMIME, FAN) (J HAR, Y K)

INDIA

The Dramatic Dance—Dancing and the drama in India are inseparable. The same words *nata*, *nati*, actor, actress, also designate dancer, danseuse, and a theatre (*nāṭya*, *naṭma*) is equally a dancing stage. The classic Indian theatre is a thing of the past, with perhaps some exceptions in the south, but its technique survives in the modern "nautch" (*nāc*). Dancing is of three sorts, according to the content, and two according to style. *Nāṭya* is dancing used in a drama (*nāṭaka*) as part of the plot (the word *nāṭayati*, "gesturing," or "acting as if," is a regular stage direction whenever a particular action or mood is to be portrayed), *nṛtya* is dancing that expounds a theme by means of explicit gestures, *nṛtta* is dancing to music, but without a definite theme, and includes folk (*deśi*) dancing. The first two are of the same character. Beyond this, *tāṇḍava* is a masculine and vigorous style of dancing, *lasya* a feminine and graceful style.

The dance in its higher forms (*nṛtya*), as distinguished from merely decorative, and from the folk dance is a sort of pantomime in which a story is told, or events or persons alluded to, by means of formal gestures (*angulābhīmayā*) presented in a rhythmic sequence and accompanied by singing and instrumental music, it is a kind of visible poetry with a definite meaning. Treatises on dancing are essentially dictionaries of gesture defining certain positions and movements of the head, neck, eyes and, above all, the hands, the latter are particularly used to convey explicit meanings, the head and eyes to express emotions. A single "hand," for example, the "flag" (*pañcaka*) hand, in which the fingers are extended in contact as when giving a slap, may have twenty or more meanings, depending on the way in which it is moved or the position in which it is held, and on the context of preceding and following "hands." In this kind of dancing the movement of the lower limbs is restricted to a quite subordinate rhythmic accompaniment, the dancer may indeed be seated.

The dance is accompanied by singing (by the dancer or by a chorus) and by instruments (usually in the north a *sārang* and drums, in the south a *tambura* and drums). The whole course of the dance may be summarized as follows. "The song should be sustained in the throat, its meaning must be shown by the hands, the mood must be shown by the glances, rhythm is marked by the feet. For wherever the hand moves, there the glances follow, where the glances go, the mind follows, where the mind goes, the mood follows, where the mood goes, there is the flavour." (Coomaraswamy and Duggarī, *Mirror of Gesture*)

Dance Songs—The songs of *bayaderes* are the lauds and songs of devotion of classical poets, the theme of their dances, the deeds of Kṛṣṇa, and the interplay of hero and heroine with their esoteric meaning. All conditions in India are penetrated and illuminated by a devotional culture. Three examples of songs, sung by the dancer while dancing and forming the theme of the dance, may be quoted (the first from northern India (*Mathura*), the second from the south (*Tanjore*), the third with an antiquity of a millennium and a half).

THE LONESOME WIFE

Left all alone, my darling gone to another land, how
can I pass the days and nights?
Left all alone, wringing both her hands, left all alone
The rainy season has begun, the lightning flashes, the
night is dark, left all alone
Senseless is my darling, my bed lies empty, left all
alone!

It should be explained that it is usual to abandon warlike operations during the rainy season, hence, if a man has not at that time returned, the suffering of the woman left at home is intensified by every reminder of the time when he should have been expected. In the actual dance, which is one of those that can suitably be performed seated, not only is the emotional experience clearly expressed, but the rain, the lightning and the dark night can all be represented.

The words of a Tanjore song are descriptive of Viṣṇu

Is he the great being who rides on Garuda?
Is he the great being who sleeps on a snake?
Is he the great being who lifted Mt. Govardhana
upon his little finger?
Is he the great being who assumed the form of
the Fish Avatār?

The avatārs of Viṣṇu are then given successively.

The words of Mālvikā's dance in Kālidāsa's classical Sanskrit play, the *Mālvikāgnimitra* (Act II) are as follow

My beloved is hard to obtain, he thou without hope with respect to him, O my heart!

But lo, I feel a throbbing in the outer corner of my left eye!
How then is this man, seen only after a long time, to be won?
My Lord, reflect that I am devoted to thee with ardent longing!

The stage direction, *Iti yathāśaṃ abhayaṇī*, is "She gestures in accordance with the flavour (or sentiment)." "

Like Indian music, the dance form begins and ends, from a Western point of view, unexpectedly there is no emotional climax, no excitement. Above all, it is not an exposition of the drama.

!A good omen.

personality. Aesthetic experience, from the Indian point of view, is the work of the spectator, all that the artist can do is to provide the conditions. The dance is in no way strange or exotic to the Indian audience, its continuous rhythm, which can be more nearly paralleled in Western art by the music of Bach than by that of Beethoven, lends the spectator not away from himself, but far into himself. It is just because the visible spectacle is not insistent, not something to be curiously observed, but something that penetrates beyond the threshold of consciousness to the inner world of each beholder, that it can be watched for many hours without fatigue. Circumstantially, of course, the dance is more varied than at first it seems to be, for example, not only do the themes of successive dances change, but with every hour of the night the modes of the accompanying music must change, in accordance with a well understood convention. It is not this variation, however, that explains the lack of monotony, that is due to a quality inherent in the art itself, whereby the spectator loses consciousness of the passage of time. It will be understood that this is not an art which can be transported to a foreign land, and perhaps the only opportunity that Europeans in Europe have ever had to witness oriental dancing was when King Sisowath brought his Cambodian dancers to Marseille and Paris.

Aesthetic Experience—Mention has been made above of flavour in Indian aesthetics. Flavour (*rasa*) is that emotional quality which distinguishes a work of art from a mere statement, and aesthetic emotion from the emotions experienced in daily life. To the Indian, the dance, like any other art, has a spiritual significance independent of its theme or charm, for "by clearly expressing the flavour, and enabling men to taste thereof, it gives them the wisdom of Brahma, whereby they may understand how every business is unstable, from which indifference to such business, and therefore, arise the highest virtues of peace and patience, and thence again may be won the bliss of Brahma."

The so-called oriental dancing of the European stage is in almost all respects unlike the dancing of the East where, for example, the dancer is always more, and not less, fully clothed than are other women in daily life, and where, if there be in the dance some erotic allusion, this not only has a definite significance, but is made in such a way as entirely to escape the notice of a western audience. The movements of the so-called oriental dancers of the West are indeed sinuous, but the fluidity of eastern movement is something far more than this. It is not even serpentine, but more like the wreathing of smoke. Nothing in India corresponds to the ball room dancing of Europe and America, the mixed dancing of this kind is shocking to Indian ideas of propriety.

Education—Dancers (female) are to a certain extent trained (Plate III, figs 3, 4) by performers of their own caste and sex, but more especially by male dancing masters, Brahmans, who are familiar with the literature as well as the practice of the art. Ganadasa speaks of the art as "a pleasing sacrificial feast to the eyes of the gods and the one chief amusement of human beings." He exhibits his pupil Mālavikā before the king, queen and certain courtiers. Her performance is adjudged perfect in the following terms: "All was blameless, and in accordance with the rules of art, for the meaning was completely expressed by her [upper] limbs, which were full of language, while the movement of her feet was in perfect time, and she represented the moods to perfection. In the successive developments of the acting, emotion kept banishing emotion from its place, it was a vivid picture of a series of passions" (*Mālavikāgnimitra*, Act. II).

An account of the education of a dancer is found in the Tamil *Silappadikāram*, ch. III. She is initiated in her fifth year by means of the *tandiyampidiyettu* ceremony. Here a horizontal rod, wound about with flowers and a new cloth, is held by two dancers. The new pupil, bringing offerings of coconut, betel leaves, etc., and standing on grains of rice, symbolizing plenty, touches the rod with folded hands, repeating verses chanted by the instructor in honour of Ganapati and Jayanta. At the same time the instructor holds the pupil's feet and moves them according to the steps of the dances, and anklets with bells are placed on the ankles. This is a life dedication to the calling of a dancer. Instruction is

begun in her seventh year, and must last at least five years. The theoretical part is usually given by a Brahmin teacher, the practical exercises by an elderly and retired danseuse. In her twelfth year the pupil may appear in public and the teacher receives a reward.

Domingo Pires, writing about 1520, describes a room in the Vijayanagar palace in which the royal dancers practised and performances were given. On one side was "a painted recess where the women cling on with their hands in order better to stretch and loosen their bodies and legs." Presumably there was a horizontal rod against the wall, like that used by modern ballet dancers for practice. At the other end of the room was the place occupied by the king during a performance, and in the middle of the wall was a golden image of a woman, or rather girl of 12 years, with her arms in the position taken at the end of a dance.

Generally speaking, the costume of a dancer does not differ markedly from that of local fashion, except by its greater richness. One part of it, the bells, however, is special and essential. A string of these, a hundred or two hundred in number, is bound round the ankles at the time of dancing, and the sound of these bells, as the dancer moves her feet in time, forms part of the music. When the dancer ties them on before dancing, she will invariably touch them to her eyes and forehead and murmur a brief prayer, and those who are learned in the lore of dancing say that "that dancing is vulgar and inauspicious which the actress does not begin with prayer."

Like other vocations in India, that of music, dancing and acting is in the main an hereditary profession. There have always been and still are some Brahmans and others of high caste who are expert both in the theory and practice of music, but the profession as practised by members of special castes has always had a low social status. At the present day the "Anti Nautch movement" represents an endeavour to boycott the professional dancers on puritanical grounds (with reference to the morals of the dancers, not to the character of the dance). It is desired to banish the danseuse alike from private and public entertainments and from all connection with temple service.

HISTORY OF THE DANCE IN INDIA

Vedic Dances—Ritualistic dances are mentioned in the Vedas. Thus, in the Mahāvratā ceremony, women celebrate to the sound of the lute the patrons of the ceremony, maidens dance round the fire with water pitchers while the Siotra is being performed. They pour water on the fire, an act of sympathetic magic intended to produce rain, and the song shows that they desire richness in milk, as well as water for the cows. At the close of the Horse Sacrifice also girls dance round the Marjāliya fire with water-pots on their heads, beating the ground with their feet and singing "This is honey." They are said to endow the sacrificers with might. Again, four or eight women dance at the house of the bride, at a wedding.

The word *rasa* in the *Black Yajur Veda* refers to the accompaniment of recitation by pantomimic gesture; the *Nata Sūtras* mentioned by Pāṇini must have been handbooks of gesture, analogous to the later works on *abhinaya*.

Dancing as a Court Function—In the Buddhist and Epic periods, dancing is well known as a normal court function and as a means of paying honour to a king or distinguished guest. Thus the festival of the gods takes place in Indra's city, he is host, and the other gods come and take their seats in due order as spectators of the dance of the Gandharvas and Apsaras. The gods themselves may sing and dance in honour of a human saint, but the dancers and musicians proper are the Gandharvas and Apsaras. The latter are beautiful girls, often employed by the gods to seduce the great sants from their meditations, for which there is a parallel in the Buddha legend in the attempted seduction of Gautama by the three daughters of Māra, who dance before him. More often the Apsaras are simply the dancers in heaven, by whom the gods are entertained and honoured. Equally characteristic was the keeping of troupes of dancers at royal courts on earth. Whatever the social status of professional dancers may always have been, and despite the fact that the art, like others, is an

almost purely professional vocation, it is certain that dancing in the Gupta and mediaeval periods was also an aristocratic accomplishment, affording in this respect a parallel to the state of painting at the same time.

Dancing as an Accomplishment.—Dancing and music as a royal accomplishment may be illustrated by the following examples. In the *Dvayavadana* (Cowell and Neill, p. 544 *et seq.*) King Rudrāyana plays the lute (*vina*) while his wife Candrāvati dances, the Gupta emperor, Samudragupta, had cons struck in which he is represented as seated and playing on the lyre or lute, while an inscription of the same great monarch at Allihāhad records his skill in music. Kālidāsa represents King Agnivarmān as competing with actors in their art. In Devendrī's *Uttarādhyāyana tika* (Meyer, *Hindu Tales*, p. 105) King Udayāna plays on the lute while his wife dances, but drops the plectrum of the lute, at which the queen is angered and asks "Why have you spoilt the dance?" In the *Mahāvamsa*, ch. lvi, v. 82, 83, Parākrama Bāhu I (of Ceylon) is said to have built a theatre beside his palace "that so he might listen to the singers, and witness the delightful dance," while his queen Rūpavati, who was young and beautiful, and an embodiment of all the traditional virtues of a Hindu wife "was skilled in dancing and was richly endowed with a mind as keen as the point of a blade of grass." These instances will suffice to show that the modern prejudice against dancing as an art to be studied by persons of honourable social status has no foundation in classic tradition.

Dancing as a Religious Office.—Still more interesting is the ritual service of dancing in temples. The proper occasions of dancing are festivals, celebrations, processions of men or gods, marriages, reunion of friends, first occupation of towns or houses, the birth of children and similar auspicious events. The dance is essentially an honour paid to the chief guest, and particularly to kings. Now the daily ritual or service performed at the shrine of a deity is essentially the same as the daily service of a king, and it is therefore only natural that dancing before the shrine should form a part of the regular morning and evening offices. At wealthy shrines a considerable number of Devadāsīs ("women servants of the deity") are permanently attached to the temple, both to perform this office and to take part in the dramas which are presented in the temple on certain holidays. This practice has survived in southern India to the present day, but we have earlier records of it on a more lavish scale (N. M. Penzer, *The Ocean of Story*). Inscriptions of Rājārāja and other of the Cola kings (in the Tanjore district, at the beginning of the 11th century) refer to theatres and the establishment of large numbers of dancers in connection with temples, and for this purpose we find that private as well as royal endowments were made. Thus the assembly or town council of Sāttanūr gave lands for the maintenance of Sanskrit plays, Rājārāja brought from other temples and settled at Tanjore as many as 400 dancing girls, Kulōttunga III appointed an additional dancing master in the temple who had to dance with gestures. The entertainment of the god enshrined is modelled upon that of a god in his heaven, and that of a king on earth.

DANCES OF THE GODS

The Veda knows of gods who dance, thus, in *Rigveda* x, 72, we have a creation hymn in which the gods, dancing apparently in a ring, set up a rhythmic flux in the primeval waters, and this magic dance sets all nature in motion.

When there, O gods, ye stood in the primeval sea, holding each the other by the hand, then rose from you as dancers (*nṛjyotiṃ sma*) clouds of dust.

Indra is also said to appear as an aged dancer, as a presage of victory in battle, Usas, the Dawn, is called a dancer adorning herself. But none of these conceptions of a dancing god or gods seems to have had the importance later attained in the case of Śiva, who as the divine dancer *par excellence* is known as Natarāja.

Dance of Śiva.—We find an invocation (commencement of the *Mirror of Gesture*) addressed to Śiva, the great patron of the drama and an actor whose gesture is the world process whose

speech is the sum of all languages and whose ornaments are the moon and stars. His dances are *tāṇḍava* dances, enigmatic and virile. The most significant is the *nāṭya*, represented in the well known south Indian metal images of Natarāja. The significance of this dance is often alluded to in the mediaeval Śaiva literature. "Our Lord is the dancer, who, like the best latent in firewood, diffuses his power in mind and matter, and makes them dance in them turn." More specifically, the dance represents the deity's five activities (*pañcāhṛtya*), viz., the world process of creation or evolution, maintenance, and destruction or involution, the embodiment of souls and their release from the cycle. The drum in the upper right hand stands for creative sound, the flame in the upper left for the fire of destruction or cosmic process is conceived as a succession of vast cycles of manifestation and nonmanifestation, or creation and destruction, and also that the phenomenal world at all times is one of perpetual change, involving perpetual creation and destruction. The dance is the entire process in all its complexity, and it is only rightly apprehended when it is realized as taking place within the worshipper's own consciousness. Śiva is also called Sudāyāyidi, Dancer of the Burning Ground (cemetery), and the heart of the lover of god, made bare of all else, is this bare field prepared for him. The same idea is met with in connection with the goddess in the form of Kali.

I have made a burning ground of my heart,
Thou, Dark One, hunter of the burning ground
Mayest dance the eternal dance therein.

Śiva also performs an evening dance on Mt. Kailāsa, before the assembled gods and the goddess, and paintings of the subject are known. The elephant headed deity, Gaṇeśa (Ganesha, Ganapati), son of Śiva, is also spoken of as taking part in this evening dance, and is represented in sculpture as dancing. It is probable that most of the dances referred to above belong to the non-Aryan and ancient Dravidian elements in the personality of Śiva-Rudra. The *tāṇḍava* in particular, and the dance of Kali, must have been originally orgiastic dances, later interpreted in a philosophical and mystical sense. The principal "primitive deity" in Ceylon, Gale Yākā, the God of the Rock, is worshipped by an annual dance on the summit of the rocks sacred to him, with which may be compared the ritual dances of south Indian hill-men in honour of Murugan.

While every Śaiva temple in southern India has a copy of the metal image of Śiva as Natarāja kept in a special hall of audience (*sabha mandapa*) at Cidambaram, he is worshipped in this form as the principal deity, there in the Golden hall (*kanakasabha*) is the premier Natarāja image of the south. The western and eastern gopurams of this temple, dating from the 13th century, contain sculptured panels with accompanying text, illustrating no less than 93 of the 108 dancing poses described in the *Bharata Nāṭya śāstra*.

Dances of Other Deities.—The elephant headed deity, Gaṇeśa, son of Śiva, is a patron of the stage, and himself often dances. In Buddhist art numerous feminine divinities, corresponding in a general way to Kālī of the Hindu pantheon, are represented as dancing. Dances of victory are attributed in the Silappadikāyam to Subrahmanya, the god of war. According to the commentator, Adyārkunallār, Subrahmanya, having slain the demon Sūrapadmāsura, danced his war dance of triumph on the heaving wave platform of the ocean stage, to the accompaniment of the rattle of his drum, and subsequently danced in denison of the flying demons the *kudakūṭṭu*, or umbrella dance. This dance is still sometimes performed during temple processions, when the god's umbrella bearer cuts some capers with his unwieldy parasol borne before the deity. Other familiar dances of a deity are those of Kṛṣṇa, the cowherd incarnation of Viṣṇu. One of these is the pot-dance (*kudakūṭṭu*), originally a pastoral folk dance, but used by Kṛṣṇa as a dance of victory after the defeat of Bāṇāsura. Another dance of victory took place after the poisonous dragon Kālāya finally had been overcome. Kṛṣṇa is again often represented dancing a childish dance with a vat of butter, or he was very fond. But the most significant of his dances

rosa mandala, the circle of pison, a round dance in which the milkmaids took part on moonlit nights beside the Jamma

FOLK DANCES

Folk dances (*desi*, i.e., "countryed") still are and no doubt have always been found all over India, among agriculturists and in primitive tribes everything is celebrated and solemnized with the dance. It should be observed that, as Col Hodson has remarked, primitive culture is the matrix of the higher, thus the folk dances have not only an interest of their own, but also they provide the material from which the dances of the aristocracy and of the higher ritual are derived. Indeed, there are many folk dances which make their appearance in the most artistically sophisticated spheres as *dances de divertissement*. Before referring to these, however, we shall discuss the dances of the people in their original environment.

There are, for example, courtship dances among the Santals. On full moon nights the drum is sounded and the girls assemble under a big banyan tree, their dresses decorated with flowers in spring, with feathers in winter. Meanwhile the young men with a banner and musical instruments gather in the rice fields beyond. The girls do not seem to see them, but are chattering together and completing their toilet. Then the banner and drum come forward, the young men approach the girls, who stand in a row, linked in pairs, arm in arm. The girls sway to and fro with the music, bending and rising, they advance and retire, but never actually mix with the young men. It is only after the dancing that young men and women have any opportunity to meet and court. The Santals have also their decorative *dances de divertissement*, for example, "the gathering of indigo," and "the quarrelling of co-wives."

In Bengal there is a women's ritual dance, never seen by men, the drummer remaining behind a curtain. This takes place during the Indra-puja festival on full moon nights. The women dance and sing erotic songs and in the morning they go down to the river and bathe.

A kind of dancing especially characteristic of southern India and Ceylon is the so-called devil dance (*Yakkum netuma*). This is a violent male dance, thus of *tandava* character. Used primarily as a means of exorcism, it is performed in cases of sickness. The possessing yaklas, regarded as demons causing disease, are first invited by beat of drum to attend the performance, afterwards, having been thus entertained, they are asked to take their departure.

The Nongkrem dance, one of the greatest festivals in the Khasi hills, is an essential part of the goat sacrifice performed by the Siem of Nongkrem. "The sacrifice is followed by twenty two men armed with swords and cowries (fly flaps). Having danced before the altar, the party returns to the house of the Siem priestess and executes another dance in the great courtyard. Then follows a great dance of girls and men in front of her house. Then there is the dance of the men. After gyrating for some time two men at a time rapidly approach one another and clash their swords together in mock combat. Dancing forms part of the ceremony of placing the ashes in the sepulchre of the clan." With the last feature may be compared the honouring of the body of the Buddha before the cremation, with song, dance and music, as mentioned in the *Mahāparinibbāna Sutta*.

Primitive dances are often symbolical enactments of events which the people desire to be successfully accomplished. "The Bhils danced at their festivals and before battles. The object was to obtain success in battle by going through an imitation of a successful battle beforehand. The Sola dance of Gond and Bagas in which they perform the figure of the grand chain of the lancers, only that they strike their sticks together instead of clashing hands as they pass, was probably once an imitation of a combat. It is still sometimes danced before their communal and hunting parties." Among the Angam Nagas, "Dancing singing go hand in hand with ceremonial dress the songs sung include both particular songs traditionally associated with the occasion, and sometimes in archaic language not fully understood except by those skilled in them" or a highly developed song language (Col Hodson, *Primitive Culture of India*).

It is by no means unusual to meet with the folk dances in the

environment of the higher culture. The Saugata Ratnakara, an authoritative work on music and dramatics enumerates 14 varieties. The Tamil *Silappadikaram* enumerates 14 dances of which the majority are for use at the Indra Puja festival and of these several, such as Kottavai dance with a rice measure, are of folk character. We also meet with these folk dances on the classical stage, as in the *Karandavya* of Bharata, where we have a circular dance performed by girls, another in which the dancers face each other in two rows, and also the stave dance (*danda rasa*) referred to above. This *danda rasa*, in which the dancers hold short staves in each hand striking them against those of the neighbouring dancer alternately to right and left, is also frequently depicted in decorative temple sculpture (fig. 6). The *rasa mandala* and other dances of Kṛṣṇa with the milkmaids of Brāhmadāyā are of folk character, being constantly represented in paintings of the Rājasth school, and are typically circular dances in which the figure of Kṛṣṇa is multiplied. Not infrequently Kṛṣṇa and Rādhā occupy the centre of the field, whirling round with feet together and leaning apart with hands clasped at full arm's length.

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MODERN DANCING

Until 1912, modern dancing was a decadent phase of 18th and early 19th century forms. In that year began a new era of popular dancing, in which 20th century industrialized society finally broke away from the courtly steps which had expressed the emotions and social attitudes of another civilization and found new steps to fit a new cultural situation. America led the way in this renaissance. Until the turn of the century, dancing in the United States was a slavish imitation of standardized and well-worn European steps. The polka, schottische, Viennese waltz and cotillon were all favoured by Yankee dancing masters of the 19th century. Sectional groups in the country developed indigenous group dances, such as the Paul Jones and the square dance. But these failed to affect the prevailing trend.

In 1912, coincident with the rise of ragtime and jazz in popular music, the United States gave birth to a new form of dancing whose nervous and gyrating motions were well suited to express the emotions of a mechanical, urbanized civilization. The first jazz dances of this century, the Turkey Trot, Bugle Rag, and Grizzly Bear, were often crude, vulgar and ugly. But the sense of exhilaration and release experienced by the dancer of these steps caused them to sweep the country. Elderly people, as well as boys and girls, were caught up in a dance enthusiasm that writers of that period called the "dance-craze." From then on, dancing was taken over by the common people, and became an authentic expression of their moods and feelings.

Before the World War of 1914 to 1918 Mr. and Mrs. Vernon Castle were the principal exponents of popular dancing. They took the crudeness out of the early jazz steps and introduced the first refinements into ballroom dancing. The most important of their original dances was the Castle Walk, a long-legged walking step in which the lady was backed around the room continuously. The Castles also pioneered when they imported a Spanish-American dance to this country. They introduced the Tango, a sinuous and extremely graceful dance whose point of origin was Argentina. The Tango remained popular until very recent years.

Between 1912 and 1915 new dances sprang up and disappeared in very rapid succession. Of more than one hundred new dances introduced during that time, the Hesitation, to Waltz music, and the Mambo, imported from Brazil, were the most popular. Between 1915 and 1935, with the exception of the Charleston, which had a slight vogue in 1925, no new dance ever achieved any noticeable degree of popularity. The Charleston was most popular as an exhibition dance

by amateurs and was extensively used in musical comedy choruses. The Black Bottom followed on the heels of the Charleston, but it was an ugly dance and short lived.

In 1915 Arthur Murray, a protégé of Vernon Castle, standardized ballroom dancing. He simplified all modern dancing by introducing five fundamental steps. In 1930 Mr. Murray introduced the Westchester style of dancing, popular with college students. This new youthful step called for a sixth basic movement—the Running Step.

The staple dance steps of the present generation are the Waltz and the Fox Trot. After a lengthy popularity, the Tango died out. The Cuban Rumba, an intricate dance, and the Longa are growing in public favour, especially among the more sophisticated circles in large cities. The Rumba is close in popularity to the Fox Trot (1930). Among the younger people of the more moderate economic classes the Shag and the Lindy Hop are popular. These two "jitterbug" dances followed on the heels of the craze for swing music, which developed after 1935 and saw the inception of a second "dance-craze." The Shag is a fast, nervous, hopping dance, performed in time to strongly accented rhythms.

The growing popularity of swing dancing led in 1937 to the first of a series of group-dances. The Big Apple, which swept the United States during 1937, was a combination of several "jitterbug" steps, including the Shag and the Lindy Hop, as well as the addition of such vivacious movements as the "Swing 0" and "Trunkin'." In the Big Apple, the "caller" an appendage of the 18th century group dancing, came into being again. The Big Apple was generally performed by a group of eight or ten couples, formed into a ring. After a march by the group as a whole, the "caller" would shout for one or another of the swing steps and at each call one of the couples would enter the centre of the ring and perform a figure.

In the summer of 1938, Mr. Murray imported the Lambeth Walk from London. The simplicity of the Lambeth Walk quickly gained it nationwide popularity. Originally, the Lambeth Walk was an old English folk-step, performed in the Limehouse district of London. It was dressed up, polished, refined and brought to America. Essentially, it was a walking dance, done in a jaunty, strutting fashion. After the Lambeth Walk, three other group dances were imported from England in succession. The Palais Glde, Chestnut Tree and Boomp-a Daisy. None of them matched the Lambeth Walk in public popularity.

The Fox Trot is still the most widely performed step, probably because its rhythm is simple enough to be easily and quickly learned by beginners, and because its possible combinations of steps are sufficiently varied to hold the interest of the most accomplished.

The Waltz, too, has become a standardized step for modern dancers. People who have learned the Waltz correctly are admittedly the most graceful dancers, and they are able to adopt other steps more readily.

All the modern dances are composed of combinations of the six Basic Steps. Without a thorough knowledge of these Basic Steps, one cannot hope to do any of the modern dances really well. With a knowledge of them, there are practically no combinations, done ordinarily in the Fox Trot and the Waltz, at least, which one should not be able to pick up readily. The six Basic Steps are: The Walking Steps, the Chassé, the Waltz, the Balance and the Pivot and the Running Steps.

Walking Steps Each of the Walking Steps takes up two beats of the music. On the first beat, place the whole foot forward on the floor, toe first, the heel barely touching—if you are doing the man's part. If you are doing the woman's part, reach backward with the toe as far as possible. On the second beat, rise slightly on the toes to give spring and pep to your step, and finish. Step smartly and lightly, shifting your weight from one foot to the other. When you take a step with one foot, always hit the other off the floor. Never drag or slide the feet along.

Practice taking long, slow steps about the room. Women, in their practice, should give special attention to walking backward. Keep the knees straight and firm and always make the toes lead. Dance as if you did not have a toe but only a great toe. Practice stretching your toes forward, or backward, as far as you can reach, and always keep them turned out to avoid a pigeon-toed appearance. Always step in a straight line, directly forward, directly back, or directly to the side. This is fundamental to a good balance, good appearance, and a sense of unity with your partner.

The Chassé The Chassé is a short, quick step directly to the side—either to the right or to the left. For the left Chassé, step directly sidewise to the left and draw the right foot up to the left. For the right Chassé, step directly to the right with the right foot and draw the left foot up to the right. Complete the movement with smartness and precision by bringing the feet together so that they actually touch each time.

The Waltz The Waltz is a combination of a Walking Step and a Chassé (in 3-4 time). In the modern Waltz, the accent falls upon the Walking Step, and all the steps are of the same length and value. Practice the Waltz Steps to modern Waltz music, counting one-two-three with a definite accent each time on the "one." Or, better still, keep time with the words, "step, side, together," the accent falling upon "step."

The Waltz may be done forward, backward, or used as a turn to left or right. The Waltz may also be danced to Fox Trot music by

holding the first step for two beats, the second and third steps of the Waltz each receive one beat.

The Balance The Balance is a Hesitation Step forward, back, or to the side with the whole weight upon one foot and rise, point, or to the side with forward, back or to the side with the toe just touching the floor. The Balance is used in many combinations in both the Fox Trot and the Waltz. When danced to Fox Trot music, it is given two counts. When danced to Waltz music, it is given three. It is a very graceful step, interesting to do, and, moreover, a sure means of developing a good sense of balance.

The Pivot is simply a particularly graceful and effective way of making a quick turn. Always see that one foot is directly in front of the other. Rock forward, on right foot, bringing the entire weight upon the ball of the forward foot, and spin round making a quarter turn. Rock back on the left foot, and repeat the motion.

The Running Steps are known as syncretized steps, because three steps are taken to four beats of the music, you take three quick running steps, then pause on the fourth beat. The syncretized steps are helpful to the lady in following because they teach her to step quickly. This is a decided asset to one who must change her step rapidly in order to follow various partners. Although the running steps are faster than walking steps, they are just as long. It is best to take long steps, whether they be fast or slow. A short step betrays a lack of confidence.

A man must train his feet by constant practice to do the various steps and combinations automatically in order to inspire confidence in his partner and to lead with that easy nonchalance that is the mark of an accomplished dancer. It is a mistaken idea that a strong leader a man must make a dead run upon his partner and push and pull with force about the floor. Hold your partner firmly, yes—especially with your right hand—and then go through your steps with certainty and precision. If she knows the steps she will be able to follow. If she does not no amount of forceful guiding upon your part will be of any help to her.

The Rumba, a graceful and exciting dance step, is based on the Rumba rhythm, one, two, three, pause, one, two, three, pause. Because the knees are actively employed in this step, the dancers stand about 8 inches apart. Stand erect, heels together, and relax your weight on the heel of the left foot and at the same time cross your right knee in front of the left. Then shift your weight to the right. Once again shift your weight to the heel of the left foot and cross the right knee in front of the left. Pause after the third count. This is the basic Rumba motion, unique for this dance, and employed in all Rumba steps, whether forward or backward.

The Shag has one man step, step on left foot and hop with left, landing on right. Step on right foot and hop with right, landing on right. Shift weight quickly to left foot, lifting the right foot about two inches off the floor. Shift weight quickly to right foot, lifting the left foot about two inches off the floor.

The Correct Position The best position is the easiest and most natural. Stand erect on the ball of your feet, making yourself as tall as possible. Rest the weight upon the foot that you are not going to use first, leaving the other one free for your initial step. Keep the back straight, the shoulders relaxed the chest out, head up, chin in, eyes directed over your partner's right shoulder, arms high, at about shoulder height. It is very important to keep the arms well up in dancing. Women who unconsciously allow their arms to sag always seem heavy, even though they may be very light on their feet.

The man holds the woman straight in front of him—never to one side—and firmly, just close enough to enable him to guide her easily. His right hand rests in the middle of her back, just below the shoulder blades. His left arm is extended to the side and bent slightly at the elbow, the left hand holding her hand lightly. The woman rests her left hand lightly upon the back of the man's shoulder. She should never curl her hand under his arm. Trick holds are out of date. Her right arm is extended to the side in an easy, graceful curve with the right hand resting lightly in the man's. Be careful to avoid a spasmodic clutch. It betrays a tension and a lack of confidence that are destructive to your partner's pleasure in dancing with you.

In starting, the man steps forward directly toward his partner, leading with his left foot. The woman steps directly backward, leading with her right foot. Don't be afraid of stepping on your partner's feet. If you start on the proper foot and step in a straight line, directly forward or directly back, you never will get in your partner's way.

There is no fixed sequence for the six Basic Steps or any of their variations. In modern dancing, the leader may swing into any step at any time, as his fancy may dictate or the music seems to suggest. This is why it is so extremely important that the woman should be thoroughly familiar with the steps her partner may decide to do. The only way to gain confidence and to overcome self-consciousness, awkwardness, and stiffness in dancing is to learn the steps and by-constant practice to master them so perfectly that you could almost do them in your sleep.

Self-assurance, ease, grace, and relaxation come as a natural consequence of knowing how. Self-consciousness, stiffness, awkwardness, and vanishing, and you will find yourself dancing with ease and spontaneity.

enjoyment See also BALLET

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DANCOURT, FLORENT CARTON (1661-1725), French dramatist and actor, was born at Fontainebleau on Nov. 1, 1661. In 1685, in spite of the strong opposition of his family, he appeared at the Theatre Français. One of his most famous impersonations was Alceste in the *Misanthrope* of Molière. His first play, *Le Notaire obéissant*, produced in 1685, was well received. *La Désolation des joueuses* (1687) was still more successful. *Le Chevalier à la mode* (1687) is generally regarded as his best work, though his claim to original authorship in this and some other cases has been disputed. In *Le Chevalier à la mode* appears the bourgeoisie infatuated with the desire to be an aristocrat. The type is developed in *Les Bourgeoises à la mode* (1692) and *Les Bourgeoises de qualité* (1700). Dancourt was a prolific author, and produced some 60 plays in all. He died on Dec. 7, 1725. The plays of Dancourt are faithful descriptions of the manners of the time, and as such have real historical value. Most of them incline to the type of farce rather than of pure comedy.

See *Oeuvres complètes* (12 vols., 1760), *Théâtre choisi*, ed. F. Sarcey (5 vols., 1884). Also J. Lemaître, *La comédie après Molière et le théâtre de Dancourt* (2nd ed., 1903).

DANDELION (*Taraxacum officinale*) and related species, perennial herbs belonging to the family Compositae (*q.v.*). The plant has a wide range, being found in Europe, Central Asia, North America and the arctic regions, and also in the south temperate zone. The leaves form a spreading rosette on the very short stem, they are smooth, of a bright shining green, sessile and tapering downwards. The name dandelion is derived from the French *dent de lion* (lion's tooth), an appellation given on account of the toothlike lobes of the leaves. The long taproot has a simple or many headed rhizome, it is very difficult to eradicate. The flower stalks (scapes) are smooth, leafless, hollow and numerous. The flowers bloom from April until August. The flower heads are golden yellow, and reach $\frac{1}{2}$ to $\frac{3}{4}$ in width, the florets are all strap shaped. The fruits are olive or dull yellow in colour, and are each surmounted by a long beak, on which rests a pappus of delicate white hairs, which occasions the ready dispersal of the fruit by the wind, each fruit contains one seed. The globes formed by the plumed fruits are nearly 2 in in diameter. The involucre consists of an outer spreading (or reflexed) and an inner and erect row of bracts. In all parts of the plant a milky juice is present. The root externally is brown and wrinkled, internally white, with a yellow centre and concentric paler rings. It is 2 in to 1 ft long, and about $\frac{1}{2}$ in to $\frac{3}{4}$ in in diameter. The leaves are bitter, but



DANDELION SHOWING THE LEAVES THAT ARE EATEN AS SALAD. THE ROOT IS USED FOR MEDICINAL PURPOSES

- 1 Unopened head
- 2 Ripe head, from which all the winged seeds except two have been removed
- 3 Ripe head, from which all the winged seeds except two have been removed

are sometimes eaten as a salad or are cooked for soups, they serve as food for silkworms when mulberry leaves are not to be had.

The root is roasted as a substitute for coffee. Several species and varieties of the dandelion are recognized by botanists, they differ in the degree and mode of cutting of the leaf margin and the erect or spreading character of the outer series of bracts.

The red seeded dandelion (*T. laevigatum*), a native of Europe, very similar to the common species but smaller, with red, shorter beaked fruits and more deeply and finely cut leaves, is widely naturalized in the United States and Canada.

Russian dandelion, *Kok saghyz* (*T. kok saghyz*), was found in 1931 around Tien Shan, Kazakstan, near the China border. It is a perennial with roots about $\frac{1}{2}$ in in diameter, producing rubber in the latex tubes. After 1931 it became a commercial source of rubber in the USSR. It was introduced into the United States in 1942 and experimental plantings were made in several states to determine its possibility as a source of rubber.

(W. C. M., X)

DANDIN (fl. 6th century A.D.), Sanskrit author and court poet of Sudraka. He wrote the *Āṣṭyādarśa*, a manual of poetics (Sanskrit text and Eng. trans. by S. K. Bhattacharya, 1924), and *Dandakumaracharita*, or "adventures of the ten princes," portraying low class city life (latest Sanskrit and English edition published at Bombay, India, 1919).

DANDOLO, the name of one of the most illustrious patrician families of Venice, of which the earliest recorded member was one of the electors of the first doge (A.D. 697). The Dandolo gave to Venice four doges, of these the first and most famous was Enrico Dandolo (c. 1120-1205), elected on Jan. 1, 1193 (*more Veneto*, 1192). Although over 70 years old and of weak sight (the story that he had been made blind by the emperor Manuel Comnenus while he was at Constantinople is a legend), he proved a most energetic and capable ruler. He re-established Venetian authority over the Dalmatians who had rebelled with the king of Hungary's protection, but he failed to capture Zara, owing to the arrival of the Pisan fleet, and although the latter was defeated by the Venetians, the undertaking was suspended. In the meanwhile the eastern emperor Isaac II (Angelus) had been deposed, and the new emperor Alexius was unfriendly to the Venetians. Dandolo therefore listened to the proposals of the crusaders who asked Venice for free passage and the means of transport. Dandolo subsidized the crusaders heavily and, with a promise that payment would be deferred, persuaded them to turn aside and assist him in the reduction of Zara. Dandolo himself commanded the expedition, and Zara was taken and sacked. He then induced the crusaders to listen to the proposals of Isaac's son, Alexius, for the dethronement of the emperor Alexius. The fleet wintered at Zara and then, under Dandolo's command, sailed for the Bosphorus. For the capture and sack of Constantinople and the erection of the Latin empire, see CRUSADES.

Immense booty was secured, the Venetians obtaining among other treasures the four bronze horses which adorn the façade of St. Mark's. Dandolo was one of the candidates for the imperial throne of the new Latin empire, but Count Baldwin of Flanders was elected and crowned on May 23. The Venetians were given Crete and several other islands and ports in the Levant, which formed an uninterrupted chain from Venice to the Black sea, a large part of Constantinople (whence the doge assumed the title of "lord of a quarter and a half of Romania"), and many valuable privileges. But hardly had the new state been established when various provinces rose in rebellion and the Bulgarians invaded Thrace. A Latin army was defeated by them at Adrianople (April 1205), and the emperor himself was captured and killed, the fragments of the force being saved only by Dandolo's prowess. But he was now old and ill, and on June 23, 1205, he died.

Enrico Dandolo's sons distinguished themselves in the public service, and his grandson Giovanni was doge from 1280 to 1289. The latter's son Andrea commanded the Venetian fleet in the war against Genoa in 1294 and, having been defeated and taken prisoner, he was so overwhelmed with shame that he committed suicide by beating his head against the mast (according to Andrea

Navagero) Francesco Dandolo, also known as Dandolo Cane, was doge from 1329 to 1339. During his reign the Venetians went to war with Martino della Scala, lord of Verona, with the result that they occupied Treviso and otherwise extended their possessions on the *terra firma*. Andrea Dandolo (c. 1307-1354), the last doge of the family, reigned from 1343 to 1354. He had been the first Venetian noble to take a degree at the university of Padua, where he had also been professor of jurisprudence. The terrible plague of 1348, wars with Genoa, against whom the great naval victory of Leros was won in 1353, many treaties, and the subjugation of the seventh revolt of Zara, are the chief events of his reign. The poet Petrarch, who was the doge's intimate friend, was sent to Venice on a peace mission by Giovanni Visconti, lord of Milan. "Just, incorruptible, full of zeal and of love for his country, and at the same time learned, of rare eloquence, wise, affable, and humane," is the poet's verdict on Andrea Dandolo (*Variorum epist. xix*). Dandolo died on Sept. 7, 1354. He is chiefly famous as a historian, and his *Annals* to the year 1280 are one of the chief sources of Venetian history for that period; they have been published by Muratori (*Rer. Ital. Script. tom. xxi*). He also had a new code of laws compiled (issued in 1346) in addition to the statute of Jacopo Tiepolo. Another well known member of this family was Silvestro Dandolo (1796-1866), son of Girolamo Dandolo, who was the last admiral of the Venetian republic and died an Austrian admiral in 1847. Silvestro was an Italian patriot and took part in the revolution of 1848.

BIBLIOGRAPHY—S. Romann, *Storia documentata di Venezia* (Venice, 1853), among other books H. Kretschmeyer's excellent *Geschichte von Venedig* (Gotha, 1905) should be consulted. It contains a bibliography of the authorities and later researches and discoveries. C. Cipolla and G. Monticolo published many essays and editions of chronicles in the *Archivio Veneto*, and the "Fonti per la Storia d'Italia," in the *Istituto storico italiano*, H. Simonsfeld wrote a life of Andrea Dandolo in German (Munich 1896).

DANDOLO, VINCENZO, COUNT (1758-1819), Italian agricultural chemist, a native of Venice, welcomed the advent of Napoleon in Italy (1796), and was a member of the grand council of the Cisalpine Republic at Milan. From 1805-09 he was governor of Dalmatia, where he sought to improve agriculture. He died at Venice on Dec. 13, 1819. Dandolo wrote several treatises on agriculture, vine-cultivation, and the rearing of cattle and sheep, and a work on silkworms, which was translated into French by Fontanelle.

DANDURAND, RAOUL (1861-1942), Canadian lawyer and statesman, was born on Nov. 4, 1861, at Montreal. Educated at Montreal college and Laval university, he was admitted to the bar in 1883. He applied himself to the local organization of the Liberal party, was called to the senate in 1898, being speaker 1905-09, and was minister without portfolio in the cabinet of 1926-30. His chief work is *Traité théorique et pratique de droit criminel* (Montreal, 1890). He was president of the 6th Assembly of the League of Nations. Dandurand died March 11, 1942.

DANDY, a word which about 1813-16 became a London colloquialism for the exquisite of the period. It is probably derived from the French *dandin*, "a nunny or booby," but in the *Northampton Mercury* (April 17, 1819), occurs the following: "Origin of the word 'dandy' This term, which has been recently applied to a species of reptile very common in the metropolis, appears to have arisen from a small silver coin struck by King Henry VII, of little value, called a *dandprat*, and hence Bishop Fleetwood observes the term is applied to worthless and contemptible persons."

It was Beau Brummell, the high priest of fashion, who gave dandyism its great vogue, though it existed before his day. About the middle of the 18th century was founded the Macaroni club. This was a band of young men of rank who had visited Italy and sought to introduce the southern elegances of manner and dress into England. Their costume is described as "white silk breeches, very tight coat and vest, with enormous white neckcloths, white silk stockings and diamond buckled, red heeled shoes." For some time the moving spirit of the club was Charles James Fox. It was with the advent of Brummell, however, that the cult of dandyism became a social force. Beau Brummell was supreme dictator in

matters of dress, and the Prince Regent is said to have wept when he disapproved of the cut of the royal coat. Around the Beau collected a band of young men whose insolent and affected manners made them universally unpopular. Their chief glory was their clothes. They wore coats of blue or brown cloth with brass buttons, the coat tails almost touching the heels. Their breeches were buckskin, so tight that it is said they "could only be taken off as an eel would be divested of his skin." A pair of highly-polished Hessian boots, a waistcoat buttoned incredibly tight so as to produce a small waist, and opening at the breast to exhibit the frilled shirt and cravat, completed the costume of the true dandy.

See Barbery D'Aureville, *Du dandysme et de G. Brummell* (1887), Sir A. Conan Doyle, *Rodney Stone* (1896).

DANEGELD, an English national tax originally levied by Aethelred II as a means of raising the tribute which was the price of the temporary cessation of the Danish ravages. This expedient was first adopted in 991 and was repeated in 994, 1002, 1007 and 1012. With the accession of the Danish king Canute, the original *raison d'être* of the tax ceased to exist, but it continued to be levied, though for a different purpose, assuming now the character of an occasional war tax. It was, apparently, not levied by Edward the Confessor in the latter part of his reign, but William the Conqueror revived it immediately after his accession, and it was with the object of facilitating its collection that he ordered the compilation of Domesday Book. It continued to be levied until 1163, in which year the name Danegeld appears for the last time in the Rolls. Its place was taken by other imposts of similar character but different name.

DANELAGH, the name given to those districts in the north and northeast of England which were settled by Scandinavian invaders in the 9th and 10th centuries and in which Danish customs subsequently prevailed. The real settlement of England by Danes began in the year 876, when a division of the great army, which had been ravaging widely over England, divided out Northumbria among its members. Next year, another portion of the same army divided out Eastern Mercia and in 880 so much of the army as remained in England divided out East Anglia. A similar division of Wessex had been prevented by the victories of King Alfred (q.v.), and between 880 and 890 definite boundaries were drawn between Alfred's kingdom and that of Guthrum, king of East Anglian Danes. The boundary thus drawn ran along the Thames estuary to the mouth of the Lea (a few miles east of London), then up the Lea to its source, then due north to Bedford, then up the Ouse to Watling street at Stony Stratford. From this point the boundary is left undefined, perhaps because the kingdoms of Alfred and Guthrum ceased to be contentious here. Thus Eastern Mercia, Northumbria from Tees to Humber, East Anglia, and the shires to the immediate west and south were handed over to the Danes and henceforth constitute the district known as the Danelagh.

The three chief divisions of the Danelagh were (1) the kingdom of Northumbria, corresponding, roughly, to the modern Yorkshire, (2) the kingdom of East Anglia, (3) the district of the five (Danish) boroughs—lands grouped round Leicester, Nottingham, Derby, Stamford and Lincoln. Of the history of the two Danish kingdoms we know very little. Guthrum of East Anglia died in 890, and later we hear of a King Eric or Eohric, who died in 902. The history of the Northumbrian kingdom is yet more obscure. The original Danish kingdom seems to have come to an end in 909, but within a decade this region was overrun by fresh invaders of Norwegian rather than Danish extraction, and Northumbria was not brought definitely under English rule before the middle of the 10th century.

More is known of the history of the five boroughs. From 907 onwards Edward the Elder, working together with Aethelred of Mercia and his wife, worked for the recovery of the Danelagh. In that year Chester was fortified. In 911-912 an advance on Essex and Hertfordshire was begun. In 914 Buckingham was fortified and the Danes of Bedfordshire submitted. In 917 Derby was the first of the five boroughs to fall, followed by Leicester a few months later. In the same year after a keen struggle all

the Danes belonging to the 'borough' of Northampton (as far as the Welland (i.e., the border of modern Northamptonshire) submitted to Edward and at the same time Colchester was fortified, a large portion of Essex submitted and the whole of the East Anglian Domes came in. Stamford was the next to yield, soon followed by Nottingham, and in 970 there was a general submission on the part of the Danes.

Although the independent existence of the Danelagh did not last for half a century, it profoundly affected the later history of this region. It was subsequently distinguished by a large population of free peasant landowners, who undoubtedly represent the descendants of the Danish settlers of the viking age. The signs of Scandinavian occupation are particularly evident in Yorkshire and the territory of the five boroughs, where land was divided into ploughlands and oxgangs instead of hides (*q.v.*) and yardlands, where the Scandinavian *uspentake* replaces the English hundred (*q.v.*) and where many traces of Scandinavian methods of monetary and fiscal computation survived into the middle ages. For at least two centuries the language of this region must have been a Scandinavian dialect, gradually modified by English influences from the south. In the early 12th century the legal custom of the Danelagh was sharply distinguished from the customs of Wessex and English Mercia, and to the present day a Scandinavian institution, the riding, survives, in the three ridings of Yorkshire. A number of Danish place names still exist in the original Danelagh.

See J. C. H. R. Steenstrup, *Normanerne*, 4 vol. (1876-82), P. Vinogradoff, *English Society in the Eleventh Century* (1908), F. M. Stenton, *Danelaw Charters* (1910) and *The Danes in England* (Oxford, 1977). The place names of this region are discussed by E. Ekwall in the *Introduction to the Survey of English Place Names*, pt. 1, ch. iv (1924) (A.M., F.M.S.).

DANGERFIELD, THOMAS (c. 1650-1683), English conspirator, was born at Waltham, Essex, the son of a farmer. He began his career by robbing his father, and, after a wandering life on the continent, took to coming false money, for which offense and others he was many times imprisoned. Faithless to everyone, he first tried to involve the duke of Monmouth and others by concocting information about a Presbyterian plot against the throne, and, this having been proved a lie, he pretended to have discovered a Catholic plot against Charles II. This was known as the "Meal-tub plot," from the place where the incriminating documents were hidden at his suggestion, and found by the king's officers by his information. Elizabeth Cellier—in whose house the tub was—almoner to the countess of Powis, who had befriended Dangerfield when he posed as a Catholic, was, with her patroness, actually tried for high treason and acquitted (1680). Dangerfield, when examined (Oct. 26, 1680) at the bar of the house of commons, made other charges against the duke of York, the countess of Powis and the earl of Peterborough. He continued to defame the Roman Catholics in a long series of pamphlets, among others being *Dangerfield's Narrative*. This led to his trial for libel, and on June 29, 1685, he received sentence to stand in the pillory on two consecutive days, be whipped from Aldgate to Newgate, and two days later from Newgate to Tyburn. On his way back he was struck in the eye with a cane by a barnster, Robert Francis, and died shortly afterward from the blow. The barnster was tried and executed for the murder.

DANGEROUS TRADES Work whether laborious, sedentary or studious, involves adverse influences on health. The effects may appear immediately, as in accidents, or insidiously over years, as in occupational diseases. Some employments, however, involve special risks, and in Great Britain these are designated dangerous trades. (For a discussion of the subject in the United States, see **INDUSTRIAL ACCIDENTS, INDUSTRIAL MEDICINE**.) This experience is marked in common speech in such allusions as painters' colic (lead poisoning), potters' rot (silicosis), mad as a hatter (mercurial poisoning) and mule spinners' cancer. In Great Britain, under the Factories Act, 1937, dangerous trades are officially recognized by a requirement for statutory periodic medical examination of certain workmen exposed to the risk of lead poisoning in such diverse occupations as the manufacture of pottery, electric accumulators, and rubber; toxic anaemia in nitro and amido processes; chrome ulceration in chromium plating; skin cancer in

patent fuel workers, and many others. Employers voluntarily supplement these arrangements in a wide variety of occupations including exposure to mercury, mineral oil pitch and tar and complex organic chemical compounds. The danger is reflected either as accidents or specific trade diseases and statistically by excessive morbidity and mortality generally or particularly from special causes.

In relation to each census the registrar general publishes a decennial supplement on occupational mortality, which directs attention to the unfavourable state of certain occupational groups and to excessive mortality among them from particular diseases. In the report of 1875 William Farr wrote, "earthware manufacture is one of the unhealthiest trades in the country," and in 1885 W. Ogle added, "this excessive mortality is in the greatest part due to phthisis and diseases of the respiratory organs." At attention was thus focused on the risks of fibroid phthisis (later silicosis, now pneumoconiosis, *q.v.*) and plumbism among pottery workers. Similarly later decennial supplements emphasized the serious excess of mortality from respiratory diseases (silicosis and tuberculosis) in tin miners, metal grinders and sand blasters, and cancer in gas workers. Occasionally the peculiar hazards of a particular industry or occupation are dramatically revealed by a disaster, e.g., a colliery explosion, failure of a submarine to surface, bursting of a ladle of molten metal, men overcome by fumes in dry cleaning, men blinded by chemicals in a dyehouse. These incidents are accidents. Occurrence of trade diseases is less spectacular and frequently is discovered only after years of observation and research in the group, as, for example, bladder cancer in workers in the dyestuffs industry, scrotal epithelioma in cotton mule spinners, fibrosis of the lungs in asbestos workers, blood diseases among workers exposed to X rays, and degeneration of the liver from the toxic effects of benzene compounds. Furthermore, many cases of trade diseases, when first diagnosed, have reached a serious stage. Little is known of the ill effects and signs of small continued exposures to toxic chemicals, and even when such disease is suspected doctors lack specific tests to identify the pathological changes. This means that against every diagnosed case of occupational disease there may be many incipient cases from the same causes. Nevertheless it is important to avoid the mistake that accidents and diseases caused by employment are major causes of sickness and incapacity. It is generally estimated that they constitute only 10% of all sickness. In 1951 under the main National Insurance act spells of sickness amounted to 7,000,000, whereas under the Industrial Injuries act there were 720,000 new awards for injuries by accident and about 50,000 for prescribed occupational diseases. Sickness cost £68,000,000 in benefits, industrial accidents and diseases cost £14,000,000.

The Factories act, 1937, requires that notification shall be made to the inspector of factories of all accidents at work which cause loss of life or disable a workman for more than three days from earning full wages at the work at which he was employed. During 1951, 182,216 reportable accidents occurred in factories among approximately 7,000,000 workers—a rate of 26 per 1,000. In addition there were 828 fatal accidents. As a means of measuring the comparative incidence of accidents in separate industries, use is made of the frequency rate, which takes account of the number of lost time accidents (that is, those involving loss of time beyond the day or shift in which the accident occurred) and also of the number of man hours worked during the year. The formula is

$$\frac{\text{total number of accidents} \times 100,000}{\text{total man hours worked}}$$

Table I, abbreviated from the annual report of the chief inspector of factories for the year 1951, presents the situation in a few selected industries. The data do not represent all firms but only those which co-operated with the factory department by making voluntary returns. As the figures refer mainly to factories where special attention is given to accident prevention, they are certainly lower than would be the case if comprehensive figures were available. They do, however, indicate broadly the trend in various industries between 1948 and 1951. For the 29 industries in the original table, covering 1,740,400 persons, the frequency rate

TABLE I—Frequency Rate of Accidents in Factories in Great Britain

| Industry | Estimated number employed | | | | Number of factories | | | | Frequency rate | | | |
|--|---------------------------|---------|---------|---------|---------------------|------|------|------|----------------|------|------|------|
| | 1948 | 1949 | 1950 | 1951 | 1948 | 1949 | 1950 | 1951 | 1948 | 1949 | 1950 | 1951 |
| Printing | 13,200 | 33,600 | 27,300 | 27,000 | 14 | 42 | 31 | 36 | 0.73 | 0.70 | 0.74 | 0.62 |
| Engineering light electrical and radio | 52,400 | 50,800 | 55,500 | 81,000 | 45 | 43 | 47 | 56 | 0.96 | 0.88 | 0.80 | 0.92 |
| Chemicals, industrial | 48,400 | 50,100 | 60,300 | 85,100 | 47 | 52 | 63 | 86 | 1.75 | 2.03 | 2.30 | 1.41 |
| Engineering, general and heavy | 283,800 | 452,400 | 440,400 | 432,000 | 202 | 308 | 414 | 410 | 0.66 | 0.70 | 0.67 | 0.71 |
| Shipbuilding and repairing | 56,700 | 82,700 | 57,500 | 62,300 | 25 | 41 | 31 | 34 | 2.55 | 3.40 | 3.32 | 1.00 |
| Building, operations | 27,400 | 16,500 | 15,600 | 21,000 | 11 | 30 | 33 | 33 | 0.64 | 0.64 | 0.64 | 0.64 |
| Iron and steel founding | 27,400 | 36,300 | 38,100 | 51,800 | 57 | 74 | 77 | 101 | 0.52 | 1.22 | 1.05 | 1.13 |
| Lin plate | 17,200 | 16,500 | 16,200 | 7,100 | 31 | 34 | 20 | 15 | 0.28 | 0.76 | 0.47 | 0.95 |

was 1.70 and in the range of 0.62 in printing and 5.95 in tin plate. The dangers and hardships endured by coal miners are greater than in any other major industry. The death rate from accident is nine times as high as in factories, and the general accident rate is six times as high. Average absenteeism from unavoidable causes—most of it caused by injury or sickness—is around 7% per annum, equivalent to the whole working time of 50,000 miners. In statistics of accidents in coal mining a person is included as "reportably injured" if he is "seriously injured," when any accident occurs which either (1) causes any fracture of the head or of any limb, or any dislocation of a limb or any serious personal injury, or (2) is caused by any explosion of gas or coal dust or any explosive, or by electricity or by overwinding. In 1950 total underground and surface accidents amounted to 134.47 per 100,000 man shifts, of which death represented 0.28 and reportable injury 1.13.

TABLE II—Manpower and Accidents at All Mines in Great Britain Under the Coal Mines Act, 1911

| Year | Persons employed (total) | Man shifts worked (in one 000) | Number of persons killed and reportably injured | | |
|------|--------------------------|--------------------------------|---|--------------------|-------|
| | | | Killed | Reportably injured | Total |
| 1910 | 760,400 | 21.1 | 993 | 3,137 | 4,130 |
| 1945 | 745,651 | 186.0 | 559 | 2,153 | 2,712 |
| 1950 | 751,550 | 171.6 | 494 | 2,020 | 2,514 |

In addition to this heavy toll of accidents, coal miners suffer inordinately from many serious incapacitating occupational diseases, as shown in Table III. Pneumonoconiosis, or dust disease of the lungs,

TABLE III—Centenaries of Disablement From Industrial Diseases to Coal Miners in Great Britain

| Year | Pneumonoconiosis | Asthma | Beal diseases | Inflammation of wrist | Dermatitis | Other diseases | Total | Persons employed |
|------|------------------|--------|---------------|-----------------------|------------|----------------|--------|------------------|
| 1940 | 484 | 1,076 | 6,132 | 3,8 | 802 | 7 | 8,249 | 760,400 |
| 1945 | 5,821 | 1,876 | 6,841 | 402 | 1,567 | 12 | 26,619 | 745,651 |
| 1950 | 4,576 | 1,65 | 10,787 | 672 | 1,313 | 14 | 28,447 | 751,550 |

is the greatest and most complex problem. The disease results from the inhalation of minute particles of mine dust and chiefly affects underground workers. Machine methods of mining have substantially increased dustiness in the pits. Strenuous and effectual efforts are being made to control the amount of dust by such methods as water infusion of the strata at the working faces. The alarming rise in the number of cases after 1940 is partly explained by the fact that until July 1945 only silicosis, a particular variety of pneumonoconiosis, was liable for compensation. After that under compensation legislation, pneumonoconiosis had a much wider connotation and so embraced many cases of lung disease previously excluded. The disease—even as it is present defined—is incurable and, indeed, in certain "infective cases" tends to progress. Its course is usually prolonged and associated with incapacity for work. The "beal" diseases mean an inflammation of the underlying cellular tissue following septic infection of abraded surfaces of the hands, knees or elbows. Beal knee—a crippling condition—accounts for about 70% of all cases.

An excess of accidents also occurs to seamen and dock labourers, while increasing mechanization in agriculture foreshadows a rise in serious accidents among farm workers.

Occupational diseases, apart from pneumonoconiosis, are uncommon as a cause of death or disabling sickness. Poisoning by lead, mercury, arsenic and phosphorus (lucifer match manufacture) prevailed in the early part of the 20th century but as a result of preventive measures these dangers were eradicated or substantially diminished. The present is dominated by pneumonoconiosis, particularly in coal miners, foundry and pottery workers, dermatitis in engineering tradesmen, epithelomatous ulceration in pitch and tar workers and workers exposed to contact with mineral oils. To expedite prompt investigation and preventive measures certain occupational diseases and allied conditions are notifiable to the chief inspector of factories. Table IV shows the trend in four major conditions since 1900.

Pneumonoconiosis and industrial dermatitis, which constitute the most serious problems, are not notifiable, statistics of these are derived from claims under the Industrial Injuries Act. The remarkable fall in

lead poisoning is largely attributable to displacement of full lead glazes by leadless or low solubility lead glazes in pottery manufacture. Ship building caused 27 of the 57 cases in 1950. In this industry the disease is caused by the inhalation of lead fume arising from the burning of

TABLE IV—Trends in Four Major Occupational Disease Conditions in Great Britain

| Disease | Reported cases (superior figures indicate deaths) | | | | | |
|----------------------------|---|------|------|------|------|------|
| | 1900 | 1910 | 1920 | 1930 | 1940 | 1950 |
| Lead poisoning | 1,057 | 693 | 307 | 64 | 104 | 57 |
| Aniline poisoning | | | | | 1 | 0 |
| Epidemiological ulceration | | | | | 1 | 10 |
| Chromic ulceration | | | | | 1 | 1 |

lead paint and stoppings by the acetylene torch in the "cutting up" of the hull. Cases should diminish as the breaking up of obsolete warships—the main source of danger—declines. Epithelomatous ulceration—almost entirely in pitch and tar workers—remains a serious problem. Periodical examination leading to earlier and more accurate diagnosis may account for the sustained level of notified cases but should ultimately achieve effective control of the risk. Anthrax, formerly a serious risk in the woolen trades, was considerably diminished by the effective treatment of certain imported wools at the government disinfecting station at Liverpool.

Complex chemical compounds have increasingly been used in the form of sprays, dusts and aerosols for the protection of fruit and field crops. Several of these substances notably parathion, an organic phosphorus insecticide, and di-nitro ortho cresol (DNOC), an ovicide and weed killer, proved extremely noxious indeed rapidly fatal, to workmen employed in spraying operations. Manufacturers and firms engaged in the treatment of crops instituted effective measures for the safety of their workmen.

The dangers of atomic energy are well recognized at atomic energy plants, in industry, where increasing use is being made of radioactive isotopes, and in hospitals. Preventive measures, however, are rigorously enforced and have achieved almost complete control. In like manner flying at high altitudes and at speeds faster than sound involves, excluding accidents, considerable risks to the physical and mental health of air crews. Aviation medicine has become a science in which physiologists, at such research stations as Farnborough, Eng., have made notable contributions to the health and safety of crews and passengers.

The real significance of dangerous trades is their call to unremitting vigilance, anticipation of danger and urgent preventive action. This is mainly an engineering problem, but the physician in industry can make a substantial contribution. (See also WORKMEN'S COMPENSATION.)

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DANIEL, the name given to the central figure of the biblical book of Daniel (see below). Two other personages mentioned in the Old Testament bear this name, see I Chron. iii, 1, Ezra viii, 2, Neh. x, 6. Daniel the prophet is known to us only as a character in Jewish fiction. He is mentioned in Ezek. xiv, 14, 20, between Noah and Job, as one of three foremost saints of Israel, and in xxviii, 3, as the type of wisdom. This may mean either that such stories as those in our book of Daniel were in circulation as early as the 6th century B.C., or (in the present writer's opinion)

much more probably that the book of Ezeiel was written in the 3rd century B.C. (see below)

According to Dan 1, 3, the Babylonian chief eunuch was commanded to bring to the court certain youths of the Judean captivity, "of the children of Israel, and of the king's seed, and of the nobles," to serve in the king's palace. It is apparent that Daniel is thought of as one of the nobles, or even of the royal line. Thus Josephus, *Ant.* x, 10, i, and the *Lives of the Prophets* (various Greek recensions), the latter adding that his birthplace was Upper Beth Horon, and that he was burned in the royal vault in Babylonia. In the biblical account, the earlier narrator says that his life extended "to the first year of king Cyrus" (1, 21, cf. vi, 29), while the later author represents him as still living "in the third year of Cyrus" (x, 1). In the late rabbinical tradition (*Midr. Sa ha Simm* vi, 8) he is said to have returned to Jerusalem among the exiles freed by the royal edict. The Jewish traveller Benjamin of Tudela (12th cent. A.D.) was shown his tomb in Susa, and notices of this tomb are found as early as the 6th century.

Daniel, Book of.—The Book of Daniel stands between Esther and Ezra in the third great division of the Hebrew Bible known as the *Hagiographa*, in which are classed all works which were not regarded as forming part of the Law or the Prophets.

The book consists of two widely different portions: a didactic and popular narrative in successive episodes, chaps. i-vi, and a series of prophetic visions, chaps. vii-xii. Chaps. i-vi are in Aramaic, the remainder is Hebrew. The unity of the whole has been maintained by the great majority of scholars (Bevan, *Comm.*, pp. 6, 23 note). Recently, however, theories of composite authorship have gained ground, see Dalman, *Worte Jesu* (1898), p. 11, and the works named below. The differences between the two parts are indeed many and striking, notably in the following particulars: (1) Style, irrespective of the changes in language and subject matter. In the first half, including the Hebrew chapter i, it is generally simple and without any unusual features, in the second half it is obscure and difficult to a remarkable degree. (2) In the mental attitude of the author, and his portrayal of the character of Daniel, there is a profound difference to be seen. (3) The Persian words, so numerous in i-vi, are entirely absent in vii-xii. (4) There is nothing in the first half of the book to suggest the presence of the arch enemy, Antiochus Epiphanes, always in the background of the second half, contrast 21, 39-43 with vii, 23-25. (5) There is a manifest contradiction between 1, 21 (cf. vi, 28), the statement that Daniel "continued until the first year of Cyrus," and x, 1, the account of the vision in that king's third year. It is natural to suppose that a later author had in mind the words of vi, 28, but forgot, or chose to disregard, those of 1, 21. (6) The use of the two languages finds its only convincing explanation in the theory of dual authorship (see following).

The great majority of scholars at the present day agree that neither the whole book nor the first half, containing the narratives, can have been written in the time of the Babylonian monarchy, or even in the earlier part of the Persian period. The chief reasons for this conclusion are the following:

1. The position of the book among the *Hagiographa* seems to show that it was introduced after the final collection of the "Later Prophets" had been made. The collectors of the prophetic writings, who in their care did not neglect even the parable of Jonah, would hardly have ignored the record of so great a prophet and foreteller of future events as Daniel is represented to have been.

2. Jesus ben Sirach (Ecclesiasticus), who wrote about 180 B.C., in his otherwise complete list of Israel's leading spirits, makes no mention of Daniel.

3. The internal evidence is even stronger than the external, as will appear in the particulars which here follow. The historical inaccuracies in the narrative chapters are such as could be credited only to a writer who lived long after the events described. The statement at the very beginning of the book, that "in the third year of the reign of Jehoiakim" Nebuchadnezzar besieged and captured Jerusalem, and carried the Jewish king and the vessels

of the temple to Babylon, finds no support in the history known to us, but seems to be the work of a writer who combined II Chron. xxxvi, 6, i with II Kings xxv, 1. The use of *Kaddim*, "Children," as the name of a class of magicians is a striking anachronism (see CHALDEANS), and the position of Daniel, a devout Israelite, as "the master of the magicians" at the Babylonian court (iv, 6) is more easily comprehensible in edifying romance than in actual history.

The four kingdoms of chap. ii introduce a still greater difficulty. The first kingdom is the Babylonian (vs. 38), the fourth is the Greek empire (cf. chap. viii), the third, immediately preceding the Greek (viii, 20 f., x, 20), is the Persian. The identity of the second kingdom is then made certain by numerous passages: it is the kingdom of the Medes, whose reigning king, called "Dir us the Mede," took possession of Babylonia upon the death of Belshazzar, and at the close of his reign was succeeded by Cyrus (v, 30, vi, 1, 29, cf. ix, 1, x, 1, xi, 1). There was, however, in fact no Median power which came "after" the Babylonian (ii, 39) and in turn yielded the throne of Babylonia to the Persians (xi, 1). The name Darius is not Median, and we have certain knowledge that the immediate successor of Nabonidus and Belshazzar as ruler of Babylonia was Cyrus. Comparison with the list of Persian kings in the book of Ezra seems to show that in the last centuries B.C. the Jewish learned tradition transposed the reign of Cyrus with that of Darius I Hystaspis, the latter being regarded as king of the Medes. The reign of Cyrus was believed to have been immediately followed by those of Xerxes and Artaxerxes, Ezra iv, 5 (where the reference is to Darius II Nottus), 6, cf. Montgomery, *Comm.*, p. 423 (See EZRA and NEHEMIAH, BOOKS OF).

The highly interesting narratives of Nebuchadnezzar and Darius can hardly be regarded as true pictures of these monarchs. The former erects a golden image and commands all the people in his realm to fall down and worship it at a given signal, afterwards he confesses the God of Israel, and decrees that any subject of his who shall say anything against this God shall be cut in pieces. Darius commands by royal statute that "whosoever shall ask a petition of any god or man for 30 days" save of the king himself, shall be cast into the den of lions. After Daniel's rescue, the king confesses the God of Israel, and writes to all the peoples, nations and languages, commanding them to fear this living God, whose dominion is everlasting. All this is plainly popular narration rather than historical record, even though one and another of the items have an undoubted basis of fact. The picture of Belshazzar in chap. v has quite generally been pronounced unhistorical by modern scholars, but recent discoveries have tended to show that the historical background of the chapter is substantially correct. Documents in cuneiform prove that Belshazzar, the son of Nabonidus, exercised at Babylon such administrative powers as belonged to no mere crown prince, indeed, it is expressly stated that in the third year of Nabonidus the king entrusted the kingship to his eldest son, Belshazzar (Sidney Smith, *Babylonian Historical Texts*, 1924, pp. 84 sqq.). This would seem to explain the dignity of "the third ruler in the kingdom," conferred upon Daniel. Whether, and in what way, Belshazzar could be correctly described as the lineal descendant ("son") of Nebuchadnezzar is a question which future discoveries may settle.

4. The late date of the second half of the book, chaps. vii-xii, is evidenced in many ways, not merely by the fact that its author presents a detailed sketch of contemporary history, especially in chap. xi, extending down to the time subsequent to the desecration of the temple at Jerusalem by Antiochus Epiphanes. In both literary and religious character it is a product of the later Greek period. The "apocalypse" as a distinct branch of Jewish literature makes its first appearance at this time, in the books of Daniel and Enoch, and continues henceforth in many similar compositions, its most characteristic features clearly represent a late stage in the history of Jewish thought. See the article "Apocalypse" in the *Jewish Encyclopedia*, Montgomery, *Comm.*, 78-81. The way in which Daniel in ix, 2, refers to the authoritative scriptures naturally suggests a time subsequent to the final redaction of the Law and the Prophets. A like impression is given by the

angelology of the visions, including the names of the archangels Gabriel and Michael (cf. the book of Tobit). The doctrine of the resurrection, xii 2, appears now for the first time in clear and definite form (it had already received expression in Is xxvi 19). Not only the resurrection of the righteous but also that of at least a part of the wicked among the Jews is predicted, and the fact well illustrates the growing prominence of the individual, as contrasted with the nation, in the type of theology here represented. Some scholars have seen in this doctrine, as well as in other features of the theology of the book, evidence of the influence of Zoroastrianism (thus Kohut, Bousset, and especially Eduard Meyer, *Ursprung und Anfänge des Christentums*), but the arguments in support of this theory are unconvincing.

5. Finally, the linguistic evidence points unequivocally to a date more than two centuries later than the supposed time of the prophet Daniel. Comparison of the language of the sufficiently abundant inscriptions and papyri shows beyond question that the Aramaic of Dan ii-vii represents a type which cannot possibly be carried back of 300 B.C. (Torrey, *Earle Studies*, 161-166; G. R. Driver, *Journal of Bibl. Lit.* xiv 110 sqq., 323, and especially Baumgartner, "Das Aramäische im Buche Daniel," *Z. A. T. W.*, xiv [1927], 122 sqq.). The Hebrew of the book is also of a very late type, see Bevan, *Comm.*, 28-35. The presence of Greek words, especially the names of the musical instruments in iii 7, 10, 15, adds its significant contribution to the many-sided argument.

The book, then, is not a record of historical fact, but in its first half an edifying romance, and in its second half a typical apocalypse. The narrative portion is excellently suited to its purpose, and in the handling of the successive episodes the author's ability as a story teller is as evident as his religious fervour. Chapter v, in particular, is powerfully dramatic, a gem of the world's literature. The popularity of the stories is early attested by the existence of varying recensions. The old Greek version (as old as the middle of the 2nd century B.C.), now extant in a single ms., supported by the Syriac Hexaplaric version, differs very considerably from the standard text in chaps. iv-vi, and is here probably the rendering of a text which was reproduced from memory. (Our standard Greek is the rendering of Theodotion, 2nd century A.D.) The influence of the second half of the book, the visions, was even more powerful and pervasive than that of the stories, determining to a considerable extent the course of the Jewish apocalyptic tradition, and affecting profoundly the early Christian scriptures. The visions are strongly patriotic in their immediate purpose, and there is abundant evidence that they gave in full measure the encouragement and the new religious impulse that they were designed to give. Very little attention is paid in them to the unseen world, their author does not concern himself with the secrets of the universe (contrast the book of Enoch). The eschatology of the book—immensely important as it is, and strongly emphasized by the author himself—is given the briefest possible space, vii 13 seq., 27, xii 1-3. That to which everything else is subordinated is the prediction of the immediate future. The Jews are soon to be delivered from their oppressors, and the faithful will triumph forever. In making his final and most vivid prophecy, the writer at length passes over from the known to the unknown in a very striking manner. In chap. xi, verses 3-39 present in the form of a prediction the detailed history of the Greek empire in the East, from the conquest of Alexander down to the latter part of the reign of Antiochus Epiphanes. Verses 40-45 continue this with an almost equally vivid description of events which had not yet taken place, but were only expected by the writer, namely, the wars which should result in the death of Antiochus and the fall of his kingdom. The mysterious symbolism employed in the computation of various intervals of time is another highly characteristic and significant feature of the Daniel visions. Thus, the "126 times, and a half" (xii 7) which must elapse before the end which has been foretold, the "weeks" (seven-year periods) of ix 24-27, and the enigmatic numbers of days in vii 14 and xii 11, sqq. For the interpretation of these ever fascinating riddles the reader is referred to the standard commentaries. The influence

of the book of Daniel on the Messianic hope of the Jews is still another fact of great importance. The "man" ("son of man") of vii 13 becomes henceforth a definitely Messianic title, as in the Book of Enoch and the Christian scriptures, on the other hand, the "anointed one" of ix 26 doubtless refers to the high priest Onias III., who was assassinated at Antioch c. 171 B.C. (II Macc iv 33-38), referred to in xi 22 as "the prince of the covenant."

The strange manner of occurrence of the two languages, first Hebrew, then Aramaic, then Hebrew again, the alternation not corresponding to any changes in subject matter or literary character, furnishes a riddle which many scholars have been content to abandon as insoluble. The view that the book, as we have it, is in its original linguistic form and the work of a single author (Behr, Kamphausen) certainly leaves the principal difficulties unexplained. It has been a favourite theory that the book was originally written in Hebrew, and that a portion of it was lost or destroyed in the Maccabean wars and afterward supplied from an Aramaic version (so Lenormant, Bevan, Prince). "This hypothesis stumbles on the fact that the Aramaic begins neatly at the appropriate point" (Montgomery, *Comm.*, p. 92). There are other significant features, mentioned above, for which it fails to account. A theory first proposed by the present writer and adopted by Montgomery, *Comm.*, recognizes two distinct halves of the book, an earlier and a later, and explains the alternation of languages as the work of the later writer, who himself devised this way of joining his own work to that of his predecessor. The original work, consisting of popular narratives written in Aramaic, comprised the first six chapters, vi 29 forming the natural conclusion. The author of the apocalyptic chapters, vii-xii, writing in the name of Daniel and with the purpose of supplementing the book already existing, composed his first vision, chap. vii, in Aramaic, wrote the remaining chapters, vii-xii, in Hebrew (the natural, almost essential, language of the older Jewish apocalypses), and replaced the original Aramaic of i 1-ii 40 with his own rendering of it into Hebrew. An excellent place for making the transition was offered by ii 4, the verse in which the Chaldaean soothsayers first address the king. This ingenious proceeding made of the whole an indissoluble unit. Chap. 1 is indispensable to ii seq., while on the other hand vii seq. (Hebrew) could not possibly be separated from vii (Aramaic), for the successive revelations are manifestly all of one piece, and vii 1b significantly alludes to the preceding vision.

The date of the latter half of the book (and thus of the complete work) is given approximately by allusions to contemporary events. It was written in the time of Antiochus IV. Epiphanes, after the desecration of the temple (vii 11-14), which took place in Dec. 167 B.C. (for this date, and the others here given, see Kolbe's epoch making *Beiträge zur syrischen und jüdischen Geschichte*, Berlin, 1926). If, as some think, vii 14 implies that the writer had seen the rededication of the sanctuary (Dec. 164), while on the other hand the passage xi 40-45 shows, as all agree, that the death of Epiphanes (April 163) was still in the future, the visions are dated almost to the month.

The date of the first half of the book, the stories, is indicated with great probability by the allusions and the symbolism in chap. ii. The historical sketch terminates with the attempted alliance, through marriage, of the Ptolemiac and Seleucid kingdoms (so most commentators) at a time when the contrast between the two was like that between iron and clay. This would perfectly apply to the political conditions at the time when the crushing blow was inflicted on the northern kingdom by Ptolemy III. Euergetes in 246 B.C., immediately after the murder of Antiochus II., the Seleucid king, and his newly espoused wife, Berenice, the daughter of Ptolemy II. At no other time in the history of the two kingdoms was the contrast so strongly marked, the northern kingdom was not only impotent, it was actually crumbling. The provinces of the Euphrates and Tigris were now lost, Asia Minor was soon to follow, the two sons of Antiochus II. were arrayed against each other. The most probable date for Daniel i-vi would seem to be between 246 and 240, the year of the peace concluded between Ptolemy III. and Seleucus II. "This dating" satisfies all the conditions known to us nor is there any evident objection to it, if

the fact of composition is accepted. Those few who postulate for Ezekiel a date c. 230 obtain an interval sufficient to account for the allusions to Daniel (see above) and for the mention of Ezekiel by the Siracide.

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The "additions to Daniel" are three: *Susanna* and the *Elders, Bel and the Dragon*, and *The Song of the Three Children*. The two former have no organic connection with the book of Daniel, the last is inserted between verses 23 and 24 of chap. iii.

Susanna—This addition was placed by Theodotion before chap. i, and *Bel and the Dragon* at the close, whereas by the Septuagint and the Vulgate it was reckoned as chap. xiii after the twelve canonical chapters, *Bel and the Dragon* as xiv. Theodotion's version is the source of the Peshitto and the Vulgate, for all three additions, and the Septuagint is the source of the Syro Hexaplaric, which was published by Ceram (*Mon. Sac. vi*). The legend recounts how that in the early days of the Captivity Susanna, the beautiful and pious wife of the rich Joakim, was walking in her garden and was there seen by two elders who were also judges. Inflamed with lust, they made infamous proposals to her, and when repulsed they brought against her a false charge of adultery. When brought before the tribunal she was condemned to death and was on the way to execution, when Daniel interposed and, by cross-questioning the accusers apart, convinced the people of the falsity of the charge.

The most interesting part of the story is the latter half, which deals with the trial. It has been plausibly conjectured that the characteristic features of this section point to its composition about 100-50 B.C., when Simon ben Shetah was president of the Sanhedrin, and when the Pharisees were attempting to bring about a reform in the administration of the law courts. See Ball in the *Speaker's Apocrypha*, ii, 329 f.

The language was Semitic. The original of Theodotion's Greek seems to have been Hebrew, notice especially the idiom (not Aramaic) in vs. 15. In the "Septuagint" version the evidence is not so clear, certain features seem rather to point to Aramaic. See further Ball in the *Speaker's Apocrypha*, Rothstein in *Kautsch's Apokryphen*, D. M. Kay in Charles' *Apocrypha*.

Bel and the Dragon—We have here two independent narratives, in both of which Daniel appears as the destroyer of heathenism. It is possible, as the comms have remarked, that some details of the story of the dragon were suggested by the Babylonian mythology. The legend of Habbakkuk, who brings food to Daniel in the lions' den, is an interesting feature. The Greek exists in two recensions, those of the "Septuagint" and Theodotion. The original language, which was certainly Semitic, seems to have been Hebrew, though this has not been demonstrated conclusively. See Ball and Rothstein (as above), Witton Davies in Charles' *Apocrypha*.

Song of the Three Children—This section is composed of the Prayer of Azariah and the Song of Hanannah, Azariah and Mishael, and was inserted after ii. 23 of the canonical text of Daniel. The original language of both prayer and hymn was certainly Hebrew, and the insertion was made in the Aramaic text. Careful comparison with the Greek versions shows that our canonical text has the original form of verses 21-25. See Ball and Rothstein (as above), Bennett in Charles' *Apocrypha*.

(R. H. CH. C. C. T.)

DANIEL (DANIEL), of Kiev, the earliest Russian travel writer, and one of the leading Russian travellers in the middle ages. He journeyed to Syria and other parts of the Levant about 1106-07. He was the *igumen*, or abbot, of a monastery probably near Chernigov in Little Russia. He visited Palestine in the reign of Baldwin I., Latin King of Jerusalem (1100-18), and apparently soon after the crusading capture of Acre (1104), he claims to

have accompanied Baldwin, who treated him with marked friendliness, on an expedition against Damascus (c. 1107). Though Daniel's narrative beginning at Constantinople omits some of the most interesting sections of his journey, his work has considerable value. His picture of the Holy Land preserves a record of conditions (such as the Saracens riding almost up to the walls of Christian Jerusalem, and the friendly relations subsisting between Roman and Eastern Churches in Syria) peculiarly characteristic of the time, his three excursions—to the Dead Sea and Lower Jordan, to Bethlehem and Hebron, and towards Damascus—gave him an exceptional knowledge of certain regions. In spite of blunders in topography and history, his observant and detailed record is among the most valuable of mediæval documents relating to Palestine. It is also important in the history of Russian language, and in the study of ritual and liturgy. Several Russian friends and companions, from Kiev and an old Novgorod, are recorded by Daniel as present with him at the Easter Eve "Miracle" in the church of the Holy Sepulchre.

There are 76 mss. of Daniel's Narrative, of which only five are anterior to AD 1500, the oldest is of 1475 (Leningrad, Library of Ecclesiastical History, 9/1086). Three editions exist of which I. P. Sakharov's (1849) is perhaps the best known (in *Narratives of the Russian People* vol. ii, bk. viii, pp. 1-151). See also the French version in *Itinéraires russes en Orient*, ed. M. B. de Khotkov (Geneva, 1886) (*Société de l'Orient latin*), and the account of Daniel in C. R. Beazley, *Dawn of Modern Geography* (1897) etc. ii, 155-174.

DANIEL, ARNAULT (fl. late 12th century), French troubadour, was born at Ribeyrac in Perigord and became a member of the court of Richard, the lion-hearted. He has become famous through the praise of Dante who ranks him with the Lustful in the seventh circle of purgatory. Arnault's amatory poems, though often obscure, are technical in mysteries of versification.

See E. Camello, *La Vita e le opere del trovatore Arnaldo Daniel* (Halle, 1883), and *Les Poésies d'Arnald Daniel, Réédition critique d'après Camello* (Toulouse, 1910).

DANIEL, GABRIEL (1649-1728), French Jesuit historian, was born at Rouen on Feb. 8, 1649. He entered the Jesuit order at the age of 18, and became superior at Paris. He is best known by his *Histoire de France depuis l'établissement de la monarchie française* (first complete edition, 1713). Daniel published an abridgment in 1724 (Eng. trans., 1726), and another abridgment was published by Dorville in 1751. Daniel also wrote a *Histoire de la milice française*, etc. (1721) and a reply to Pascal's *Provincial Letters*, entitled *Entretiens de Clément et d'Eudoxe sur les lettres provinciales* (1694), two treatises on the Cartesian theory as to the intelligence of lower animals, and other works.

See Sommervogel, *Bibliothèque de la Compagnie de Jésus*, t. ii.

DANIEL, SAMUEL (1562-1619), English poet and historian, was born near Taunton in 1562, and died at Beckington, near Devizes, on Oct. 14, 1619. His brother, John Daniel, was a musician and the author of *Songs for the Lute, Viol and Voice* (1606). In 1579 Samuel was admitted a commoner of Magdalen hall, Oxford, where he remained for about three years. He was first encouraged and, he says, taught in verse, by Sir Philip Sidney's sister, Mary, countess of Pembroke, whose household he had entered as tutor to her son, William Herbert. His first known volume of verse is dated 1592; it contains the cycle of sonnets to *Deha* and the romance called *The Complaint of Rosamond*. Twenty-seven of the sonnets had already been printed at the end of Sir Philip Sidney's *Astrophel and Stella* without the author's consent. Several editions of *Deha* appeared in 1592, and they were very frequently reprinted during Daniel's lifetime. *The First Four Books of the Civil Wars*, an historical poem in *ottava rima*, appeared in 1595. *Poetical Essays* apparently first printed in 1599, contained, besides the "Civil Wars," "Musophilus" and "A letter from Octavia to Marcus Antonius," poems in Dan's finest and most mature manner. About this time he became tutor to Anne Clifford, daughter of the countess of Cumberland. On the death of Spenser, in the same year, Daniel received the title of poet laureate, which he seems, however, to have shortly resigned in favour of Ben Jonson. About this time, and at the recommendation of his brother-in-law, Giovanni Florio, he was taken into

favour at court, and wrote a *Panegyric Congratulatory offered to the King at Burleigh Harrington in Rutlandshire, in ottava rima*. In 1603 this poem was published, and in many cases copies continued in addition his *Poetical Epistles* to his patrons and a prose essay called *A Defence of Rime* (originally printed in 1602) in answer to Thomas Campion's *Observations on the Art of English Poetrie*, in which it was contended that rhyme was unsuited to the genius of the English language. Daniel's essay and Campion's were published together, *Bodley Head Quarto*, No. 14 (New York, 1925). In 1603 Daniel was appointed master of the queen's revels. In this capacity he brought out a series of masques and pistoral tragicomedies, of which were printed *A Vision of the Twelve Goddesses*, in 1604, *The Queen's Arcadia*, an adaptation of Guarini's *Pastor Fido*, in 1606, *Tethys Festival or the Queen's Wake*, written on the occasion of Prince Henry's becoming a knight of the bath, in 1610, and *Hymen's Triumph*, in honour of Lord Roxburgh's marriage in 1615. Meanwhile had appeared, in 1605, *Certain Small Poems*, with the tragedy of *Philotas*, which brought its author into difficulties, as *Philotas*, with whom he expressed some sympathy, was taken to represent Essex. In 1607, under the title of *Certain small Works heretofore divided by Samuel Daniel*, the poet issued a revised version of all his works except *Dulca* and the *Civil Wars*. In 1609 the *Civil Wars* had been completed in eight books. In 1612 Daniel published a prose *History of England*, from the earliest times down to the end of the reign of Edward III.

Daniel was made a gentleman extraordinary and groom of the chamber to Queen Anne, and was now acknowledged as one of the first writers of the time. Later in life he threw up his titular posts at court and retired to a farm called "The Ridge," which he rented at Beckington, near Devizes, in Wiltshire, where he died.

Of Daniel's works, the sonnets are now, perhaps, most read. They depart from the Italian sonnet form in closing with a couplet, as is the case with most of the sonnets of Surrey and Wyatt, but they have a grace and tenderness all their own. Of a higher order is *The Complaint of Rosamond*, a soliloquy in which the ghost of the murdered woman appears and bewails her fate in stanzas of exquisite pathos. Among the *Epistles to Distinguished Persons* will be found some of Daniel's best work. The epistle to Lucy, countess of Bedford, is remarkable among those as being composed in genuine *terza rima*, till then not used in English. *Hymen's Triumph* is perhaps the best of all his dramatic writings. An extract from this masque is given in *Lamb's Dramatic Poets*, and it was highly praised by Coleridge. In elegant verse he always excelled, but most of all in his touching address to *The Angel Spirit of the Most Excellent Sir Philip Sidney*. *Musophilus* is one of the most characteristic writings of Daniel. It is a dialogue between a courtier and a man of letters, and is a general defence of learning, and in particular of poetic learning as an instrument in the education of the perfect courtier or man of action. It is addressed to Fulke Greville, and written in a sort of *terza rima*, or, more properly, *ottava rima* with the couplet omitted. Daniel is wanting in fire and passion, but he is pre-eminent in scholarly grace and tender, mournful reserve.

Daniel's works were edited by A. B. Grosart in 1885-96, *Selected Verse* (Pembroke Booklets, No. 6, 1905).

DANIELL, the name of a number of English late 18th and early 19th century artists. THOMAS D. (1749-1840) was best known for his collaboration with his nephew William on *Oriental Scenery*, drawn in India in 1784-93 and published in six aquatinted volumes in 1808. WILLIAM D. (1769-1837) was also noted for his Madras panoramas, for his aquatinted *Picturesque Voyage to India* (1810) and for *A Voyage Round Great Britain* (4 vol., 1814-25). He made soft ground etchings (1808-14) of G. Dance's portraits of John Flaxman, Benjamin West, etc. Thomas and William were both under the general influence of Paul Sandby. William's brother SAMUEL D. (1775-1811) travelled into Bechuanaland in 1801, one result being his aquatinted *African Scenery and Animals* (2 parts, 1804-05). Settling in Ceylon in 1806 he published in 1808 *Picturesque Illustrations of Ceylon*. (See *Dictionary of National Biography*, London, 1888.)

Of Daniells unrelated to the above the most notable was the

Rev EDWARD THOMAS D. (1804-43), a Norwich amateur landscape etcher, dry point engraver and water colourist. He was early taught by J. Crome and J. S. Cotman and was later a friend of J. M. W. Turner. (See J. Laver, *Hist. Brit. and American Etching*, London, 1929.) Others included ABRAHAM D. (d. 1803), miniaturist of Bath, J. D. (fl. c. 1800), London miniaturist, JAMES D. (fl. c. 1800) etcher, and JOSEPH D. (fl. c. 1810), etcher.

DANIELL, JOHN FREDERIC (1790-1845), English chemist and physicist, was born in London on March 17, 1790, and in 1831 became the first professor of chemistry at the newly founded King's college, London. His name is best known for his invention of the Daniell cell (*Phil. Trans.*, 1826, see BATTERY), still extensively used for telegraphic and other purposes. He also invented the dew point hygrometer known by his name (*Quar. Journ. Sci.*, 1830) and a register pyrometer (*Phil. Trans.*, 1830), and in 1830 he erected in the hall of the Royal society a water barometer with which he earned out a large number of observations (*Phil. Trans.*, 1832). A process devised by him for the manufacture of illuminating gas from turpentine and resin was in use in New York for a time. His publications include *Meteorological Essays* (1833), an *Essay on Artificial Climate considered in its Applications to Horticulture* (1824), which showed the necessity of a humid atmosphere in hot-houses devoted to tropical plants, and an *Introduction to the Study of Chemical Philosophy* (1839). He died suddenly on March 13, 1845, in London while attending a meeting of the council of the Royal society, of which he became a fellow in 1813 and foreign secretary in 1839.

DANIELS, JOSEPHUS (1862-1948), U.S. publisher and politician, was born at Washington, N.C., on May 18, 1862, and educated briefly at the University of North Carolina at Chapel Hill. Publisher, and intermittently editor, of the *Raleigh State Chronicle* from 1885 to 1904 and the *Raleigh News and Observer* from 1904 to 1948, he was a leader of movements for railroad regulation and prohibition. A supporter of William J. Bryan from 1896 to 1910, he turned in 1911 to Woodrow Wilson for leadership of the Democratic party and helped nominate Wilson for the presidency in 1912. Appointed secretary of the navy in 1913 by President Wilson, Daniels attempted to democratize the naval service, fought against the armour plate monopoly and helped bring the navy to peak size and efficiency during World War I. He was appointed ambassador to Mexico by Pres. Franklin D. Roosevelt in 1933 and won Mexican friendship and helped prevent Mexican expropriation of U.S. oil properties from disrupting Mexican-US relations. His five volume autobiography (*Tar Heel Editor*, 1939, *Editor in Politics*, 1941, *The Wilson Era*, *Years of Peace*, 1944, *The Wilson Era*, *Years of War and After*, 1946, and *Short Sleeve Diplomat*, 1947) is a major contribution to American historical literature. He died on Jan. 15, 1948, at Raleigh, N.C.

(A. S. L.)

DANISH LANGUAGE Danish is a Germanic language, closely related to Swedish, Norwegian and Icelandic, which are all derived from a common Scandinavian language, the separation of the four languages began at about A.D. 1000. The primeval Nordic language (c. A.D. 250-800) is known from relatively few runic inscriptions, among which is the famous Danish *Gold Horn Inscription* (c. 400). In the period of so called runic Danish (800-1100) remarkable changes took place, mainly through fracture, mutation, n-mutation and assimilation, and through the disappearance of unstressed short vowels. While these and other phenomena apply to all the Scandinavian languages, other changes, such as the monophthongization of *es* into *e*, *au* into *ø*, and *ey* into *ø*, and the disappearance of *h* in front of *k*, *n* and *r*, are characteristic only of the east Scandinavian languages (Swedish and Danish). The period of Middle Danish (1100-1500) is characterized by a weakening of the vowels *a* and *i* into *e*, in an unstressed position and by a change of the plosives *p*, *t* and *k* into *b*, *d* and *g*, after a vowel sound. Other characteristic changes are from *ja* into *jø*, from *ju* into *jy*, from a long *a* into the *a*-sound and from the unvoiced *th* sound (written *þ*) into *t*. A general simplification of declension and grammar took place at the same time, more slowly in the eastern Danish provinces of Samsø, Halland and Blekinge most radically in the western dialects of Jutland.

Already in the viking period a number of loan words of Latin

and Greek origin penetrated into the Danish language, this tendency was continued in the middle ages, when there was also a great influx of Low German words prefixes and suffixes, because of the influence of Hanseatic merchants.

Modern Danish may be divided into two periods, before and after 1700. While the general simplification of the language continued steadily many new words came into the language, mainly from High German and French but also from a variety of other languages. Several of these loan words disappeared again, to some extent the result of the deliberate efforts of language purists, but many came to stay. An influx of English loan words is noticeable from about 1870.

A characteristic phenomenon of the modern spoken language is the glottal stop (*Stød*), derived from an original tonal accent.

The grammatical structure of modern Danish is nearly as simplified as that of modern English, as in English there are only two cases (nominative and genitive), but there are two genders (common gender and neuter). In addition to the letters of the English alphabet, Danish has the three letters *æ*, *ø* and *å*. A spelling reform of 1948 abolished the previous general use of capital letters for nouns and replaced the letter *aa* by *a*.

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(E. L. Br.)

DANISH LITERATURE Denmark's first literature is found in the runic inscriptions scratched on stone or carved on metal, mainly epitaphs of warriors, kings and priests, occasionally with short, unrhymed alliterative verses reflecting the viking spirit. Runic inscriptions were used in Denmark from about A.D. 250, but most of those preserved date from 800–1100.

Middle Ages—With the introduction of Christianity Latin became the predominant language. Andreas Suneson (1160–1228) wrote *Hevameron*, a long Latin poem describing the creation and the ecclesiastical dogmas. This poem, the poetry of Morten Borup (c. 1446–1526), and two poems of mourning and despair of unknown origin are Denmark's most important contributions to mediaeval Latin poetry. A number of legends and biographies of saints date from the early middle ages, notably one about Canute the Holy, by Ælnoth, an English monk, various annals of monasteries, as well as historical chronicles, have also survived. Svend Aggesen's brief outline of Danish history before 1185, *Historia Regum Danie Compendiosa*, was shortly to be followed by the *Gesta Danorum* by Saxo Grammaticus, Denmark's first important contribution to world literature. Of its 16 books, written between 1185 and 1222, the first 9 cover prehistoric Danish antiquity, based on pagan legends and heroic poems passed down by word of mouth from generation to generation.

Danish mediaeval literature also includes a number of edifying works, hymns and various provincial laws, the "Law of Scania," two "Zealandish Laws," and the "Law of Jutland," the latter being accepted by the rulers of the kingdom in 1241. Other important treasures are Peder Laale's *Proverbs* (14th century), some medical books by Henric Harpestreng (13th century), *Læcdarius*, a mediaeval "encyclopaedia," and *Rimkrønike*, a versified Danish history, incidentally the first Danish book to be printed (1495).

In a class by themselves are the Danish mediaeval ballads, of which 539 are known in more than 3,000 versions, but nearly all were written down after the end of the middle ages. No country possesses a finer treasure of mediaeval ballads than Denmark. The first printed edition appeared in 1591.

The Reformation and the Renaissance—In 1536 the Reformation came to Denmark, and this marked the end of the middle ages. The beginning of the 16th century was characterized by its many religious polemic pamphlets, for or against the Roman Catholic Church. This inaugurated a new literature in the mother tongue. European humanism and the Renaissance made their influence felt also in Denmark, where Christiern Pedersen (d. 1554) ranks as the most prominent among the humanists who supported the Reformation. He edited the first printed edition of Saxo's *Gesta Danorum* (in Paris, 1514) and Laale's *Proverbs*, translated

the New Testament and adapted Martin Luther's pamphlets into Danish. Of supreme importance is his participation in the translation of the Bible (1550). Poul Helgesen (c. 1485–c. 1535) was the most gifted opponent of the Lutheran reformation (also the author of the *Shuby Chronicle*) and Hans Tausen (1494–1561) its most talented spokesman. The *Visitation Book* of the Lutheran bishop Peder Palladius (1550–60) is a charming literary document.

The bulk of 16th-century Danish poetry was either religious or polemical, the main lyrical contributions being some fine love poetry and some hymns. Hans Thomsson's collection of hymns (1569) was the first one of importance, Hans Christensen Sthen (1544–1610) the first notable hymnist known.

The earliest plays—mysteries, miracles, moralities, farces and school plays—date from the beginning of the 16th century, but many of them have been lost. *Ludus de Sancto Canuto*, a miracle play, dates from c. 1530. The most important playwright of the period was Hieronymus Justesen Ranch (1539–1607) and the farce *Karrig Nidding* his best play.

Anders Sørensen Vedel (1542–1616) translated Saxo's work into Danish and edited the first collection of ballads, Peder Clausen Fris (1545–1614), a Norwegian, translated Snorri's *Hæmskrigle*, and Arild Huitfeldt (1546–1609) wrote *Danmarks Riges Krønike* in ten volumes. In the field of astronomy Tycho Brahe (1546–1601) acquired European fame.

In the 17th century literary renaissance reached Denmark, which led to a strict adherence to classical patterns. It was an age of orthodoxy and blind belief in authority, whether in political, religious or literary matters. Niels Hemmingsen (1513–1600), a theologian of European reputation, had fallen a victim to the heresy hunt in the previous century, and in religious literature Latin dogmatics, edifying leaflets and a host of pamphlets reflecting the superstitions of the century were dominant.

It was, however, a great era of science and scholarship. Caspar Bartholin (1585–1629) and his son, Thomas Bartholin (1616–80), were famous anatomists whose works were known far outside the boundaries of Denmark. Niels Steensen—or Nicolaus Steno—(1638–86) was a renowned anatomist and geologist, Ole Rømer (1644–1710) a physicist, Simon Pauli (1603–80) a botanist and anatomist, and Ole Worm (1638–1654) an antiquarian, famous for his book on the runic inscriptions, the *Monumenta Danica* (1643). Thormod Torfæus (1636–1719) and Arni Magnusson (1663–1730) introduced the scholarly study of Old Norse literature, and Peder Hansen Resen (1625–88), who wrote a description of Denmark, *Danske Atlas*, edited and translated some of the poetry of the *Edda*, Erik Pontoppidan (1616–78), with his *Grammatica Danica* (1690), and Peder Syv (1631–1702), with his *Betænkninger om det danske Sprog* (1663) and his *Danske Sprog-Kunst* (1685), introduced the linguistic study of the Danish language.

The most important Danish prose work of the 17th century is *Jenners Munde*, the memoirs of Leonora Christina (1612–98), the daughter of Christian IV, a fascinating human document about her 20 years' imprisonment in the Blue Tower of Copenhagen. The manuscript was first discovered and published in 1869.

Danish poetry in the 17th century tended to follow the classics slavishly, and the favourite forms were the hexameter, the Alexandrine and the sonnet. Simplicity is deliberately avoided, the style is precious, allegories, euphemisms and metaphors abound. Anders Arrebo (1587–1637) translated the Psalms and wrote a free Danish adaptation of Du Bartas' *Hexameron* (1661). The century was rich in occasional poetry celebrating weddings and birthdays, or mourning for a deceased paragon of virtue, didactic and pastoral poems were also frequent. Anders Bording (1619–77), an interesting exponent of Danish baroque poetry, was also the founder of the first Danish newspaper, *Danske Mercurius* (from 1666), in which the news appeared in rhymed Alexandrines. The only truly great poet was Thomas Kingo (1634–1703), a supreme master in almost every field of poetry. His hymns reflect a violent, passionate character, worldly and deeply religious at the same time. Among the few playwrights Mogens Skel (1650–94) deserves mention.

ment, Johan Ludvig Heiberg (q.v., 1791-1860) was it his zenith the dictation of literary taste in Copenhagen. As a dramatist he tempted to revivify Danish drama by importing French vaudeville and in his serious romantic plays (e.g. *Lærkevej* and *Syngedag*), there is an interplay between the worlds of poetic and pedestrian reality. His honest achievement is the comedy *En sjæl efter døden* (*I Soul After Death*, 1841). He was a literary critic of high distinction strongly influenced by the philosophy of Hegel. After his death his wife Johanne Louise Heiberg (1812-90), published her fine *Memoirs*. Henrik Hertz (q.v., 1797-1870) also regarded perfection of form as more important than content as clearly expressed in his *Letters of a Ghost* (1850). As a poet he was a clever imitator of style, as a playwright he contributed both light comedies and serious romantic plays (e.g. *Svend Dyrnings Hus*).

A revival of lyrical poetry took place in the 1830s and 1840s, led by Christian Winther (q.v., 1796-1876), Ludvig Adolf Bødtker (1793-1874) and Emil Aarestrup (1800-56). They are mainly concerned with love and nature, treated in a purely aesthetic manner. Winther was a Zealander poet, who sung the praises of his native island and of woman. His long verse novel *Hjortens Flugt* (*The Flight of the Stag*, 1855) is his main work. Bødtker wrote only a handful of poems, several of which are inspired by the Aladdin scene. His poetry is delicate, sensitive and artistically sober. Aarestrup Gallic in his taste was an epicurean a lover and connoisseur of beauty, he is Denmark's erotic poet par excellence. Frederik Paludt Müller (q.v., 1809-76), originally a light and frivolous disciple of Byron, became eventually an uncompromising moralist condemning the world and the flesh. His main work, *Idam Homo* (1841-48), a poetic epic in 12 cantos, is a bitter contemporary satire. The subjects of his poems are often mythological or biblical.

Hans Christen Andersen (q.v., 1805-75) wrote novels (e.g., *The Improvisatore*), poems, plays and a number of travel sketches, but of lasting value are only his *Fairy Tales and Stories*, 164 in all, the first four published in 1835. Some are based on Danish folk tales, some on historical incidents, the plots of others are from foreign sources, but most of them are his own invention, often springing from some personal event. They were told for children, but their ideas are often better understood by the grownups. His own story is told in *Mit Livs Eventyr* (1855).

Søren Aaby Kierkegaard (q.v., 1813-55) holds an entirely isolated position in Danish literature, unattached to any group of writers and with hardly any followers in his lifetime. His religious philosophy is expressed in such works as *Either/Or* (1843) and *Stages on Life's Way* (1845). He spent his last years in a violent and passionate attack on "official Christianity."

M. A. Goldschmidt (1819-87), a Danish Jew, was the editor of a rebellious, anti-racist weekly, *Conservet*, 1840-46. Many of his novels are concerned with Jewish life in the Danish community (e.g., *A Jew*, 1845). The 1850s and 1860s produced hardly any new Danish writers of importance. The poetry of Carl Ploug (1813-94) has little inspiration, and the Grundtvigian songs and light comedies of Jens Christen Hostrup (1818-92) have more popular than literary value. Christian Richardt (1831-92) and H. V. Kaalund (1818-83) did little more than relish the better-known Romantic themes. Edvard Lemcke (1815-97) should be mentioned for his translations of Shakespeare and Byron. The novels of Vilhelm Bergsøe (1835-1911), e.g., *La Piazza del Popolo* (1866), Carl Bruchgård (1816-1900), who wrote under the nom de plume of Carl Eldar, and H. P. Ewald (1821-1908) are mainly entertaining. The most original novelist of the period was Hans Egede Schack (1820-59), whose novel *Phanasterne* (1857) reveals great psychological gifts. Philosophers of some distinction are Frederik Christian Sibbern (1785-1872), Rasmus Nielsen (1809-84) and Hans Brichner (1820-75).

Radical Realism—*Det moderne gemmebrud* is the Danish term used to describe the new movement beginning about 1870 in which a modern (i.e., naturalistic or realistic) literature emerged—a movement of which Georg Brandes (q.v., 1842-1927) was the spiritual leader. Originally influenced by H. A. Laune, C. A. Sainte Beuve and J. Stuart Mill he felt it his mission as a critic to awaken the Danes and bring Denmark out of her backwater and

isolation. His *Main Currents in 19th Century Literature* (1871-87) caused a great sensation, and his demands that literature should concern itself with life and reality, not with dreams and fantasy, and that it should work in the service of progress, not in the service of reaction, provoked much discussion. Among his many critical and scholarly books his various biographies of great men (e.g., Shakespeare, Goethe, Voltaire) should be mentioned, these were to some extent written under the influence of I. W. Nietzsche whose "aristocratic radicalism" he came to share. His influence was not limited to Denmark. Both Henrik Ibsen and August Strindberg were influenced by him. J. P. Jacobsen (q.v., 1847-85) was among the first Danish writers to be influenced by Brandes. Especially his novel *Niels Lyhne* and his short stories deal with the problem of dreams versus reality. In *Marie Grubbe* he introduced the naturalism of Gustave Flaubert. Holger Drachmann (q.v., 1846-1908), the greatest lyrical poet of the period, began his career as a staunch supporter of Brandes, against whom he reacted strongly later on. He holds a high place as a lyric poet, passionate, impulsive and capricious. He is the author of many fine love poems, much of his poetry and prose is concerned with the sea and with the lives of sailors and fishermen. The novels and peasant stories of Sophus Schandorff (1856-1901) show prose realism of less artistic value. Vilhelm Tøpssø (1840-87) depicted contemporary life with subtle irony in his prose works. Edvard Brandes (1847-1931) discussed contemporary problems in his plays.

Henrik Pontoppidan (1857-1943) holds rank as one of Denmark's greatest novelists. His early stories reveal social injustices, and in several of his short novels he discusses the political, moral and religious problems of his day. But his greatest contribution is his three long novel cycles, *Det forfættede Land* (1891-95), *Lykke Føi* (1898-1904) and *De dødes Rige* (1913-16). They are all concerned with contemporary Denmark and are most penetrating and convincing, though little flattering, analyses of Danish national character. Herman Bang (1857-1912) is another novelist who cultivated the small things: insignificant people, the gray and lonely and miserable men and women who are normally overlooked because nothing ever seems to happen in their underdramatic lives. In his best novels, e.g., *Ved Vejen* (1886), *Tine* (1889) and *Det hvide Hus* (1898) he displays the virtuosity of his impressionistic technique. Carl Gjellerup (1857-1919) began as a disciple of Brandes, whom he later opposed. There is a fine poetic beauty in his best novels, e.g., *Minna* and *Møllen*, but the metaphysical idealism of his later novels have made them unreadable.

Other notable prose writers toward the end of the century were Gustav Wied (1858-1914), a novelist and playwright, whose wit is cynical and bitter, his "satyr-plays" and his novels (e.g., *Livsens Ondskab* and *Knægted*) are full of malicious humour, Peter Nansen (1861-1918), whose stories are in the style of Maupassant, Carl Ewald (1856-1908), whose nature stories are based on Darwinian philosophy, Otto Benzon (1856-1927) and Gustav Esmann (1860-1904), playwrights, and Carl Larsen (1860-1931), who caught the atmosphere of Copenhagen and drew a picture of Danish "cockneys" with fine linguistic precision. Sven Lange (1868-1930), Einar Christensen (1861-1939) and Henri Nathansen (1869-1944) are three notable playwrights.

Poetic Revival—In the 1890s a Neo Romantic poetic revival took place. Emotions and fantasy were reinstated. The lyric poets of the '90s called themselves "Symbolists," as their object was "to express the inexpressible in symbolic form." Their poems often describe mental processes and religious and mystic experiences. Johannes Jørgensen (1865-) was their leader, he became a convert to Roman Catholicism, and apart from his poetry many of his prose books are widely read, e.g., his *Parables*, his books of travel, his biographies of saints (e.g., of St. Francis and of St. Catherine of Siena) and his autobiography, *Mit Livs Legende* (1916-28). Viggo Stuckenberg (1863-1905) is a poet who gives tender expressions of sad resignation. Sophus Clausen (1865-1921) is a lush and sensual lover of female beauty, a pantheistic lover of nature and a sophisticated and capricious aesthete, whose poems are often obscure riddles. Helge Rode (1870-1937) was a religious mystic, in addition to poetry he also wrote plays and

critical works attacking modern intellectualism. Ludvig Holstein (1864-1945) is a poet more akin to Goethe and Ohlenschläger than to his own generation of Symbolists. Other notable Neo-Romantic poets of the same period were Sophus Michaelis (1865-1913), Thor Lange (1851-1915) and Niels Møller (1859-1941).

Several women made important contributions to Danish literature toward the end of the century and after. Gyrithe Lenche (1866-1945) is well known for her novel cycle *Edwardsgaard*. Agnes Henningsen (1868-) is a brilliant prose writer, whose novels are often concerned with the erotic experiences of the emancipated woman. Karin Michaelis (1872-1950) is a fine psychologist, among her many novels *The Dangerous Age* (1910) is best known.

From 1900 to 1920—The two greatest Danish novelists of the beginning of the 20th century are Martin Andersen Nexø (1869-) and Johannes V. Jensen (q.v., 1873-1950). Andersen Nexø's fame is based almost entirely on his two great epics of proletarian life, *Pelle the Conqueror* (1906-10) and *Daughter of Man* (1917-21). All his novels and short stories are concerned with the lives of poor people. His *Memoirs* rank among the finest in Danish literature. Jensen, a north Jutlander, expressed his Darwinian philosophy in his long novel cycle *The Long Journey* (1908-22), an ambitious epic of man from the bronze stage to modern times. His *Himmerlandshistorier* contain forceful descriptions of the people and scenery of northern Jutland, and his novel *The Fall of the King* (1901) holds high rank, his eight volumes of *Myths* are a happy mixture of fiction and essay. He is also a great and original lyric poet and a prolific essayist.

Another Jutlander was Jeppe Aakjær (1866-1930), whose novels of social criticism are less important than his poetry, which has a widely popular appeal. Two other notable Jutland poets were Johan Skjoldborg (1861-1936) and Thøger Larsen (1875-1928).

Jakob Knudsen (1858-1917) is the Carlyle of Denmark, one who believes in the inequality of man and in the necessity of authority and obedience, he discusses Christian and moral problems in his novels, e.g., *Den gamle Præst* and *Lærer Urup*. The novels of Marie Biegdahl (1867-1940), Harry Søberg (1880-) and Thomas Olesen Løkken (1877-) all contain faithful descriptions of Jutland.

Harald Kilde (1878-1918) is a solitary, introspective and melancholy novelist, preaching a gospel of renunciation and humility, as, for example, in *Åge og Elve* and *Halten*. Knud Hjørts (1869-1931) is a keen and intelligent observer, whose novels are mainly psychological. Provincial life is described in a baroque and fanciful manner in the novels of Johannes Buchholtz (1887-1940), e.g., *Egholm and his God* and *The Miracles of Clara van Haag*. Other noteworthy novelists are Hans Povlsen (1886-), Otto Rung (1874-1945), Poul Levin (1869-1929), J. Anker Larsen (1874-), Thit Jensen (1876-) and Astrid Ehrencron Kilde (1874-).

Two important lyrical poets of the period were Valdemar Rørdam (1872-1946) and Kai Hoffmann (1874-1949).

After 1920—The most significant poets of the 1920s were Tom Kristensen (1893-), who was also an important novelist (e.g., *Livets Arabesk* and *Harværk*), Otto Gelsted (1888-), Emil Bønnelycke (1893-1953), Hans Hartvig Seedorff Pedersen (1892-), Harald Bergstedt (1877-) and Per Lange (1901-). Jakob Paludan (1896-) is an important novelist, whose main works are *Birds under the Light* and *Jørgen Siem*. The novels of Hans Kirk (1898-), especially *The Fishermen*, represent social realism at its best. Knuth Becker (1893-) is another social novelist whose main work, a long novel cycle begun in 1932, was still incomplete in the mid-1950s. Harald Hergal (1900-) is a disciple of Andersen Nexø, his novels reveal the rottenness and the hypocrisy of present society. Mogens Klugegaard (1906-45) and Leck Fischer (1904-) have both been concerned with the middle classes in their novels and short stories.

The novels of Jørgen Nielsen (1902-45) are set among Jutland peasants, and their themes are suppressed feelings, hatred, sin and fear. Similar problems, but in a different milieu are treated in the novels of Michael Tejn (1911-) and Aage Dons (1903-).

is a novelist who concentrates on feeling and penetrating analyses of the depths and conflicts of the human soul. H. C. Branner (1903-) is an important novelist and playwright whose works (e.g., *The Riding Master*) deal with the loneliness of man, the dangers of fear and of power. He is a superb short story writer full of outstanding psychological penetration. Martin A. Hansen (1909-) recalls Johannes V. Jensen in his early novels but later works showed a tendency toward an anti-intellectual mysticism, related to that of the youngest generation of postwar poets. Knud Sønderby (1909-) is a novelist, a short story writer and a playwright with a brilliant style and a deep psychological understanding. Hans Scherfig (1905-) writes novels usually disguised as detective stories, full of acid satire.

Nis Petersen (1897-1943) holds a high position as a poet and is also a distinguished novelist (e.g., *The Street of the Sundaal makers* and *Spilt Milk*). Karen Blixen (1885-) whose first novel, *Seven Gothic Tales*, was first published in English under the nom de plume of Isak Dinesen in 1934, is a refined aristocratic writer, with a subtle irony and with an unusual elegance and sensitivity. Her books *My African Farm* and *Winter's Tales* should also be mentioned. Two Faroese novelists have also made significant contributions to contemporary Danish literature: Jørgen Frantz Jacobsen (1900-38) and William Heinesen (1900-).

Sven Clausen (1893-) and Svend Borberg (1888-1946) represent the first postwar generation of Danish playwrights influenced by German expressionism, by symbolism, by Luigi Pirandello and by Sigmund Freud. Kaj Munk (1898-1944) is a dramatist of unusual qualities, who revived the "heroic Shakespearean and Schillerian drama." Among his best plays are *En Idalvis* and *Ordet*. He was a religious agitator who used the stage as a pulpit, and all his dramas are concerned with the problems of God and man. Kjeld Abell (1901-) is an iconoclast both as far as form and content are concerned. His first plays mark a complete break with naturalistic drama, and there is always a deep and radical perspective underlying his remarkably witty and sparkling dialogue. His most important plays are *The Melody that Got Lost* and *Anna Sophie Hedvig*. C. E. Soya (1896-) is yet another brilliant playwright as well as a short story writer and a novelist.

Kaj Fris Møller (1888-) is a distinguished poet and critic also a fine translator of French and English poetry. Paul I. Cour (1902-) is a lyrical poet influenced by the modern French intellectual school. Other poets who have already established their names in Danish literature are Hulda I. Iken (1896-1948), Jens August Schade (1903-), Alex Garff (1904-), Tove Ditlevsen (1918-), who is also a fine novelist and short story writer, and Morten Nielsen (1922-44). The most interesting lyrical poets of the mid 20th century were Ole Sarvig, Ove Abildgaard, Ole Wivel, Halfdan Rasmussen, Frank Jøger Thorkild Bjørnvig, Erik Knudsen, Grethe Helberg and Grethe Riisberg-Thomsen. The leading literary scholars and critics of the century were Axel Olrik (1864-1917), Vilhelm Andersen (1864-1953), Valdemar Vedel (1865-1942), Hans Brax (1870-), Vilhelm Grønbech (1873-1948) and Paul V. Rubow (1896-). In the field of philosophy Harald Høffding (1843-1931) and Herbert Iversen (1890-1920) were the most prominent names.

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DANKL, VIKTOR, FREIHERR VON (1854—), Austro-Hungarian general, was born in Udine on Sept. 18 1854. In the World War he commanded at the outset the I Army and defeated the Russians in the battle of Krassnik (Aug. 23–25, 1914). After the Italian declaration of war he became in May 1915 commander of the defence forces in Tirol. As an army commander in the following years he took a successful part in the offensive against Asiago Asiago, but shortly afterwards retired from his post on account of ill health.

DANNAT, WILLIAM T (1853–1929), American artist, was born in New York city in 1853. He was a pupil of the Royal Academy of Munich and of Munich and became an accomplished draughtsman and a distinguished figure and portrait painter. He early attracted attention with sketches and pictures made in Spain and a large composition, "The Quartette," now in the Metropolitan Museum of Art, New York, was one of the successes of the Paris Salon of 1884. Dannat settled in Paris, he is represented in the Luxembourg, was president of the Paris Society of American Painters and a member of the National Institute of Arts and Letters. He died in France on March 12, 1929.

DANNECKER, JOHANN HEINRICH VON (1758–1841), German sculptor, was born at Stuttgart, on Oct. 15, 1758, and died there on Dec. 3, 1841. His father was employed in the stables of the duke of Württemberg. The boy was entered in the military school at the age of 13, but after two years he was allowed to follow his taste for art. The duke made him sculptor to the palace (1780), and employed him on child angels and caryatids for the decoration of the reception rooms. In 1783 he left for Paris with Scheffauer, and placed himself under Pajou, in 1785 he went to Rome, where he worked for five years. Goethe and Herder were then in Rome, and became his friends, as well as Canova, who was the hero of the day, and who had undoubtedly a great and powerful influence on his style. The marble statues of Ceres and Bacchus (in the Schloss at Stuttgart) were done at this time. On his return to Stuttgart, which he never afterwards quitted, except for short trips to Paris, Vienna and Zurich, the double influence of his admiration for Canova and his study of the antique is apparent in his works. The *Anadine* (1806), in the Bethmann museum, Frankfurt, is the most popular of his works. Many of the illustrious persons of the time were modelled by him, among others, Lavater, Metternich, Countess Stephanie of Baden and General Benckendorff. Of the three portrait busts of Schiller the first in date (1797) is life size, and is at Weimar, the second, modelled in colossal size, is in the Stuttgart museum, the third was made for the then Crown Prince Louis of Bavaria. Dannecker was director of the Gallery of Stuttgart, and received many academic and other distinctions.

DANNEWERK or DANEWERK (Dan, *Dannevirke* or *Dannevirke*, "Danes' rampart"), the ancient frontier rampart of the Danes against the Germans, extending 103 mi. from just south of the town of Schleswig to the marshes of the river Treene near the village of Hellingstedt. The rampart was begun by Gudoör (*Godefridus*), king of Vestfold, early in the 9th century. In 934 it was passed by the German king Henry I, after which it was extended by King Harold Bluetooth (940–985), but was again stormed by the emperor Otto II in 974. The chronicler Saxo Grammaticus mentions in his *Gesta Danorum* the "rampart of Jutland" (*Jutland moenia*) as having been once more extended by Valdemar the Great (1157–82), which has been cited among the proofs that Schleswig (*Sønderrjylland*) forms an integral part of Jutland (*Manuel hist. de la question de Slesvig*, 1906). After the union of Schleswig and Holstein under the Danish crown, the *Dannevirke* fell into decay, but in 1848 it was hastily strengthened by the Danes, who were, however, unable to hold it in face of the superiority of the Prussian artillery, and on April 23 it was stormed. From 1850 onwards it was again repaired and strengthened at great cost, and was considered impregnable, but in the war of 1864 the Prussians turned it by crossing the Schlei, and it was thereupon destroyed by the Prussians, in spite of which, however, a long line of imposing ruins still remains. The systematic excavation of these, begun in 1900, has yielded some notable finds,

especially of valuable runic inscriptions (F. de Jessen, *La Question de Slesvig*, pp. 25, 44–50, etc.).

See Lorenzen, *Dannevirke og Omegn* (2nd ed., Copenhagen, 1864), H. Handelman, *Das Dannewerk* (Kiel, 1885), Philippsen and Sunksen, *Führer durch das Dannewerk* (Hamburg, 1903).

DANNREUTHER, EDWARD (1844–1905), German pianist, teacher and writer on music, was born at Strisburg on Nov. 4, 1844, and was brought up in the United States. He studied music (1859–63) at Leipzig under Moscheles, Hauptmann and Richter, and settled in London in 1863. There he rendered great service to the English musical world in a variety of ways—by his own interpretations of the great German classics, by his musical writings in general, and by his propagandist labours on behalf of Richard Wagner in particular. He was professor of the pianoforte at the Royal College of Music from 1895. Dannreuther's principal works are *Musical Ornamentation* (1893–95), the standard English work on the subject, and vol. vi ("The Romantic Period") of the *Oxford History of Music*.

DANSVILLE, a village of Livingston county New York, U.S.A., 49 mi. S. of Rochester, adjoining Stony Brook state park. It has an airport, and is served by the Dansville and Mount Morris and the Lackawanna railways. Pop. (1950) 5,338. Large nurseries for growing fruit and ornamental trees and several manufacturing plants are there. The *Instructor*, a magazine for teachers, with a national circulation, is published there. Dansville Memorial hospital is located there. Clara Barton established the first chapter of American Red Cross in Dansville, Aug. 1881. Dansville was settled about 1800 and incorporated in 1845.

DANTAN, JEAN PIERRE (1800–1869), French sculptor, born in Paris on Dec. 28, 1800. His father was a carver in wood, and Jean in company with his brother Antoine Laurent were trained in his studio. The two brothers then studied under Bosio and in 1828 went to Rome. On his return to Paris Jean Pierre became known for his caricature statuettes. He portrayed many famous men (Talleyrand, Wellington, Rothschild, William IV, Brougham, Liszt, Victor Hugo and many others). He died in Baden-Baden on Sept. 6, 1869.

ANTOINE LAURENT DANTAN (1798–1878), brother of Jean Pierre, made many monuments for churches, public buildings and squares (St. Raphael in the Madeleine, Paris, St. Duquesne in Dieppe, La Place in Caen).

JOSEPH EDUARD DANTAN (1848–1897), French historic painter, son of Jean Pierre, studied under Pils. He exhibited regularly in the Salon des Artistes Français, and he also illustrated Zola and Victor Hugo.

DANTE (or **DURANTE**) **ALIGHIERI** (1265–1321), the greatest of Italian poets, was born at Florence about the middle of May 1265. He was descended from an ancient family, but from one which at any rate for several generations had belonged to the burgher and not to the knightly class. Dante himself does not, with the exception of a few obscure and scattered allusions, carry his ancestry beyond the warrior Cacciaguida, whom he met in the sphere of Mars (*Par. xv 87 seq.*). Of Cacciaguida's family nothing is known. The name, as he told Dante (*Par. xv 130, 135*), was given him at his baptism. He further tells his descendant that he was born in the year 1091, and that he married a lady from the valley of the Po, from whom the name Alighieri or Alighieri passed to his descendants. He also mentions two brothers, Morante and Eliseo, and that he accompanied the emperor Conrad III upon his crusade into the Holy Land, where he died (1147) among the infidels. From Alighiero, son of Cacciaguida, were descended the Alighieri Bellincione, son of Alighiero, was the grandfather of Dante. His father was a second Alighiero of whom little is known. Dante appears to have been the son of Alighiero's first wife, Bella, whose family name is doubtful. By his second wife, Lapa di Chiarissimo Cialuffi, Alighiero had a son Francesco and a daughter Tana (Gaetana), another daughter, who married Leone Roggi and whose name is not known, was perhaps the poet's sister. Thus the family of Dante held a most respectable position among the citizens of his beloved city, but had it been reckoned in the very first rank they could not have remained in Florence.

after the defeat of the Guelphs at Montaperti in 1260. It is clear, however, that Dante's mother at least did so remain, for Dante was born in Florence in 1265. The heads of the Guelph party did not return till 1267.

Apart from his love for Beatrice, we know very little of Dante's boyhood and early life. His early biographers, Boccaccio and Leonardo Bruni, represent him as an assiduous student. From

the age of 18 he, like most cultivated young men of that age, wrote poetry assiduously, in the philosophical amatory style of which his friend, older by some years than himself, Guido Cavalcanti, was a great exponent, and of which Dante regarded Guido Guinicelli of Bologna as the master (*Purg.* xxvi 97, 8). He doubtless owed much to the paternal influence of Brunetto Latini (d. 1294), the philosopher and rhetorician, who figured largely in the councils of the Florentine commune. Of Brunetto Latini Dante himself speaks with the most loving gratitude and affection, though he does not hesitate to brand his vice with infamy. He had some knowledge of drawing, at any rate he tells us that on the anniversary of the death of Beatrice he drew an angel on a tablet, he is said to have been an intimate friend of Giotto, who has immortalized his youthful lineaments in the chapel of the Bargello. Nor was he less sensible to the delights of music. Milton had not a keener ear for the loud uplifted angel trumpets and the immortal harps of golden wires of the cherubim and seraphim, and the English poet was proud to compare his own friendship with Henry Lawes with that between Dante and Casella, "met in the milder shades of purgatory." There is some evidence that Dante was at Bologna not later than 1287, but it is doubtful whether, as Boccaccio states, he studied at the university. It is clear that, from his youth onwards, he began to make himself master of all the sciences of his time, while playing his part in society and in touch with every aspect of Florentine life.

Political Life—We must now consider the political circumstances in which lay the activity of Dante's manhood. From 1115, the year of the death of Matilda, countess of Tuscany, Florence developed as a self governing commune attached to the cause of the Church. According to tradition, the Guelph and Ghibelline factions were introduced into the city in 1215. Buondelmonte de' Buondelmonti, a noble youth of Florence, being engaged to marry a lady of the house of Amidei, allied himself instead to a Donati, and was attacked and killed by the Amidei and Uberti at the foot of the Ponte Vecchio, close by the pilaster which bore the image of Mars (*Par.* xvi 136-147). Although a number of noble families, headed by the Uberti, now ranged themselves with the Ghibellines, the commune remained Guelph, but, in 1248, with the aid of German horsemen sent by Frederick II, the Uberti and the Ghibellines gained the upper hand and expelled the Guelph nobles. In 1250, when the emperor was dying, there was a revolution by the Primo Popolo, the first democratic constitution of the republic, was established, with a captain of the people to counterbalance the podestà, and the Guelphs were recalled. The Uberti and other Ghibellines—in understanding with Manfred who had succeeded his father Frederick as king of Sicily—attempted to rebel in 1258, were expelled from the city and their houses and towers destroyed. The reception of the exiles in Siena brought on the war which resulted in the great battle of Montaperti, Sept. 4, 1260, "which dyed the Arbia red," in which the Florentine Guelphs and their allies were completely defeated by the Senese and the German troops of Manfred. At a congress at Empoli, in which the Ghibelline cities of Tuscany were represented, it was proposed to destroy Florence—a proposal defeated by the bold patriotism of Farnata degli Uberti (*Inf.* x 91-93).



PORTRAIT OF DANTE FROM A WOOD CUT OF 1521

The Ghibellines now held sway in Florence as elsewhere in Tuscany, until Charles of Anjou—to whom the pope had offered the crown of Apulia and Sicily—came to Italy, and on Feb. 26, 1266, defeated and killed Manfred at Benevento. In 1267 the Guelphs were recalled, and the Ghibellines were driven out. Florence was for a while under the suzerainty of Charles of Anjou, but in 1282, after the "Sicilian Vespers," the *Secondo Popolo*—the second democratic constitution of Florence—was established. By this the government was placed in the hands of the Priors of the Arts, who, associated with the Captain of the People, became the chief magistrates of the republic. The Arts or Guilds—seven *maggiori* and 14 *minori*—were organized, to be the backbone of the State. The Priors, elected from the Arts were six in number and held office for two months. Siena had become Guelph, but Pisa and Arezzo remained Ghibelline, and Florence led a Guelph Tuscan league against them in a war which culminated on June 11, 1289, at Campaldino near Poppi, in the Casentino, where the Ghibellines were utterly defeated. They never again recovered any hold in Tuscany, but the violence of faction survived under other forms. Several allusions in the *Commedia* (*Inf.* xxi 1, xxi 95, *Purg.* v 92) indicate that Dante saw military service in this war, and a passage in a letter of his, no longer extant but quoted by Leonardo Bruni, states that he fought in the front rank at Campaldino.

Meeting with Beatrice—As he tells us in the *Vita Nuova*, Dante had first met the girl whom he calls Beatrice, the love for whom was to be the guiding star and inspiration of his life, in 1274, when she was at about the beginning of her ninth year, and he at about the end of his ninth year. If she has been rightly identified with Bice Portinari, she married Simone de' Bardi. Beatrice died on June 8, 1290 (the date June 9 is due to a mystification in the *Vita Nuova*). The last chapter of the *Vita Nuova* relates how, after the lapse of some undefined time, "it was given me to behold a wonderful vision, wherein I saw things which determined me to say nothing further of this blessed one until such time as I could discourse more worthily concerning her. And to this end I labour all I can, as she in truth knoweth. Therefore if it be his pleasure through Whom is the life of all things that my life continue with me a few years, it is my hope that I shall yet write concerning her what hath not before been written of any woman. After the which may it seem good unto Him who is the lord of courtesy that my spirit should go hence to behold the glory of its lady, to wit, of that blessed Beatrice who now gloriously gazes on the countenance of Him *qui est per omnia secula benedictus*." In the *Convivio* he resumes the story of his life. "When I had lost the first delight of my soul (that is, Beatrice) I remained so pierced with sadness that no comforts availed me anything, yet after some time my mind, desirous of health, sought to return to the method by which other disconsolate ones had found consolation, and I set myself to read that little-known book of Boetius in which he consoled himself when a prisoner and an exile. And hearing that Tully had written another work, in which, treating of friendship, he had given words of consolation to Laelius, I set myself to read that also." At some unspecified date, perhaps about 1292, he married Gemma, daughter of Manetto Donati, a connection of the celebrated Corso Donati, afterwards the leader of the party opposed to Dante's own. By this wife he had two sons, Jacopo and Pietro, and either one or two daughters (Antonia being perhaps the same as the daughter who became a nun, Suora Beatrice at Ravenna). Although he never mentions his wife in the *Divina Commedia*, and although she did not accompany him into exile, there is no clear evidence for the belief that the union was otherwise than happy. Certain it is that he spares the memory of Corso in his great poem and speaks with affection of his kinsmen Piccarda and Forese, the latter of whom was one of his own intimate friends.

In 1293 Giano della Bella, a man of old family who had thrown in his lot with the people, induced the commonwealth to adopt the so-called "Ordinances of Justice," a severely democratic constitution, by which among other things it was that no man of noble family even though engaged in tr.

hold office as prior, or be a member of the popular councils of the State, and a new magistrate, the *Gonfaloniere di Giustizia*, was added to the Signoria. Two years later Gino was banished, but the ordinances remained in force, though their severity was modified.

Banishment.—Dante now began to take an active part in politics. He was inscribed in the *arte* of the *Meches* and *Speasali*, which made him eligible for the priorate. Documents still existing in the archives of Florence show that he took part in the deliberations of the several councils of the city from the latter part of 1295 onwards, and there is record of an important speech of his in the Council of the Hundred on June 5, 1296. In May 1300 he served on a special embassy, to the commune of San Gimignano. From June 1, to Aug. 14, 1300, he sat in the Signoria as one of the six priors, which, he says, was the cause and origin of all his misfortunes. The spirit of faction had again broken out in Florence. The two rival families were the *Guichi* and the *Donati*—the first of great wealth but recent origin, the last of ancient ancestry but poor. A quarrel had arisen in Pisa between the two branches of the Cancellieri—the *Binchi* and *Neri* the Whites and the Blacks. The quarrel spread to Florence, the Donati took the side of the Blacks, the Cerchi of the Whites. Pope Boniface was asked to mediate and sent Cardinal Matteo d'Acquasparta to maintain peace. He arrived just as Dante entered upon his office as prior. The cardinal effected nothing, but Dante and his colleagues banished the heads of the rival parties in different directions to a distance from the capital. The Blacks including Corso Donati, were sent to Città della Pieve in the Tuscan mountains; the Whites, among whom was Dante's dearest friend Guido Cavalcanti, to Sarzana in the unhealthy Maremma. After the expiration of Dante's office the banished Whites were allowed to return, Guido Cavalcanti so ill with fever that he shortly afterwards died. In the following year, 1301, in consequence of a treasonable meeting in the church of S. Trinità a number of the Blacks were banished and a fresh sentence passed against Corso Donati. The Whites now controlled the politics of Florence, and expelled the Blacks from Pisa.

In this same year, 1301, we have several records of Dante's political activity. One of these is noteworthy. The pope had demanded the service of 100 Florentine horsemen and on June 19, in the council of the Hundred, Dante urged "*Quod de servitio faciendo domino Papae nihil fiat*," thus showing himself a firm opponent to papal interferences in Florentine politics. Pope Boniface had already sent for Charles of Valois, brother of the French king Philip the Fair, to act as "peacemaker." The priors sent at the beginning of October, three ambassadors to the pope, one of whom, according to the chronicler Dino Compagni, was Dante. Charles entered Florence on All Saints' day, 1301, and was followed by Corso Donati and his allies. The Blacks, restored to power, appointed Cante de' Gabrielli of Gubbio as podestà, a man devoted to their interest. More than 600 Whites were condemned to exile and cast as beggars upon the world. On Jan. 27, 1302, Dante with four others of the White party, was charged before the podestà with *baratteria*, or corrupt practices in and out of office and with offences against the Guelph party, and, not appearing, was condemned to pay a fine of 5,000 lire of small florins. If the money was not paid within three days their property was to be destroyed, if they did not pay the fine they were to be exiled for two years from Tuscany, and never again to hold office in the republic. Dante's innocence of "barattery" is unquestionable, his real offence was his opposition to the power of Boniface and his Florentine supporters. On Mar. 10, 1302, Dante and the Blacks were condemned to be burned alive in Italy should come into the power of the republic.

Dante's Wanderings in Exile.—It is probable that Dante was not returned from his embassy to the pope. Leonardo Bruni says that he received the news of his banishment at San. He probably joined his fellow exiles who met at Gargnano, a castle between Siena and Arezzo, and made Arezzo their headquarters in preparation to make their way back to Florence by means. On Jan. 9, 1302, a meeting was held at San Giovanni in place in the

Florentine territory, Dante's presence at which is proved by documentary evidence and an alliance was there made with the powerful Ghibelline clan of the Ubaldini. In Sept. 1303 the fleet of his had entered Anagni, and Christ had a second time been made prisoner in the person of his vicar (*Purg.* xv. 80-90). Boniface did not survive the insult long but died in the following month. He was succeeded by Benedict XI and in March 1304 the cardinal Niccolò di Prato came to Florence sent by the new pope to make peace. The people received him with enthusiasm, ambassadors came to him from the Whites, and he did his best to reconcile the two parties. But the Blacks resisted all his efforts. He shook the dust from off his feet, and departed, leaving the city under an interdict. In July with aid from the Ghibellines of Tuscany and other regions, the exiles made an unsuccessful attempt to enter Florence from Livorno, the failure of which further disorganized the party.

Dante had, however, already separated from the "ill conditioned and foolish company" (*Par.* xvii. 61-69) of his fellow exiles who rejected his counsels of wisdom, and had learnt that he must henceforth form a party by himself. He appears to have been for a while at Forlì in Romagna, of which city *Scrittura degli Ordellaifi* was lord, and probably towards the end of 1303, he went to Bartolomeo della Scala, lord of Verona, where the courtesy of the great Lombard gave him his first refuge and his first hospitable reception. Can Grande, to whom he afterwards dedicated the *Paradiso*, was then a boy. Bartolomeo died in 1304, and it is possible that Dante may have remained in Verona till his death. It is very difficult to determine with exactness the order and the place of Dante's wanderings. He was probably at Bologna in 1304 and 1305. A rather questionable document attests his presence at Padua in Aug. 1306, the time when Giotto was working upon the frescoes of the Madonna dell'Arena. In Oct. 1306 he was unquestionably the guest of the Marchesques of the house of Malaspina in Lunigiana, where he acted as their ambassador in making peace with the bishop of Luni. From this time till the arrival of the emperor Henry VII in Italy, Oct. 1310, all is uncertain. His old enemy Corso Donati had at last allied himself with Uguccone della Fagguola, the leader of the Ghibellines, and in 1308 was declared a traitor, attacked in his house, put to flight and killed.

It is not impossible that Dante about this time visited Paris, but that he ever crossed the Channel or went to Oxford may safely be disbelieved. The election in 1308 of Henry of Luxemburg as emperor stirred again his hopes of a deliverer. At the end of 1310, in a letter to the princes and people of Italy, he proclaimed the coming of the saviour, at Milan he did personal homage to his sovereign. The Florentines, in alliance with King Robert of Naples, made every preparation to resist the emperor. Dante wrote from the Casentino a letter dated March 31, 1311, in which he rebuked them for their stubbornness and obstinacy, and another on April 17, to the emperor himself, upbraiding his delay and urging him on against Florence. A new sentence against the poet was pronounced on Sept. 2. Henry passed from Genoa to Pisa, and on June 29, 1312, was crowned by the pope's legates in the church of St. John Lateran at Rome, the Vatican being in the hands of his adversary King Robert of Naples. Then at length he moved towards Tuscany and reached Florence on Sept. 19. He did not dare to attack it, but returned in November to Pisa. In the summer of the following year he prepared to invade the kingdom of Naples, but in the neighbourhood of Siena he caught a fever and died at the monastery of Buonconvento, on Aug. 24, 1313. He lies in the Campo Santo of Pisa, and the hopes of Dante and his party were buried in his grave.

After the death of the emperor Henry (Bruni tells us) Dante joined the king at his life as an exile, sojourning in various places throughout Lombardy, Tuscany and the Romagna, under the protection of various lords, until at length he retired to Ravenna where he erected his life. After the death of the French pope Clement V he addressed a letter, in the spring or summer of 1314, to the cardinal in conclave, urging them to restore the papacy to Rome. About this time he probably came to Lucca, after having conquered by Uguccone della Fagguola. In May

1315 a general recall of exiles offered Dante an opportunity of returning to Florence. The conditions given to the exiles were that they should pay a fine and be subjected to the ceremony of "oblation" as penitents in the Baptistery. Dante refused to tolerate this shame, and the letter is still extant in which he declines to enter Florence except with honour secure that the means of life will not fail him, and that in any corner of the world he will be able to gaze at the sun and the stars, and meditate on the sweetest truths of philosophy. In Aug. 1315, Ugucione won the great battle of Montecatini over the united arms of Florence and Naples, but lost Pisa and Luca at the beginning of the following year. A fresh sentence of death had been pronounced by Florence upon Dante in Nov. 1315, and he seems now to have taken refuge with his most illustrious protector Can Grande della Scala of Verona, then a young man of 25, rich, liberal and the favoured head of the Ghibelline party, whose name has been immortalized by an eloquent panegyric in the 17th canto of the *Paradiso*.

The last few years of the poet's life were spent at Ravenna under the protection of Guido da Polenta. In his service Dante undertook an embassy to the Venetians, on his return from which he caught a fever and died in Ravenna on Sept. 14, 1321. His bones still repose there. His doom of exile has been reversed by the union of Italy which has made the city of his birth and the various cities of his wanderings component members of a common country. His son Piero, who wrote a commentary on the *Divina Commedia*, settled as a lawyer in Verona, and died in 1364. His daughter Beatrice lived as a nun in Ravenna, dying at some time between 1350 (when Boccaccio was commissioned to bring her a present of ten gold crowns from a Florentine guild) and 1371. His direct line became extinct in 1509.

The *Divina Commedia*.—Of Dante's works, that by which he is known to all the educated world, and in virtue of which he holds his place as one of the half dozen greatest writers of all time, is of course the *Commedia*. (The epithet *divina*, it may be noted, was not given to the poem by its author, nor does it appear on a title page until the 16th century.) The poem is absolutely unique in literature, it may safely be said that at no other epoch of the world's history could such a work have been produced. Dante was steeped in all the learning, which in its way was considerable, of his time, he had read the *Summa Theologica* of Aquinas, the *Treasure* of his master Brunetto, and other encyclopaedic works available in that age; he was familiar with most of what was then known of the Latin classical and post-classical authors. Further, he was a deep and original political thinker, who had himself borne a prominent part in practical politics. The age was essentially one of great men, of free thought and free speech, of brilliant and daring action, whether for good or evil. It is easy to understand how Dante's bitterest scorn is reserved for those "sorry souls who lived without infamy and without renown, displeasing to God and to His enemies."

The time was thus propitious for the production of a great imaginative work, and the man was ready who should produce it. It called for a prophet, and the prophet said, "Here am I." "Dante," says an acute writer, "is not, as Homer is, the tribler of poetry springing in the freshness and simplicity of childhood out of the arms of mother earth, he is rather like Noah the father of a second poetical world, to whom he pours forth his prophetic song fraught with the wisdom and the experience of the old world." Thus the *Commedia*, though often classed for want of a better description among epic poems, is totally different in method and construction from all other poems of that kind. Its "hero" is the narrator himself, the incidents do not modify the course of the story, the place of episodes is taken by theological or metaphysical disquisitions, the world through which the poet takes his readers is peopled, not with characters of heroic story but with men and women known personally or by repute to him and those for whom he wrote. Its aim is not to delight, but to reprove, to rebuke, to exhort, to form men's characters by teaching them what courses of life will meet with reward, what with penalty; hereafter, "to put into verse," as the poet says, "things difficult to think." For such new matter a new vehicle

was needed. We have Bembo's authority for believing that the *terza rima* surpassed if at all, only by the ancient hexameter, as a measure equally adaptable to sustained narrative, to debate, to fierce invective to clear-cut picture and to trenchant epigram, was first employed by Dante.

The action of the *Commedia* opens in the early morning of the Friday before Easter in the year 1300. The poet finds himself lost in a forest, escaping from which to ascend the mountain of felicity, he has his way barred by a wolf, a lion and a leopard. This seems to indicate that at this period of his life about the age of 35, Dante went through some experience akin to what is now called "conversion." The strong vein of mysticism, found in so many of the deepest thinkers of that age, and conspicuous in Dante's mind, no doubt played its part. His efforts to free himself from the "forest" of worldly cares were impeded by the temptations of the world—cupidity (including ambition), the pride of life and the lusts of the flesh, symbolized by the three beasts. But a helper is at hand. Virgil appears and explains that he has a commission from three ladies on high to guide him. The ladies are the Blessed Virgin (representing the Divine Mercy), St. Lucy (symbol of illuminating grace) and Beatrice. In Virgil we are apparently intended to see the symbol of what Dante calls philosophy, what we should rather call natural religion, Beatrice standing for theology, or rather revealed religion. Under Virgil's escort Dante is led through the two lower realms of the next world: Hell and Purgatory meeting on the way with many persons illustrious or notorious in recent or remoter times as well as many well enough known then, but who, without the immortality, often unenviable, that the poet has conferred on them, would long ago have been forgotten. Popes, kings, emperors, poets and warriors, Florentine citizens of all degrees are there found, some doomed to hopeless punishment, others expiring their offences in milder torments, and looking forward to deliverance in due time. It is remarkable to notice how rarely, if ever, Dante allows political sympathy or antagonism to influence him in his distribution of judgment. Hell is conceived as a vast conical hollow, reaching to the centre of the earth. It has three great divisions, corresponding to Aristotle's three classes of vices, incontinence, brutishness (which Dante identifies with violence) and malice. The first is outside the walls of the city of Dis, the second is within. The sinners by malice, which includes all forms of fraud or treachery lie at the bottom of a gigantic pit, called Malebolge with vertical sides, and accessible only by supernatural means: a monster named Geryon bearing the poets down on his back. The tortures here are of a more terrible, often of a loathsome character. Ignominy is added to pain, and the nature of Dante's demeanour towards the sinners changes from pity to hatred.

At the very bottom of the pit is Lucifer, immovably fixed in ice, climbing down his limbs they reach the centre of the earth whence a cranny conducts them back to the surface at the foot of the purgatorial mountain which they reach as Easter Day is dawning. Before the actual Purgatory is attained they have to climb for the latter half of the day and rest at night. The occupants of this outer region are those who have delayed repentance till death was upon them. They include many of the most famous men of the last 30 years. In the morning the gate is opened, and Purgatory proper is entered. This is divided into seven terraces, corresponding to the seven deadly sins which encircle the mountain and have to be reached by a series of steep climbs, compared by Dante in one instance to the path from Florence to Samminato. The purifying penalties are not degrading but rather tests of patience or endurance and borne voluntarily by the souls, in several cases Dante has to bear a share in them as he passes. On the summit is the Earthly Paradise. Here Beatrice appears in a mystical pageant. Virgil departs, leaving Dante in her charge. By her he is led through the various spheres of which, according to both the astronomy and the theology of the time, Heaven is composed to the supreme Heaven, or Empyrean, the seat of the Godhead. For one moment there is granted him the intuitive vision of the Deity, and the comprehension of all mysteries, which is the ultimate goal of

mystical theology, his will is wholly blended with that of God, and the poem ends. The date of composition of the *Commedia* is still uncertain, but the *Paradiso* was unquestionably written in the last years of Dante's life.

Other Works.—The *Vita Nuova* (*Young Life* or *New Life*), for both significations seem to be intended) contains the history of Dante's love for Beatrice. He describes how he met Beatrice as a child, himself a child, how he feigned a false love to hide his true love, how he fell ill and saw in a dream the death and transfiguration of his beloved, how she died, and how the tender compassion of another lady nearly won his heart from its first affection, how Beatrice appeared in his imagination and reclaimed his heart, and how at last he saw a vision which induced him to devote himself to study that he might be more fit to glorify her who gazes on the face of God for ever. It is in the form of lyrics—canzoni, one ballata, and sonnets—set in a prose narrative with scholastic divisions and explanations, and was probably completed about 1293, though the reference to the vision may be later.

The *Convivio* or *Banquet* (less accurately *Convito*) is the work of Dante's manhood, as the *Vita Nuova* is the work of his youth. It consists, in the form in which it has come down to us, of an introduction and three treatises, each forming an elaborate commentary on a long canzone. It was intended, if completed, to have comprised commentaries on 11 more canzoni, making 14 in all, and in this shape would have formed a *tesoro* or handbook of universal knowledge, such as Brunetto Latini and others have left to us. It is perhaps the least well known of Dante's Italian works, but contains many passages of great beauty and elevation, the magnificent apotheosis of Rome and her empire in the fourth treatise being the first expression of his ideal imperialism. Indeed a knowledge of it is quite indispensable to the full understanding of the *Divina Commedia* and the *Monarchia*. It was probably written between 1304 and 1308.

Besides the poems contained in the *Vita Nuova* and *Convivio*, Dante composed a considerable number of canzoni, ballate and sonnets which are collected under the general title of *Rime* or *Canzoniere*, and which secure him a place among lyrical poets scarcely if at all inferior to that of Petrarch. Some scholars—very questionably—would attribute to Dante a rendering of the *Roman de la Rose* in 324 sonnets entitled *Il Fiore* (*The Flower*).

The treatise *De vulgari eloquentia* in Latin, is mentioned in the *Convivio*. It was probably written between 1304 and 1306. Its object was first to establish the Italian language as a literary tongue, and to distinguish the noble or "courtly" speech which might become the property of the whole nation, at once a bond of internal unity and a line of demarcation against external nations, from the local dialects peculiar to different districts, and secondly, to lay down rules for poetical composition in the language so established. The work was intended to be in four books, but only two are extant. The first of these deals with the language, the second with the style and with the composition of the canzone. It contains much acute criticism of poetry and poetic diction, and its treatment of the Italian dialects is of singular interest.

The Latin treatise *Monarchia*, in three books, contains the mature statement of Dante's political ideas. In it he propounds the theory that the universal temporal monarchy or empire is necessary for the well being of the world, that the Roman people acquired this dignity by right, and that the authority of the emperor depends immediately upon God though he must reverence the pope as the first born of the Father. Pope and emperor are the guides divinely appointed to lead the human race to eternal life and temporal felicity. Dante's ideal of the empire is a power above national conflicts to preserve universal peace and liberty, in order that the goal of civilization the realization of all man's potentialities may be achieved. The work was probably composed at the time of the descent of Henry VII into Italy, between 1310 and 1313. The book was first printed by Oporinus at Basle in 1559, and placed on the Index of forbidden books.

In the last years of his life Dante wrote two eclogues in Latin, in answer to Giovanni del Virgilio, who invited him to compose a

Latin poem on some contemporary event and come from Ravenna to Bologna to receive the laurel crown. The most interesting passage is that in the first poem (1319) where he expressed his grief that when he has finished the third part of the *Commedia* his grey hairs may be crowned with laurel on the banks of the Arno.

The *Questio de aqua et terra* purports to be a discourse which Dante delivered at Verona in June 1320 as a solution of the question which was being at that time much discussed—whether in any place on the earth's surface water is higher than the earth. It was first published at Venice in 1508, by an ecclesiastic named Moncetti. Since Dr Moore, from internal evidence, made out a very strong case for it, its authenticity has been generally accepted.

There are 13 Latin *Letters* ascribed to Dante. Those to the princes and peoples of Italy announcing the coming of Henry of Luxemburg, to the Florentines, to the emperor himself, to the Italian cardinals, and to a Florentine friend refusing the base conditions of return from exile, have been already mentioned. These are certainly authentic, as probably is also a long letter to Can Grande della Scala, containing directions for interpreting the *Divina Commedia*, with especial reference to the *Paradiso*. Of less importance are the letters to cardinal Niccolò da Prato, to the nephews of Count Alessandro da Romena, to the marquis Morcello Malaspina, to Cino da Pistoia, and three written in the name of the Countess of Battifolle.

Dante's reputation has passed through many vicissitudes, and much trouble has been spent by critics in comparing him with other poets of established fame. Read and commented upon with more admiration than intelligence in the Italian universities in the generation immediately succeeding his death, his name became obscured as the sun of the Renaissance rose higher towards its meridian. His fame is now fully vindicated as one of the world's universal poets and the national poet of Italy.

(A J Bu, E G G)

BIBLIOGRAPHY.—We have now two authoritative editions of the text of the complete *Opere di Dante* the *testo critico* of the Società Dante Alighiana, edited by M. Barbi and others on the occasion of the sixth centenary (Florence, 1921), reproducing the forms and orthography of the poet's own time, the *Oxford Dante* of Edward Moore, revised and re-edited by Paget Toynbee (1913). Dr Toynbee's *Concise Dictionary of Proper Names and Notable Matters in the Works of Dante* (1914) is invaluable. Concordances—based upon editions previous to the *testo critico*, but still highly useful—to the *Commedia* by E. A. Fay (Boston, 1888), to the minor Italian works by E. S. Sheldon and A. C. White (1908) and to the Latin works by E. K. Rand and E. H. Wilkins (1912), are due to American scholars.

Editions of the Divina Commedia and Commentaries. The first three editions of the *Commedia* were printed in 1472 at Foligno, Mantua and Jesi. They were reprinted, together with the Neapolitan edition of 1471, by Lord Vernon and A. Panzani in *Le Prime Quattro Edizioni della D. C. letteralmente rismontate* (1858). The first Venetian edition is of 1477, the first Milanese (Nidobeatina) of 1478, the first Florentine of 1481. In 1502 Aldus produced the first "pocket" edition in his new "italic" type. The *Commedia* began to be the subject of commentaries as soon as the author was in his grave, beginning, before 1330, with those of Dante's son, Jacopo Alighieri, and Grazzino de' Bambaghini of Bologna on the *Inferno*, and of another Bolognese, Jacopo della Lana, on the whole poem. Somewhat later, but still before 1350, come the *Ultimo Commento* attributed to the Florentine notary Andrea Lancia, and those of Dante's other son, Pietro, and the Carcatelli delivered at Florence in 1373, stops short at *Inferno*. It is accessible, together with the two versions of his famous life of Dante, edited by D. Guerri, in the *Scrittori d'Italia* series (Bari, 1918). The great Latin commentary of Boccaccio's disciple, Benvenuto da Imola (1375-80), who lectured at Bologna, was published by William Warren Vernon with the aid of James Lancia in 1887. Another noteworthy early commentator is Francesco da Buti who lectured at Pisa towards the close of the same century. Extracts from the early commentaries are given by G. Biagi in *La D. C. nella figurazione artistica e nel secolare commento* (Turin, 1921, etc.). The foundations for the establishment of an accurate text were laid by Carl Witte in his edition of 1862. The fullest 19th century commentary, that of G. A. Scartazzini, is now somewhat out of date. Among the best of more recent editions, with notes or commentaries, are those of F. Torraca, of T. Casati, revised and amplified by S. A. Barbi, and of Isidoro del Lungo. An excellent pocket edition of the text alone with a critical introduction, is that of Mario Casella (Bologna, 1923). For English readers, the three small volumes in the Temple Classics, with text, translation and commentaries by H. Oelsner, T. Olney and P. H. Wicksteed, are very useful, as also the *Readings in the Inferno, Purgatorio and Paradiso* of William Warren Vernon.

Editions of the Minor Works The *Vita Nuova* was first printed at Florence in 1576, the *Convivio* at Florence in 1490. The *De Vulgari Eloquutio* was first published in Trusino's Italian translation at Vicenza in 1528, and in the original Latin, from a ms now preserved at Grenoble, at Paris in 1577, the *Monarchia* at Basel in 1599. There are critical editions of the *Vita Nuova* by M. Barbi (Florence, 1907), of the *De Vulgari Eloquutio* by Po. Rajna (1896), of the *Ecologie*, by P. H. Wicksteed (*Dante and Giovanni del Virgilio*, 1902) and G. Albini (Florence, 1903), of the *Letters* with translation and commentary by Fagel Toynebee (1920). The *Cansuere* or *Rime*, were first adequately edited, the genuine pieces separated from the doubtful and spurious, by Michele Barbi in the *testo critico* of the Società Danteica Italiana (1927).

English Translations The entire *Divina Commedia* appeared first in English in the version of Henry Bore (1802), and was followed by the admirable blank verse rendering of H. F. Cary (1814, 2nd ed., 1819), which has remained the standard translation. Of the numerous later translations may be mentioned those of Longfellow, of J. A. Carlyle (*Inferno* only), C. E. Norton and H. F. Torz in prose, G. Musgrave of the *Inferno* in Spenserian stanzas, C. L. Shadwell, of the *Purgatorio* and *Paradiso* in the metre of Marvell's "Ode to Cromwell", Hasel-foot and M. B. Anderson in *terza rima*. D. G. Rossetti's translation of the *Vita Nuova* will always hold its place as a thing of beauty. Translations of the *Vita Nuova* by T. Olney, of the *Rime*, *Convivio*, *Monarchia*, *Letters*, *Ecologie*, *Quattro de Aqua et Terra*, by P. H. Wicksteed and of the *De Vulgari Eloquutio* by A. G. I. Howell are published in the Temple Classics, with full explanatory notes. See, in general, P. Toynebee, *Dante in English Literature from Chaucer to Cary* (1909), and *Brigitte's Tribute to Dante in Literature and Art 1380-1920* (1921).

Acts and Studies It is only possible here to mention a few works useful to English readers. As general introduction, P. Toynebee, *Dante Alighieri, his Life and Works* (4th ed., 1910), E. G. Gardner, *Dante* (1923), N. Zingarelli, *Vita di Dante in compendio* (Milan, 1902), and his larger *Dante* (1903). Among critical studies, or elucidations of particular aspects of Dante's work, E. Moore, *Studies in Dante* (four series, 1896-1917), P. Toynebee, *Dante Studies and Researches* (1902), *Dante Studies* (1921), P. H. Wicksteed, *Dante and Aquinas* (1913), *From Vita Nuova to Paradiso* (1921), then volumes of Dante studies by J. D'Oro, now reprinting in the collected edition of his works. F. Torraca, *Studi danteschi* (1912) and *Nuovi Studi danteschi* (1921), E. G. Parodi, *Poesia e storia nella Divina Commedia* (1921), B. Croce, *La Poetica di Dante* (1921, Eng. trans. by D. Anselmi), C. Ricci, *L'ultimo rifugio di Dante* (new ed., 1921), F. Ercole, *Il pensiero politico di Dante* (Milan, 1920). Copious bibliographical indications on disputed points are given in the latest edition of the *D. C.* with the commentary of Casini and S. A. Barbi (Florence, 1926). The *Giornale dantesco* and the *Studi Danteschi* directed by M. Barbi are important periodical publications dealing with every aspect of the subject.

Portraits of Dante It is now generally agreed that the repainted figure of Dante in a fresco of the podestà's palace in the Palazzo Vecchio in Florence is authentic and by Giotto, probably painted (c. 1334) from a sketch taken in the poet's early life. The Torngam mask, now in the same chapel, long supposed to have been made from a death-mask, is probably a work of the 15th or 16th century. It is possible that the later representations of Dante may have been influenced by the portrait by Taddeo Gaddi in Santa Croce (destroyed in 1566). Noticeable among these are the miniature in codex 1040 of the Biblioteca Riccardiana (c. 1436), the fresco transferred to canvas of Andrea del Castagno in Sta. Apollonia (c. 1450) the symbolical picture by Domenico di Michelino (1465) in the duomo at Florence the bronze bust at Naples (late 15th century), the recently discovered panel attributed to "Amico di Sandro". In the 16th century, we have the figure of Dante in Luca Signorelli's fresco at Orvieto, and in Raphael's "Parnassus" and "Disputa" in the Vatican. A famous signed sketch of Dante by Raphael is in the Albertina at Vienna. See R. T. Holbrook, *Portraits of Dante from Giotto to Raphael* (1912). Attempts have frequently been made to discover the portrait of Dante in various 14th century frescoes, and there have been recent "discoveries" of this kind at Assisi and elsewhere, the only one that is in the least plausible is that in Orcagna's "Paradise" in Santa Maria Novella at Florence.

(E. G. G.)

DANTON, GEORGES JACQUES (1759-1794), French revolutionary leader, was born at Arcis sur Aube on Oct. 26, 1759. He belonged to a respectable family of Champagne, his father, who died in 1762, was an attorney at the local tribunal, his maternal grandfather the roads and bridges contractor of the province. His mother neglected his upbringing, and the boy was allowed to run wild beside the Seine, finding vent for his animal spirits in rustic games, in wood and field, in wrestling with the beasts on the farm and in defying his schoolmistress, who tried to tame him with the whip. At the age of 14, after a short term at the small seminary at Troyes, this wild young ruffian, with pock-marked face, was entered at the *Oratoriens* to finish his studies. He won the prize for mythology, *accessus* for rhetoric and Latin verse, and for French essay. His imagination was fired

by republican Rome, and this appeal to the essential part of his nature, was strengthened from day to day by his assiduous study of the ancient historians and moralists.

Deciding to study law he went to Paris in 1780, where, thanks to his confidence in himself, he was admitted to the chambers of Maître Jean Nicolas Vinot. The manifold sources of interest provided by the courts could not, however, entirely absorb him, and his passion for physical exercise found outlet in swimming, fencing and tennis. Once, in an interval between two cases, we find this high spirited clerk plunging into the Seine and hurling angry imprecations against the towers of the Bastille as the symbol of oppression. Back at his lodgings he greedily read the *Encyclopédie*, the writings of Montesquieu and Voltaire, of Rousseau and Buffon, and Beccaria's *Traité des délits et des peines*, which, as early as 1764, heralded a revolution in European criminal law. As a probationer advocate in the *parlement*, Danton was engaged in pleading, in a case in which a shepherd was in dispute with his overlord, he asserted his love of equality, and obtained the approval of Linguet.

His marriage with Angelique Charpentier forced him to settle down—or to appear to do so. In 1787, therefore, he became advocate in the *conseils du roi*. This required him to take an oath "to observe and keep strictly the laws and ordinances of the kingdom" and also to deliver a speech in Latin on his admittance.

He paid a high price for this post, but it gave him a thorough insight into public law and administration, civil and ecclesiastical affairs, commerce and finance, the whole machinery of monarchy, the intricacies of customary law, and the law of corporations and property. He was elected to the Masonic lodge of the *Neuf Seigneurs*, to which Franklin and Voltaire had belonged, and there met Bailly, Desmoulins, Condorcet, Chamfort and Sieyès. He continued his studies, and it should be noted that he read and spoke fluently Italian and English, he had read, in the original, Pope, Shakespeare and Adam Smith's *Wealth of Nations*.

We may picture him at this time—a broad face with strong features, sharply curved mouth and brilliant eyes, blazing with inward fire and passion.

At the outbreak of the Revolution (1789) Danton belonged to Cordeliers district, his house was exactly where his statue stands to day. He was as impetuous as he always had been from childhood in Champagne. As captain of the civic guard he attempted, on the night of July 15, to force the gates of the Bastille that he had before defied. He was already taking sides against both the supporters of the old regime and the moderates. He opposed Lafayette, elected to the States General by the nobility of Auvergne, who, after July 14, became chief of the National Guard, but who, on Oct. 5 and 6, defended the royal family. He went further than Bailly, the learned mayor of Paris. Danton's position is clear from the time of the events of October, when the king and the assembly, the only two lawful authorities, became prisoners of the people, when Louis XVI had to leave Versailles and return to the Tuileries, escorted by a hunger-maddened mob. It was Danton who had the tocsin rung, and Danton who was charged by the general assembly of the Cordeliers to thank the king for having graciously taken up his residence in *sa bonne ville*. Although on Aug. 13, 1793, he was to affirm before the Convention that "the republic had existed in all men's minds 20 years before its proclamation," he, at this time, professed himself a good Royalist. His record at the *Palais Royal*, and even more at the Cordeliers, shows him quick in conciliating and incapable of refusing popular favour. At each re-election to the presidency of the district, the assembly "accompanies" its unanimous vote with an outburst of enthusiasm. Persuasion and force of character made him, the popular tribune, dominant. "Danton, the president of the Cordeliers," writes Taine, "could secure in his district the arrest of any one he pleased. His violence in speech and counsel made him, in the absence of wider opportunities the ruler of his quarter."

After the fall of the Bastille, the commune of Paris displaced the former council and took up its quarters at the hotel de ville. This municipal organization was to play an important part in the Revolution. By the decree of May 21, 1790, it was divided into

The river can be divided into three sections, the upper course, above Bratislava, the middle course, between Bratislava and the Iron Gates and the lower course, below the Iron Gates.

The direction of the Alpine foreland. Rising in the crystalline rocks of the Black Forest it flows eastward across a narrow belt of Jurassic rocks to Sigmaringen and from thence to Regensburg along the northern edge of the Swiss plateau (*see* ALPS), its bed being in the soft Molasse (Upper Oligocene and Miocene rocks) and its direction following the so called Danube Fault, which passes from Schaffhausen to Regensburg. Below the latter town the river is deflected south eastward by the Bohemian massif and flows in part upon the crystalline rocks of the latter and in part upon the Molasse, but at Krems it turns eastward across the Molasse and after passing Vienna it flows through the gap which separates the eastern Alps from the Carpathians. The valley of the Danube above Sigmaringen is narrow, the scenery being wild and beautiful, especially above Tuttingen, where castles crown every possible summit on the neighbouring hills. Below Immenndorf much water escapes by subterranean fissures into the river Ach, a tributary of the Rhine. After it is joined on the right bank by the Iller, which tributary rises in the Allgauer Alps, the Danube attains a width of 78 yd and an average depth of 3 ft 6 in and becomes navigable downstream for specially constructed craft of 100 tons. At Donaueschingen (height 1,330 ft) it receives the Lech, which tributary rises near the Iller and flows in a direction parallel to it, whilst at Regensburg (height 949 ft) the Danube receives on the left bank the river Naab which rises in the Fichtel Gebirge. Below Regensburg, at Deggendorf, it is joined by the Isar, on the banks of which stands Munich. The upper course of the Danube lies in German territory, rising in Baden and flowing through Württemberg and Bavaria. At Passau (height 800 ft) it enters Austria and approximately 100 m. of the north western boundary of that country is formed by the Danube, its right bank tributary the Inn, and the Salzach which flows into the Inn on its right bank. The rivers Isar, Inn and Salzach drain a large portion of the eastern Alps and have many important towns on their banks. The Inn joins the Danube at Passau.

GREIN WHIRLPOOL

From Passau to Linz the Danube is hemmed in by mountains, but its valley becomes wider below the latter town where the river subdivides into several arms which unite again at the once famous whirlpool near Grein. Below Grein, the river flows through another narrow defile as far as Krems but once more subdivides as it passes toward Vienna. The district between Linz and Vienna is renowned for its beauty and for the numerous places of historical and archaeological interest along the river's banks. At Vienna the river is 316 yd wide, and 499 ft above sea level and below the town is the district of Marchfeld which is a low lying country across which the Danube frequently subdivides forming numerous islands. An important left bank tributary, the March, which drains Moravia, joins the main stream here. Before reaching Bratislava (Poszony, Pressburg), the Danube passes through the narrow gap between the lower spurs of the Alps and the Carpathians and enters upon the middle section of the river. At this gap the river also passes out of Austria and for a few miles is entirely in Czechoslovakia but it very soon becomes the boundary between that country and Hungary, until it reaches Esztergom (Gran), below which town it enters Hungary.

The Danube flows for the first 100 m. of its middle course upon alluvial and Quaternary deposits of the Little Hungarian Plain. This latter is separated from the Great Hungarian Plain by the Bakony Wald ridge, the innermost arc of the Carpathian mountain system, and the Danube breaks through this ridge at Esztergom. After leaving Bratislava, the river divides into three channels forming several islands but these join together again at Komárom where the river is also joined on its left bank by the river Waag which rises in the Carpathians. Higher up the stream at Gyor (Rab) the outer branch of the divided Danube is joined by the river Ráb which rises in the Styrian Alps. Between Esztergom and Waiden (Vác) the valley becomes narrow until

at the latter town the river turns southward to flow in that direction for 230 m. across the great Hungarian plain. In this long stretch, the Danube meanders about in a wide alluvium filled valley, frequently dividing into two or more streams and passing Budapest, Bija (where it leaves Hungary and enters Yugoslavia) and Mohács. At Almás, 14 m. east of Osijek, the Danube is joined by the important right bank tributary, the Drava (height 81 ft), which rises in Tirol and drains a large portion of the Eastern Alps. The Danube is again diverted eastward at Borovo by the Fruška Gora, and it flows along the northern edge of this range, passing Novi Sad (Újvidék), until it reaches Belgrade. Between these two towns, the Danube receives the important left bank affluent, the Tisa (Theiss), which, rising in the Carpathians, drains the greater part of the western slopes of those mountains, as well as the great Hungarian plain. At Belgrade, the Danube is joined by the important right bank affluent, the Save, which, rising in the Julian Alps, flows eastward and drains the greater part of western Yugoslavia, whilst the eastern part of that country is drained by the Morava, which joins the Danube between Belgrade and Bazias, also on its right bank.

The whole character of the Danube valley changes suddenly at Bazias, and between that town and Turnu Severin, the river has worn out for itself a channel through the mountain ridge which joins the Carpathian arc with the Balkan mountains. A large part of the great Hungarian plain, which covers an area of about 30,000 sq m., is remarkably flat and low-lying, and the altitude rarely exceeds 300 ft. In consequence, natural drainage by the Tisa and the Danube is very poor, and where artificial drainage has not been carried out, the banks of the rivers are in many places lined by wide swamps and marshes, which in winter form large ice-fields. Until comparatively recent geological times, this plain formed an extensive inland sea, whose final effluent followed the present course of the Danube through the Kazan defile and the Iron Gates. By the lowering of its channel through the gap (the level of the Danube at Orsova is now 42 ft above sea level), this epicontinental sea was drained, leaving the great Hungarian plain covered with a thick deposit of alluvial sands and gravels. Hemmed in by precipitous rocks, the river passes through the stupendous Kazan defile (162 yd wide), then widens out to nearly a mile at Orsova, but becomes narrower again at the Iron Gates. The river has been cleared of numerous obstructions to make possible navigation along this stretch.

THE LOWER COURSE

The lower course of the Danube stretches from the Iron Gates to the Black Sea. From Bazias to the junction with the small right bank tributary, the Timok, the Danube forms the boundary between Yugoslavia and Rumania. From the Timok to a point 27 m. east of Ruschuk, it forms the boundary between Rumania and Bulgaria, after which it flows entirely through Rumanian territory. Along its lower course, the Danube flows over Quaternary deposits covered by river sands and gravels. Its north bank is low, flat and marshy with numerous small lakes, but its south bank is crowned by low heights which make excellent town sites, e.g., Vidin, Lom Palanka, Vratsov, Ruschuk and Silistra. At Ruschuk, the railway from Bucharest to Varna, crosses the Danube. The river receives many tributaries along this stretch, those on its left bank, of which the Oltul and Dambovitia, on which stands Bucharest, are the most important, draining the Transylvanian Alps, and those on its right bank, draining the northern ridges of the Balkan mountains. At Cernavoda, where the river is crossed by the railway from Bucharest to Constanta, the Black Sea port, the Danube is diverted northward by the hills of Dobruja, which form an isolated remnant of the Hercynian foreland of Europe. Along this stretch as far as Braila, the river subdivides into several channels and spreads out over the surrounding country forming numerous lakes. The river changes its direction again at Gabis, the chief port on the delta of the Danube, and flows eastward toward its mouth. Sea going vessels having a register up to 4,000 tons can run in the river as far as Braila, but those up to 600 tons can sail as far as Turnu Severin. Two left bank affluents, the Siret and the Prut, which drain the eastern side of the Carpathian

mountains, enter the river near Galatz. For 30 m in an easterly direction from Galatz, the Danube flows as a single channel until it breaks up into the several branches of its delta. Along the northern shore of the river from Galatz to the sea there is a large number of shallow lakes, which indicates the poor drainage of the region. The most important mouths of the river are, reading from north to south, the Kilia, Sulina and St. George, and in 1905 the ratio of the discharge of these three branches was Sulina 9%, St. George 24%, and Kilia 67%. The mean annual outflow of all the mouths is estimated at 315,300 cu ft per sec, and the amount of silt brought down at 108 million tons per year. As the currents of the Black sea along this coast flow from north to south, the silt brought down by the Kilia branch tends to block up the mouths of the other channels.

The delta of the Danube, which is about 1,000 sq m in area, is a mere wilderness of swamps and marshes covered by tall reeds and through which the silt laden distributaries of the river slowly meander. The monotony of this waste of country is relieved here and there by isolated elevations covered by oak, beech and willows, many of them marking ancient coast lines. The most important towns in the delta region are Ismail, Chilia and Vilkof on the Kilia branch, Sulina at the mouth of the Sulina branch and Tulcea and St. George on the St. George's branch. The Kilia branch itself breaks up into a wide delta which is continually advancing seaward, and it is estimated that its various mouths pour into the sea 3,000 cu ft of sediment per minute. The Sulina branch breaks off from the Tulcea (St. George's) branch, 7 m below the town of Tulcea, and the St. George's branch again subdivides before entering the sea.

Before engineering works were commenced to make the channels navigable, ships drawing only 8 ft of water experienced great difficulty in entering, for the depth of water in few portions of the channels rarely exceeded this figure and the frequent occurrence of numerous sand banks and bars further added to the difficulty of shipping. To-day, ships drawing 22 ft of water can reach Braila.

Traffic—The Danube may be divided for traffic purposes into the maritime Danube from the sea to above Braila, and the fluvial Danube from this point up to Regensburg, where the river at present ceases to be navigable for large craft. Braila and Galatz, situated respectively 171 and 150 kilometres from Sulina (at the mouth of the river), are the usual points for transhipment between seagoing vessels and barges. Besides transshipping goods on to barges, seagoing vessels also tranship on to railways at Braila and Galatz. Traffic has never equalled that on the Rhine, where the countries are much more highly developed industrially.

The European Commission—The administration of the Danube was formerly controlled by the single European commission of the Danube, an institution set up with a provisional character by the Treaty of Paris in 1856. Its headquarters were at Galatz, and it administered the Danubian delta only, eight interested nations being represented on it. The conservancy of the other Danubian reach of international importance—the Iron Gates—was entrusted to Austria-Hungary, and assigned by her to Hungary.

In the Treaty of Bucharest (May 1918) the Central Powers reduced the membership of the European commission to "states situated on the Danube or the European coasts of the Black sea." The Treaty of Versailles (June 1919) reinstated the commission in "the powers it possessed before the war." It went on that "as a provisional measure, only representatives of Great Britain, France, Italy and Rumania shall constitute this commission." The commission acquired definite character when the Danube statute was signed in Paris on July 23, 1921. In future, subject to the unanimous consent of the states represented on the commission, any European state which is able to prove its possession of sufficient maritime commercial and European interests at the mouths of the Danube may be represented on it. Up to 1926, however, the representation had not been increased.

The International Commission—The Treaty of Versailles, Art. 347, provided that "from the point where the competence

of the European commission ceases," i.e., from above Braila, "the Danube system referred to in Art. 331," i.e., as far as the highest navigable point at Ulm, "shall be placed under the administration of an international commission composed as follows—

Two representatives of German riparian States

One representative of each other riparian State

One representative of each non-riparian State represented in the future as the European commission of the Danube."

This commission was to carry on the administration provisionally until the conclusion of a definite statute concerning the Danube.

On July 23, 1921, this statute was signed. Many of its provisions simply followed the lines of the "convention on the regime of navigable waterways of international concern" concluded at Barcelona on April 20, 1921. Article 1 declared navigation on the Danube system to be unrestricted and open to all flags, on a footing of complete equality, from Ulm to the Black sea, and the internationalised portions of the Danube tributaries were defined. The provisional composition of the international commission was confirmed. It had to see that the declaration in Art. 1 was not infringed by any riparian State or States, to draw up a programme of public works for the improvement of the waterway on the basis of proposals submitted by the riparians, controlling and if necessary modifying the annual programmes of the riparian states for current works of maintenance. The cost of such works was borne by the riparian State concerned, assisted, if the commission so decided, by other States interested.

The cost of works of improvement (not maintenance) might be covered by navigation dues, to be imposed (with the commission's authorisation) by the riparian State which had executed the works, or by the commission itself, if it had executed them at its own charges. Dues were to be assessed on the ship's tonnage and not based on the goods transported, revenue from them was to be applied exclusively to the works for which they were imposed, there was to be no differential treatment of flags. Customs duties levied by a riparian on goods loaded or discharged at the Danubian ports in its territory, were also to be levied without distinction of flag or hindrance to navigation, and were not to be higher than duties levied at other frontiers of the same state. The transport of goods and passengers, even between ports of the same riparian State, was to be unrestricted and open to all flags on a footing of perfect equality, with the exception of regular local services which may only be carried out by foreign craft subject to the observance of the national law of the local sovereign, and in agreement with the authorities of the riparian state concerned (Art. 22). Passage of goods and passengers in transit was to be free. Uniform police regulations were to be drawn up and applied by each riparian on its own territory. A special joint service of Rumania and Yugoslavia, organised with the approval of the commission, will have to take over the maintenance and improvement of the Iron Gates section, with headquarters at Orsova. The commission was to decide on special works to be undertaken (and dues to be levied for the purpose) and to have power to abolish the service when its work was done, it could inaugurate like services elsewhere if necessary.

The commission was to determine its own procedure and administer its own budget, the presidency being held for six months by each delegation in turn. Its seat was to be at Bratislava the first five years, and thereafter it might be established at other towns on the Danube, selected at its discretion, for five-year periods in rotation. Its property and members were to enjoy diplomatic privileges and it was to fly its own flag. It was to deal in the first instance with questions regarding the interpretation and application of the convention, but the special jurisdiction set up by the League of Nations would ultimately have to deal with complaints from a state that the commission was acting *ultra vires*, or from the commission against a state for neglecting to carry out its decisions. Every effort was made to insure uniformity between the workings of the International and the European commissions, and between different signatory states.

The convention came into force on June 30, 1922. One of the

most important questions that has been raised since that date was connected with the interpretation of article 25 (above) since certain states in Western Europe were anxious to reserve to their own flag the passenger and goods traffic between ports in their own territory. In the discussion on article 2, the Rumanian delegate stated that the carriage of goods on river craft between two ports in the same country did not constitute a violation if the goods were subsequently transhipped to a seagoing vessel to export, and that article 25 imposed no restriction on the traffic carried on up to that time by Greece.

The principle of freedom of navigation of the Danube for all nations was recognized following World War II, but in practice it was controlled and monopolized by the U.S.S.R. and its Balkan satellites.

The old Iudovis canal connecting the Danube and the river Main was enlarged to form the Rhine-Main Danube canal, thus making navigation between the Atlantic Ocean and the Black Sea through the European continent possible.

Many legends are woven around the course of the Danube. A distinct link between Austria and Germany is still called the Nibelungen ring in memory of one of the most famous legends.

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DANVERS, a town of Essex county, Mass., 25 mi. N.E. of Boston inland with a river port. It is served by the Boston and Maine railroad. The population was 15,720 in 1950. It is a residential suburb with manufacturing industries including electrical products, and is the seat of a state hospital for the insane.

A part of what is now Danvers was included in the grant made by the court of assistants to Gov. John Endecott and Rev. Samuel Skellern of the Salem church in 1632. Danvers was set off from Salem as a district in 1752 and was incorporated as a township in 1757, but the act of incorporation was disallowed in 1759 by the privy council on the recommendation of the board of trade, in view of George III's disapproval of the incorporation of new townships at that time. This explained the significance of the words on the seal of Danvers, "The King Unwilling." In 1775 the district was again incorporated as Salem village, which was within the limits of modern Danvers, was the centre of the famous witchcraft delusion in 1692.

In 1835 South Danvers was set off as a separate township, and in 1868 was named Peabody (qv) in honour of George Peabody, who was born and buried there. In 1857 part of Beverly was annexed to Danvers. Among natives of Danvers were Samuel Holton (1738-1816), a member (1778-1780 and 1782-1787) of the Continental Congress and (1793-1795) of the Federal Congress, Irtzel Putnam, Moses Porter (1755-1822), who served through the War of Independence and the War of 1812, and Grenville Mellon Dodge (1831-1916), a railway engineer, who fought in the union army in the Civil War, reaching the rank of major general of volunteers, and was a Republican member of the national house of representatives, 1867-1869, and in 1898 president of the commission which investigated the management of the war with Spain.

See J. W. Hanson, *History of the Town of Danvers* (r848), and A. P. White, "History of Danvers" in *History of Essex County* (1888).

DANVILLE, a city of eastern Illinois, U.S., 124 mi. S. of Chicago, on the bluffs of the Vermilion river, the county seat of Vermilion county. It is served by the Chicago and Eastern Illinois, the Illinois Traction (electric), the New York Central and the Wabash railways. Pop. (1950) 37,864, (1910) 36,979.

Danville is the commercial centre of a rich farming and coal

mining region and has substantial manufacturing industries, including railroad locomotive and repair shops, lumber mills, foundries, large brick plants and a zinc smelter.

The bank clearings in 1949 were \$68,373,989.78. The assessed valuation of property in 1949 was \$72,692,663. There are large dairy and stock farms round about. At the western boundary of the city is Lake Vermilion, a reservoir 8 mi. long with a capacity of 2,500,000,000 gal. completed in 1925. A branch of the National Home for Disabled Volunteer Soldiers was established there in 1895. The National Soldiers home for veterans of U.S. wars has been converted into a neuropsychiatric unit of the Veterans administration. About 1,800 patients are cared for. Danville was the site of an Indian village. Pinkeshaw, the centre of many trails. In 1824 Dan Beckwith, for whom the city was named, built his trading cabin there, and in 1826 the settlement became the county seat. It was incorporated as a city in 1869. A commission form of government was adopted in 1927.

See C. C. Burford, *The History and Romance of Danville Junction* (1914).

DANVILLE, a city in the bluegrass region of Kentucky, U.S., 75 mi. S.E. of Louisville, the county seat of Boyle county. It is a division centre of the Southern railway. The population was 8,686 in 1950 and 6,734 in 1940 by the federal census. The city of Danville is an important market for tobacco, horses, cattle, hogs and sheep, is the trading centre for a large area, and has a clothing factory, shoe factory, gas-fired water heater factory, chair manufacturing plants and railroad shops. It is the seat of the Kentucky Deaf institute (founded 1823), the first state institution of the kind in the U.S., and Centre college (Presbyterian, chartered 1819). There are many fine old mansions in and near the city, and beautiful landscapes and river scenery in every direction. Herrington lake, created by the hydroelectric development on the Dix river, has 75 mi. of shore line. The battlefield of Perryville is 11 mi. west. At Pleasant Hill, 13 mi. N., are the massive stone buildings of an abandoned Shaker community. Danville was on the Wilderness road, and was one of the first settlements (1781) in Kentucky. It was the home of Ephraim McDowell (1771-1830), who in 1809 performed the first entirely successful operation for ovarian tumour, and was the birthplace of Justice John M. Harlan. From 1786 to 1790 an influential "political club" held long winter evening debates in the Gilt tavern, and there met the nine conventions which discussed the terms of separation from Virginia and framed the first state constitution.

DANVILLE, a borough of Montour county, Pa., U.S., on the high northern bank of the Susquehanna river, at the base of Montour ridge, 110 mi. N.W. of Philadelphia, the county seat and an active manufacturing centre. It is on federal highway 11, and is served by the Lackawanna, the Pennsylvania and the Reading railways. The population was 6,994 in 1950 and 7,122 in 1940 by the federal census.

It is in the centre of a rich agricultural region and has varied industries, including medicinal drugs, cement machinery and coal pulverizing and stone crushing equipment. An outstanding mental hospital, the Danville State hospital (established 1868), is located there, as well as the George F. Geisinger Memorial Hospital and Clinic, a noted general hospital, and the first Catholic Slovak Girls' academy in the U.S. Settlement was made there about 1776, and in 1792 a town was laid out, called Dan's Town after Gen. Daniel Montgomery, the founder. Ore was discovered on Montour ridge and the town as an iron centre grew rapidly. It was incorporated in 1849. The first "T" rail in the United States was rolled there in 1845.

DANVILLE, a city in Pittsylvania county of Virginia, U.S., is located on the Dan river in southern Virginia, the heart of the famous Piedmont section. It is on federal highways 29, 53 and 360 and is served by the Southern, the Atlantic, and Danville and the Danville and Western railways, by Eastern Airlines and bus and truck lines. Pop. (1950) 35,066, (1940) 32,479.

Danville is the home of a large single-unit textile mill, an important auction market for flue-cured bright leaf tobacco, and a trade centre for the large agricultural area around it. Other

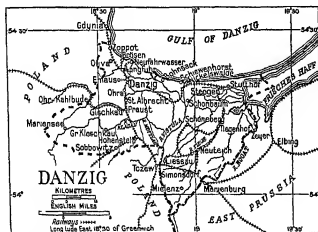
industries include the manufacture of knit goods, elevators, paints, rayon fabrics, fertilizers, millwork, meat and food products, bakery goods and many other diversified products. Danville Technical Institute, Virginia Polytechnic Institute extension, Averett college and Stratford college are located there.

In 1865 Danville was made the capital of the Confederacy when Pres. Jefferson Davis established his headquarters there for a few days. Established as a town by the Virginia legislature in 1793, Danville was incorporated in 1830 and became an incorporated city in 1890.

In 1950, under a state optional enabling act adopted by vote of the people, Danville established the council-manager form of government. Utilities owned and operated by the city included an auditorium, water works, electric generation and distribution and gas manufacturing and distribution.

See J. R. Meade, *I Live in Virginia* (1935)

DANZIG, in Polish GDAŃSK, a Baltic port and town close to the mouth of the river Vistula, belonging to Poland. From 1919 until Sept. 1, 1939, the town was the centre of the autonomous territory or Free City of Danzig (*Freie Stadt Danzig*) established by the treaty of Versailles. To the north Danzig is bordered by the gulf of Danzig and protected against heavy seas by the peninsula of Hel. It is connected with the sea by two tidal arms of the Vistula, dredged to a depth of 15 ft to allow larger ships to approach the inner wharves, for a distance of 4 mi. the harbour canal is navigable for ships with a draught of 30 ft. Until 1945 Danzig had largely preserved its picturesque mediaeval scenery,



MAP SHOWING BOUNDARIES OF THE FREE CITY OF DANZIG AS ESTABLISHED BY THE TREATY OF VERSAILLES, 1919. THE STATE WHICH WAS A BOUNDARY LINE OF 147 MI. WAS UNDER THE PROTECTION OF THE LEAGUE OF NATIONS UNTIL 1939.

its narrow streets with gabled houses and carved stone balconies and its old churches, gates and towers, the most famous of which is the late mediaeval Marienkirche high above the town. In March 1945, however, Danzig suffered from Russian artillery.

History—Danzig is first mentioned as Gdanyń, in the *Vita Sancti Adalberti* (10th century). Later it was included under the bull of Pope Eugenius III (1148), in which it is called Kdanec, in the Polish diocese of Włocławek. Just before this, however, the Polish king's governor of eastern Pomorze had taken the title of *dux Pomoranus* and founded a dynasty with its seat at Danzig. These dukes built a castle and a church there, and under them the Cistercian abbey of Oliva was founded, which began the settlement of peasants and the drying of the lowlands in the Vistula estuary. With the eastward extension of the shipping and trade of Lubek, a market of German merchants developed and this, c. 1225, led to the foundation of the city of Danzig which in 1263 received Lubek law (see HANSEATIC LEAGUE). By the late 13th century Danzig was an important link in the chain of Hanseatic towns which carried on the trade between eastern and western Europe. Its trade connections stretched from Novgorod to Flanders and England and its position at the mouth of the Vistula made it the natural outlet for the export trade of its vast hinter-

land then entering into relations with the west through the quick progress of colonization. The last Polish duke of Pomorze, Mestwin II, died without issue in 1294 and bequeathed his duchy to his cousin Przemysł II, duke of Great Poland. But in 1308 the Teutonic Knights already established in Old Prussia east of the Vistula invaded Pomorze and on Nov. 14 seized Danzig and put its Polish inhabitants to the sword. Danzig, however, continued to flourish. In the 14th century its population rose to about 10,000, and its trade developed apace. As the leading town of the Teutonic state of Prussia it played an important part in the councils of the Hunsenau league. Its inhabitants were Germans or germanized Slavs, with some immigrants from England, Scandinavia, Poland, Bohemia, Hungary and Flanders, the Flemings having their separate *halles Vlammengens*. Many immigrants were granted full citizen rights and the English community had its own governor and privileges. Danzig became the main entrepot in the east for imported cloth and corn and timber exports of the eastern Baltic.

The kings of Poland, however, never renounced their rights to Pomorze. Władysław II Jagiello, calling himself *Pomoranus dominus et haerens*, defeated the Teutonic Knights at Grunwald in 1410 but failed to secure Pomorze and Danzig. In 1454 the nobility and towns of Pomorze applied to Poland for help against the Teutonic Knights and offered their submission to the Polish crown. The new war between Poland and the Teutonic Order which broke out in consequence of this revolt lasted 17 years, largely kept up by the great wealth and sea power of Danzig, which succeeded in withstanding sieges and in defeating enemy fleets. In 1466, by the treaty of Toruń (Thorn), the Teutonic Order restored Pomorze and Danzig to Poland. As a reward for its loyal services Casimir IV Jagiello granted the city far-reaching autonomy. As it became the main port of Poland, then a great power, Danzig rapidly attained a position of great prosperity. In the late 16th century half of the entire traffic through the sound had Danzig as its destination, but by then the large majority of the ships belonged to Amsterdam and other western towns, and often fewer than 100 Danzig ships passed through the sound.

Danzig was strongly affected by the Reformation. In 1525 the lower orders overthrew the aristocratic town council and established a popular government which abolished Catholic worship and dissolved the monasteries. The deposed authorities appealed to the king of Poland, who by force restored Catholicism and aristocratic government. Yet the Reformation advanced quietly and was firmly established by 1540, though the aristocratic council remained in power.

In the early 17th century Danzig probably had 40,000 to 50,000 inhabitants, and its corn exports amounted to considerably more than 200,000 tons yearly as compared with about 120,000 in the late 16th century and about 25,000 tons in the late 15th century. The Polish squire sold their produce there and bought western luxury goods and the paintings, engravings and other products of the native artisans. Danzig's links with Poland, however, were cut by the first partition of 1772. It became surrounded by Prussian territory, and Prussian customs formed a barrier to all traffic on the Vistula. At the second partition (1793) Danzig became a Prussian town and the capital of the province of West Prussia. In 1807 Danzig was taken by Napoleon's general Pierre François Joseph Leclercq, who next year was given the title of duke of Danzig. Napoleon made Danzig a free city, with a Franco-Polish garrison, but after his defeat the city was restored to Prussia. The wars and sieges of the period and the continental blockade had gravely impaired the city's wealth, and the English corn laws caused a further decline of its trade. Although its recovery was furthered by Prussian efforts, the town cut off from its natural hinterland became an administrative and provincial centre and a garrison town and ceased to be the great emporium of the Baltic trade, the relative importance of which also declined sharply. Some industrialization, especially shipbuilding, provided a measure of compensation for lost greatness.

The treaty of Versailles restored eastern Pomorze to Poland, the "Polish Corridor" separating East Prussia from Germany proper. The Allied powers recognized Poland's right of access to

the sea but hesitated to give it Danzig, an almost purely German city. Accordingly Danzig was separated from Germany early in 1920, occupied by British troops (which stayed until November) and made a free city under the protection of the League of Nations, with a territory of about 710 sq mi. and about 360,000 inhabitants. A high commissioner, appointed by the League, was to reside at Danzig and to deal in the first instance with all differences between Poland and Danzig. The free city was included within the Polish customs frontiers, Poland was granted the free use of all waterways, docks, etc., the control and administration of the Vistula and of all railways in Danzig, with the right to develop and improve them, and authority to conduct the foreign relations of Danzig (articles 100-104 of the peace treaty). The customs were administered by Danzig itself. It also appointed its own officials and had its own currency and postal services, but the port was administered by a mixed harbour and waterways board. In the elections to the constituent assembly, the Polish parties gained 7 out of 120 seats. The democratic constitution adopted was approved and guaranteed by the League. It corresponded to that of the Weimar republic, with a *Volksrat* elected by universal franchise, responsible to it was a city government or senate formed by the majority parties and headed by a *Senatspräsident*.

This complicated regime never worked satisfactorily because the free city's German government adhered to the general line of German policy toward Poland seeking through permanent conflict to bring about a revision of the territorial settlement of Versailles. Unable, therefore, to rely on any good will from Danzig, the Poles decided to build a port of their own at Gdynia, 10 mi. to the north. Although Gdynia's trade developed quickly, Danzig continued to prosper economically every year from 1927 to 1931 the tonnage of ships arriving and the quantity of goods handled amounted to four times the totals of 1913. But by 1932 Gdynia's turnover was equal to Danzig's.

The prosperity of Danzig did not make the conflict of nationalities less bitter, nationalism having gained the upper hand over economic interests. This conflict was acerbated by the rise of the Nazi party. In May 1933, the nazis gained 39 seats in a *Volksrat* of 72 and accordingly formed the new city government. This attempted to nullify Danzig by unconstitutional means, against which the opposition parties appealed in vain to the League council. As a result of the council's inactivity the opposition parties were dissolved, their leaders imprisoned and freedom of the press abolished. By 1938 Danzig was completely *gleichgeschaltet* with a Nazi *Gauverwalter* as supreme authority, subordinate only to Hitler. Late in 1938 Hitler demanded the return of Danzig to Germany, but Poland refused. In 1939 Germany smuggled weapons and troops into Danzig, and at the outbreak of World War II Danzig was quickly occupied by German troops and reincorporated with Germany, again becoming the capital of the province of West Prussia. The League's last high commissioner, Professor Karl Burckhardt, was forced to leave. At the end of the war Danzig was given to Poland. German inhabitants who had not fled before the advancing soviet army were expelled and partially replaced by Poles. The population was 117,894 in 1946, but had risen to 193,500 by the end of 1950 (*cf.*, however, the prewar figure of 291,000).

Trade.—Danzig's port facilities suffered less from destruction in World War II than Gdynia's. In 1947 Danzig handled more than 16% of Poland's total exports (mainly minerals and coal) compared with Gdynia's 14%, and more than 28% of Poland's total imports compared with Gdynia's just less than 28%. The two ports were thus nearly equal, but as a fishing port Gdynia had nine times the turnover of Danzig. In 1947 both ports together handled 4,368 ships and 4,497,000 tons of shipping, that is, 90% of Poland's total for that year but less than one third of the pre-war figures. In 1950, however, they together handled more than 10,000,000 tons, compared with 14,500,000 in 1938. They were treated as one administrative unit, with a combined port area of 1,460 ac.

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DAPHNAE (Τάφηναι, mod. *Defenech*), an ancient fortress near the Syrian frontier of Egypt on the Pelusian arm of the Nile. Here King Psammethichus established a garrison of foreign mercenaries, mostly Carians and Ionian Greeks. After the destruction of Jerusalem by Nebuchadnezzar in 583 B.C., the Jewish fugitives, of whom Jeremiah was one, came to Taphnath. When Naucratis was given by Amasis II the monopoly of Greek traffic the Greeks were all removed from Daphnae, and the place never recovered its prosperity; in Herodotus' time the deserted remains of the docks and buildings were visible. The site was discovered by Sir Flinders Petrie in 1886, the name "Castle of the Jew's Daughter" seems to preserve the tradition of the Jewish refugees.

DAPHNE (Gr. laurel tree), in Greek mythology, was the daughter of the Arcadian river god Ladon, or the Thessalian Peneus, or of the Laconian Amyclas. She was beloved by Apollo, and when pursued by him was changed by her mother Ge into a laurel tree (Ovid, *Metam.*, 1, 452-567). In the Peloponnesian legends, another suitor of Daphne, Leucippus, son of Oenomaus of Pisa, disguised himself as a girl and joined her companions. His sex was discovered while bathing, and he was slain by the nymphs (Pausanias, viii, 20; Parthenius, *Erotica*, 15).

DAPHNE, a genus of much cultivated, showy, and sometimes evergreen, Eurasian shrubs, belonging to the family Thymelaeaceae, and containing about 40 species. *D. Laureola*, spurge laurel, a small, widely cultivated shrub with green flowers in the leaf axils towards the ends of the branches and ovoid black, very poisonous berries, is found in England. *D. Mezereum*, mezeorum, a rather larger shrub, 2 to 4 ft. high, has deciduous leaves, and bears fragrant pink flowers in clusters in the axils of last season's leaves, in early spring before the foliage. The bright red ovoid berries are cathartic, the whole plant is acrid and poisonous. It is a native of Europe and north Asia, and found apparently wild in copses and woods in Britain. It is a well known garden plant, and several other species of the genus are cultivated in the open air and as greenhouse plants. *D. Cneorum* (garland flower) is a hardy evergreen trailing shrub, with pink sweet-scented flowers. *D. odora* (China and Japan) is a hardy evergreen with showy, rosy purple, fragrant flowers. *D. indica* (China) and *D. japonica* (Japan) are greenhouse evergreens with respectively red or white and pinkish purple flowers.

DAPHNEPHORIA, a festival held every ninth year at Thebes in Boeotia in honour of Apollo Ismenius or Galaxius. It consisted of a procession in which the chief figure was a boy, of good family and noble appearance, whose father and mother must be alive. Immediately in front of the boy, who was called *Daphnephoros* ("laurel bearer"), walked one of his nearest relatives, carrying an olive branch hung with laurel and flowers and having on the upper end a bronze ball from which hung several smaller balls. Another smaller ball was placed on the middle of the branch or pole, which was then twined round with ribbons.

These balls were said to indicate the sun, stars and moon, while the ribbons referred to the days of the year, being 365 in number. Then followed a chorus of maidens carrying suppliant branches and singing a hymn to the god. The *Daphnephoros* dedicated a bronze tripod in the temple of Apollo. The festival is described by Proclus (in Photius, *Cod.*, 239).

See also A. Mommsen, *Feste der Stadt Athen* (1898), L. R. Farnell, *Cults of the Greek States*, iv, 284-86.

DAPHNIS, the legendary hero of the shepherds of Sicily, and reputed inventor of bucolic poetry. According to his countryman Diodorus (iv, 84), and Aelian (*Var. Hist.*, x, 18), Daphnis was the son of Hermes and a Sicilian nymph, and was found by shepherds in a grove of laurels (whence his name). He won the affection of a nymph, who made him promise to love none but her, threatening that if he proved unfaithful he would lose his eyesight. He failed to keep his promise and was smitten with blindness. Daphnis, who endeavoured to console himself by playing the flute and singing shepherds' songs, soon afterwards died, or was taken up to heaven by his father Hermes, who caused a spring of water to gush out from the spot where his

on had been carried off. Ever afterwards, the Sicilians offered sacrifices at this spring. In Theocritus, *Id. I*, Daphnis' apparently has offended Eros and Aphrodite, and in return has been smitten with unrequited love, he dies, although Aphrodite, moved by compassion, endeavours, but too late, to save him.

See H. W. Stoll in Roscher's *Lexikon*, and G. Knaack in Paulys-Wissowa's *Realencyclopädie*.

DARAB (originally DARABGIRD), a town and district of the province of Fars in Iran. Its salt mines have for centuries been important, its bitumen deposits once were. In the middle ages its textiles were famous. Today it produces a great quantity of dates and the best tobacco in Iran. Darab town, 140 mi. S.E. of Shiraz formerly one of the most important in Fars, has a population of about 5,000. Persian legend recounts that it was founded by Darab, father of Darius III Codomanus (336-330 B.C.). It is surrounded by citrus groves and large date plantations. Nearby are the Qala-i Darab, or "Citadel of Darab," 31 mi. S., a series of circular earthworks around an isolated rock, the history of which is unknown, and the great Sassanian rock reliefs of Naqsh-e Rostam, showing the investiture of Artaxerxes I (224-221), Shapur I (242-272) and his followers, and the triumph of Shapur in 260 over the Roman emperor Valerian.

D'ARANYI, JELLY (1895-), Hungarian violinist, grand niece of Dr. Joachim and one of the most brilliant players of her day, was born at Budapest on May 3, 1895. She studied under Hubay and quickly attracted notice by her exceptional powers, eventually winning world-wide recognition. She resides in London. Her sister, Madame Adila Fachini, also a violinist, is likewise a player of the first rank.

DARAS, a fortified Roman city on the Mesopotamian frontier about 12 miles N.W. of Nisibis, founded A.D. 504 by Anastasius to replace Nisibis, ceded to the Persians A.D. 563. It was built near the head of, and almost completely blocking, a narrow valley running north-north-east and south-south-west. It flanked the road to Mardin.

Belisarius, aged 24, appointed General of the East by Justinian in 529, was stationed here in June, 530, when Perozes arrived at Nisibis with a Persian army of 40,000 horse and foot, to invade the Roman empire. Reinforcements from Lebanon raised Belisarius' army to 25,000 undisciplined troops, discouraged by recent defeats. Daras was dominated on three sides by high ground. Thus, and the low spirits of the troops, made it unwise to stand a siege. Belisarius caused a ditch to be dug across the valley, the flanks protected by the high ground unsuitable to cavalry. Openings allowed the Romans to counter attack. In the centre a triangular projection, like an entrenched camp, gave flanking fire across the front and protected the front and exposed flanks of

and skirmished, but did not attack. Only a short time before, a Persian force had ridden to disaster into a similar ditch dug for them by the Ephthalite Huns. Perozes did not like the unusual steadiness in the Roman ranks any more than he liked the ditch. Also a stream, whose bed was four feet deep, probably interfered with his power to manoeuvre. The next day reinforcements brought the Persian strength to a total said to be 50,000 men. The Persians advanced about noon. Perozes relieved the front line with the second to keep up a continuous fire of archery, but the wind favoured the Roman bowmen. Both sides suffered heavy losses in this missile fight. The Persian horse charged the Roman left. The Roman cavalry gave way. Then the squadron of Pharas, moving along the high ground, fell on the Persian rear, and the 600 Hunnish cavalry from the left (east) angle of the central bastion, took the enemy in flank. The Persian horse was routed with heavy loss.

Belisarius noted a movement of the Persians, including the "Immortals," toward his right. He ordered the victorious Huns from the left flank to reinforce the similar detachment on the right, and added troops from his reserve. The Persian attack drove in the Roman cavalry on their front, but the Huns, charging from the west angle of the trench, penetrated between the two Persian lines and created disorder. The reinforcements sent by Belisarius charged also, and the defeated Roman cavalry rallied and counter-attacked. Surprised and almost surrounded, the Persians broke. The Roman lines now advanced across the ditch, and the victorious cavalry rolled up the Persian flank. Belisarius called an early halt to the pursuit lest his undisciplined troops might get out of hand and fall into an ambush.

This victory restored the prestige of Roman arms, raised morale and discipline, and established the reputation of Belisarius. The use of the ditch afforded security to the weakest part of the line. By its location, it protected the front, flanks and rear. It economized force by making use of the walls of Daras and the citizens to cover a possible retirement. It left the cavalry the greatest freedom of manoeuvre. Finally, it permitted a counter attack.

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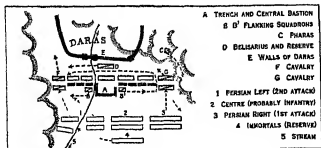
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(J. M. Sc.)

DARBHANGA, a town and district of British India, in the Tirhut division of Bihar. The town is on the left bank of the Little Bagmati river, and has a railway station. Pop. (1941) 69,203. The town is really a collection of villages round the residence of the Maharaja, a large modern building in extensive grounds. There are a hospital, with a medical college and a Lady Duffeim hospital attached, and a town hall and large tanks extending for over a mile. The district of Darbhanga extends from the Nepal frontier to the Ganges. Area 3,347 sq. mi. Pop. (1941) 3,457,070. The district consists entirely of an alluvial plain, in which the principal rivers are the Ganges, Burh Gandak, Bagmati and Little Bagmati, Balan and Little Balan, and Tiljuga. Rice is the staple crop, and the cultivator is especially dependent on the winter harvest. In 1897 a famine affected the whole district except the Samastipur subdivision, and an other affected half the district in 1906-07. Indigo manufacture was formerly an important industry, but has declined. Sugar cultivation and manufacture have to some extent taken its place. Tobacco is also a valuable crop. The district is traversed by the main line of the Bengal and North-Western railway. Pusa (q.v.) in the west of the district is the headquarters of the Imperial Agricultural Department.

The Darbhanga raj, which was founded in the 16th century, is a name applied to a large estate which includes parts of the districts of Darbhanga, Muzaffarpur, Monghyr, Purnea and Bhagal-



PLAN OF THE BATTLE OF DARAS A.D. 530 IN WHICH BELISARIUS DEFEATED THE PERSIANS

two bodies of 600 Hunnish light cavalry, placed on either side of this bastion. Infantry manned the centre, and cavalry was posted on the flanks. In concealment, on the high ground beyond the Roman left (east) flank, was posted a squadron of 300 light horse, under Pharas. Belisarius kept a reserve under his own hand. The city walls gave the protection of overhead fire from the bows of the inhabitants of Daras and, probably, artillery engines.

Perozes arrayed his host in two lines. He kept the "Immortals" in reserve. The first day the Persians looked over the situation.

It is erroneous to suppose that every shepherd called Daphnis in pastoral poetry and romance is this Daphnis.

pur. It was held by one of the chief noblemen of the province, Sir Rameshwara Singh Bahadur, Maharajadhiraja of Darbhanga, who was born in 1860 and on attaining his majority in 1878 was appointed to the Indian statutory civil service, which he resigned in 1885 in order to manage his estates. He was created raja bahadur in 1886 maharaja bahadur on his succession to the raj in 1898, and hereditary maharajadhiraja in 1930. Upon his death in 1939, he was succeeded by his son, Col Hon Dr Sir Kameshwara Singh, Maharajadhiraja of Darbhanga, K.C.I.E., who was born in 1907. He is the head of the Maithil Brahmins in India.

D'ARBLAY, FRANCES (1752-1840), English novelist and diarist, better known as Fanny Burney, daughter of Dr. Charles Burney (q.v.), was born at King's Lynn, Norfolk, on June 13, 1752. Her mother was Esther Sleepe, granddaughter of a French refugee named Dubois. Fanny was the fourth child in a family of six. Of her brothers, James (1750-1821) became an admiral and sailed with "plain Cook on his second and third voyages, and Charles Burney (1757-1817) was a well known classical scholar. In 1760 the family removed to London and Dr. Burney, who was now a fashionable music master, took a house in Poland street. Mrs. Burney died in 1761, when Fanny was only nine years old. Her sisters, Esther (Hetty), afterwards Mrs. Charles Rousseau Burney and Susanna, afterwards Mrs. Phillips, were sent to school in Paris, but Fanny was left to educate herself. Early in 1766 she paid her first visit to Dr. Burney's friend Samuel Crisp at Chessington Hill, near Epsom. Dr. Burney had first made Samuel Crisp's acquaintance about 1745 at the house of Luke Greville, grandfather of the diarist, and the two studied music while the rest of the guests hunted. Crisp wrote a play, *Virginia*, which was staged by David Garrick in 1754 at the request of the beautiful countess of Coventry (née Maria Gunning). The play had no great success, and in 1764 Crisp established himself in retirement at Chessington Hall, where he frequently entertained his sister, Mrs. Sophia Gast, of Burford, Oxfordshire, and Dr. Burney and his family, to whom he was familiarly known as "daddy" Crisp. It was to her "daddy" Crisp and her sister Susan that Fanny Burney addressed large portions of her diary and many of her letters. After his wife's death in 1767, Dr. Burney married Elizabeth Allen, widow of a King's Lynn wine merchant.

From her 15th year Fanny lived in the midst of a brilliant social circle, gathered round her father in Poland street, and later in his new home in St. Martin's street, Leicester Fields, London. Garrick was a frequent visitor and would arrive before eight o'clock in the morning. Of the various "lyons" they entertained she leaves a graphic account, notably of Omai, the Otaheitan native, and of Alexis Orlov, the favourite of Catherine II of Russia. Dr. Johnson she first met at her father's home in March 1777. Her father's drawing room, where she met many of the chief musicians, actors and authors of the day, was in fact Fanny's only school. Her reading, however, was by no means limited. Macaulay stated that in the whole of Dr. Burney's library there was but one novel, Fielding's *Amelia*, but Austin Dobson points out that she was acquainted with the abbe Prevost's *Doyen de Kallérois*, and with Marivaux's *Vie de Marianne*, besides *Clarissa Harlowe* and the books of Mrs. Elizabeth Griffith and Mrs. Frances Brooke. Her diary also contains the record of much more strenuous reading. Her stepmother, a woman of some cultivation, did not encourage habits of scribbling. Fanny, therefore, made a bonfire of her MSS., among them a *History of Caroline Evelyn*, a story containing an account of Evelina's mother. Luckily her journal did not meet with the same fate. The first entry in it was made on May 30, 1768, and it extended over 73 years. The earlier portions of it underwent wholesale editing in later days, and much of it was entirely obliterated. She planned out *Evelina*, or *A Young Lady's Entrance into the World*, long before it was written down. *Evelina* was published by Thomas Lowndes in the end of Jan. 1778, but it was not until June that Dr. Burney learned its authorship, when the book had been reviewed and praised everywhere. Fanny proudly told Mrs. Thrale the secret. Mrs.

Thrale wrote to Dr. Burney on July 22: "Mr. Johnson returned home full of the Prayers of the Book I had lent him, and protesting that there were passages in it which might do honour to Richardson. We talk of it for ever, and he feels aident after the denouement, he could not get rid of the Rogue, he said." Miss Burney soon visited the Thrales at Streatham, "the most consequential day I have spent since my birth," she calls the occasion. It was the prelude to much longer visits there. Dr. Johnson's best compliments were made for her benefit, and eagerly transcribed in her diary. His affectionate friendship for "little Burney" only ceased with his death.

Evelina was a continued success. Sir Joshua Reynolds sat up all night to read it, as did Edmund Burke, who came next to Johnson in Miss Burney's esteem. She was introduced to Elizabeth Montagu and the other bluestocking ladies, to Richard Brinsley Sheridan, and to the gay Mrs. Mary Cholmondeley, the sister of Peg Woffington, whose manner, as described in the diary, explains much of *Evelina*. At the suggestion of Mrs. Thrale, and with offers of help from Arthur Murphy, and encouragement from Sheridan, Fanny began to write a comedy. Crisp, realizing the limitations of her powers, tried to dissuade her, and the piece, *The Wivings*, was suppressed in deference to what she called a "hissing, groaning, catcalling epistle" from her two "daddies." Meanwhile her intercourse with Mrs. Thrale proved very exciting and left her little time for writing. She went with her to Bath in 1780, and was at Streatham again in 1781. Her next book was written partly at Chessington and after much discussion with Mr. Crisp. *Cecilia*, or *Memoirs of an Heiress*, by the author of *Evelina*, was published in 5 vols. in 1782 by Messrs. Payne and Cadell (who paid the author £250—not £2,000 as stated by Macaulay).

On April 24, 1783, Fanny Burney's "most judicious adviser and stimulating critic," "daddy" Crisp, died. He was her devoted friend, as she was to him, "the dearest thing on earth." The next year she was to lose two more friends. Mrs. Thrale married Piozzi and Johnson died. Fanny had met the celebrated Mrs. Delany in 1783, and she now attached herself to her. Mrs. Delany, who was living (1785) in a house near Windsor castle, presented to her by George III., was on the friendliest terms with both the king and queen, and Queen Charlotte soon after offered Miss Burney the post of second keeper of the robes, with a salary of £200 a year, which after some hesitation was accepted. Fanny's own misgivings as to her unfitness for court life were quite justified. From Queen Charlotte she received unvarying kindness, though she was not very clever with her waiting maid's duties. She had to attend the queen's toilet, to take care of her lap-dog and her snuff box, and to help her senior, Mrs. Schwelzenberg, in entertaining the king's equerries and visitors at tea. The constant association with Mrs. Schwelzenberg, who has been described as "a peevish old person of uncertain temper and impaired health, swaddled in the buckram of backstairs etiquette," proved to be the worst part of Fanny's duties. The strain told on her health, and after pressure both from Fanny and her numerous friends, Dr. Burney prepared with her a joint memorial asking the queen's leave to resign. She left the royal service in July 1791 with a retiring pension of £100 a year, granted from the queen's private purse, and returned to her father's house at Chelsea.

In 1792 she became acquainted with a group of French exiles, who had taken a house, Juniper Hall, near Mickleham, where Fanny's sister, Mrs. Phillips, lived. On July 31, 1793, she married one of the exiles, Alexandre D'Arblay, an artillery officer, who had been adjutant general to La Fayette. They took a cottage at Bookham on the strength, it appears, of Miss Burney's

¹His letters to Mrs. Gaw and another sister, Anne, were edited with the title of *Burford Papers* (1906), by W. H. Hutton.

second play, *Love and Fashion*, was actually put in rehearsal in 1799, but was withdrawn in the next year. In 1801 Madame D'Arbaly accompanied her husband to Paris, where he eventually obtained a place in the civil service. In 1812 she returned to England, bringing with her her son Alexandre to escape the conscription. In 1814 she published *The Wanderer, or Female Difficulties*. Possibly because readers expected to find a description of her impressions of revolutionary France it had a large sale, from which the author realized £7,000. Nobody, it has been said, ever read *The Wanderer*. At the end of that year she returned to France. During the Hundred Days of 1815 she was in Belgium, and the vivid account in her *Diary* of Brussels during Waterloo may have been used by Thackeray in *Vanity Fair*. General D'Arbaly now received permission to settle in England. After his death at Bath on May 3, 1818 his wife lived in Bolton street, Piccadilly. There she was visited in 1826 by Sir Walter Scott, who describes her (*Journal Nov. 18, 1826*) as an elderly lady with no remains of personal beauty, but with a gentle manner and a pleasing countenance. The later years of her life were occupied with the editing of the *Memoirs of Dr Burney*, arranged from his own Manuscripts, from family papers and from personal recollections (3 vols, 1832). Her style had, as time went on, altered for the worse, and this book is full of extraordinary affectations. Madame D'Arbaly died in London on Jan 6, 1840 and was buried at Walsot, Bath, near her son and husband.

Madame D'Arbaly's best title to the affections of modern readers is the *Diary and Letters*. Dr Johnson lives in its pages almost as vividly as in those of Boswell, and King George and his wife in a friendlier light than in most of their contemporary portraits. Croker, in *The Quarterly Review*, April 1833 and June 1842, made two attacks on Madame D'Arbaly. The first is an unfriendly but largely justifiable criticism on the *Memoirs of Dr Burney*. In the second a review of the first three volumes of the *Diary and Letters*, Croker abused the writer's innocent vanity, and declared that, considering their bulk and pretensions, the *Diary and Letters* were "nearly the most worthless we have ever waded through." These pronouncements drew forth the eloquent defence by Lord Macaulay, first printed in *The Edinburgh Review*, Jan 1843, which perhaps did more than anything else to maintain Madame D'Arbaly's constant popularity.

Bibliography.—*The Diary and Letters of Madame D'Arbaly* was edited by her niece Charlotte Frances Barrett, in 7 vols (1842-46). The text, covering the years 1778-1840, was edited with preface, notes and reproductions of contemporary portraits and other illustrations, by Mr Austin Dobson in 6 vols (1904-05). This *Diary*, which begins with the publication of *Evensong*, was supplemented in 1886 by *The Early Diary of Frances Burney (1768-78)*, which in the first instance had been suppressed as being of purely private interest, edited by Mrs Annie Raime Ellis, with an introduction giving many particulars of the Burney family. Mrs Ellis also edited *Evelling for "Bohn's Novelist's Library"* in 1881, and *Cretia* in 1882. See also Austin Dobson, *Fanny Burney (Madame D'Arbaly)* (1903), in the "English Men of Letters Series"; S. E. Burney, *The Early Diary of Frances Burney*, with a selection from the journals of her sisters Susan and Charlotte Burney (1907); F. E. Moore, *The Keeper of the Robes*, (1911); C. B. Tinker, *Dr Johnson and Fanny Burney* (1912); T. B. Macaulay, *Essay on Frances Burney* (1919); R. B. Johnson, *Fanny Burney and the Burneys* (1919).

DARBOUX, JEAN GASTON (1842-1917), French mathematician, was born at Nîmes on Aug. 13, 1842. His father died in 1849, and under the guidance of his mother, and with her encouragement, he was educated at the Ecole Normale, Paris. Pasteur became interested in Darboux, and created a teaching post for him at the Ecole Normale. After acting as assistant to Bertrand in the chair of mathematical physics at the Collège de France (1866-67) he became successively professor of mathematics at the Lycée Louis le Grand (1867-72), Maître de conférences at the Ecole Normale (1872-73), assistant to the professor of rational mechanics at the Sorbonne (1873-80), professor of higher geometry at the Sorbonne (1880-86), dean of the faculty of science (1889-90) and perpetual secretary of the Academy of Science. Darboux, besides being an excellent teacher and a notable mathematician, was also a very capable organizer and the last two posts he held gave him ample scope in this direction. He died in Paris on Feb. 25, 1917.

Practically all his mathematical work was on geometry, his early papers (1864 and 1866) were on orthogonal surfaces, these were followed by a memoir on partial differential equations of the second order (1870), which embodied a new method of integration. In his treatise *Sur une Classe remarquable de courbes* (1873) Darboux developed the theory of the class of surfaces called cycloids. *Leçons sur la Théorie générale des surfaces et les applications géométriques du calcul infinitésimal* (4 vols, 1887-96) is one of Darboux's most important works, dealing with infinitesimal geometry, it embodies most of his previous research work. In 1898 the publication of *Leçons sur les systèmes orthogonaux et les coordonnées curvilignes* was commenced. Darboux was the author of a number of papers and memoirs on the approximation to functions of very large numbers, on discontinuous functions and on other subjects.

Darboux held honorary degrees of many foreign universities, he was a foreign member of the Royal Society and in 1916 was awarded the Sylvester Medal.

DARBOY, GEORGES (1813-1872), archbishop of Paris, was born at 1491 Billot in Haute Marne on Jan. 16, 1813. He was appointed bishop of Nancy in 1859, and in January 1863 was raised to the archbishopric of Paris. The archbishop was a strenuous upholder of episcopal independence in the Gallican sense, and sought to suppress the jurisdiction of the Jesuits and other religious orders within his diocese. At the Vatican council (1869) he strongly opposed the dogma of papal infallibility, against which he voted as inopportune. When the dogma had been finally adopted, however, he submitted. During the Franco-Prussian War he organized relief for the wounded and remained at his post during the siege of Paris and the brief triumph of the Commune. On April 4, 1871, he was arrested by the Communards as a hostage and confined in the prison at Mazas, from which he was transferred to La Roquette on the advance of the army of Versailles. On May 7 he was shot within the prison along with other hostages. He died in the attitude of blessing and uttering words of forgiveness. His body was recovered with difficulty and received a public funeral (June 7). Darboy was the third archbishop of Paris who perished by violence between 1848 and 1871. He wrote a *Vie de St Thomas Becket* (1859) and translated the works of St Denis the Areopagite and the *Imitation of Christ*. See J. A. Foulon *Histoire de la vie et des œuvres de Mgr Darboy* (1889) and J. Guillemin, *Vie de Mgr Darboy* (1888) biographies written from the clerical standpoint.

DARBY, a borough of Delaware county, Pa., U.S.A., on the south west border of Philadelphia, near the Delaware river, served by the Baltimore and Ohio, and the Pennsylvania railways. It is largely a residential suburb.

The population was 13,188 in 1950 and 10,341 in 1940 by the federal census.

Darby was settled by eight Friends in 1682, and his one of the oldest libraries in the country. It was incorporated in 1853, but most of its development has taken place since 1900.

DARCY, THOMAS DARCY, BARON (1407-1537), English soldier, was a son of Sir William Darcy (d. 1488). In 1505, having been created Baron Darcy, he was made wardens of the east marches towards Scotland. In 1511 Darcy led some troops to Spain to help Ferdinand and Isabella against the Moors, but he returned almost at once to England, and was with Henry VIII on his French campaign two years later. Darcy, who was one of the most powerful nobles on the border, was also a member of the royal council, dividing his time between state duties in London and a more active life in the north. He brought forward accusations against his former friend, Cardinal Wolsey, however, after the cardinal's fall his words and actions caused him to be suspected by Henry VIII. Disliking the separation from Rome, Darcy asserted that matrimonial cases were matters for the decision of the spiritual power and he communicated with Eustace Chapuys, the ambassador of the emperor Charles V., about an invasion of England in the interests of the Roman Catholics. Detained in London by the king, he was not allowed to return to Yorkshire until late in 1535, and about a year after his arrival in the north the rising known as the Pilgrimage of Grace broke out. For a short time Darcy defended Pontefract Castle against

the rebels, but soon he surrendered to them this, stronghold, which he could certainly have held a little longer, and was with them at Doncaster, being regarded as one of their leaders. Darcy may have assisted to suppress the rising which was renewed under Sir Francis Blyden early in 1537, but the king believed, probably with good reason, that he was guilty of fresh treasons, and he was seized and hurried to London. Tried by his peers, Darcy was found guilty of treason, and was beheaded on June 20, 1537.

DARDANELLES (Turk *Chanak Kulu* or *Çanakkale*), the chief town of a Turkish vilayet which includes the peninsula of Gallipoli, the ancient Troad, and the adjoining islands. Pop. (1940) 24,621. It is at the mouth of the Rhodius, and at the narrowest part of the strait of the Dardanelles, where its span is but a mile across. The pottery trade, from which the town derived its Turkish name (*Chanak* means "pot" in Osmani) has declined in importance, valonia and cereals are the chief products of this section.

DARDANELLES (Turk *Bahr-Sefed Boghazı*), the strait (anciently called the Hellespont) that unites the Sea of Marmora with the Aegean. The city of Dardanus in the Troad, where Mithridates and Sulla signed a treaty in 84 B.C., gave the strait its name. The shores are formed by the peninsula of Gallipoli on the north west and by Asia Minor on the south-east, it extends for a distance of about 47m with an average breadth of 3 or 4 miles. At the Aegean extremity stand the castles of Sedil Bahr and Kum Kaleh respectively in Europe and Asia, and near the Marmora extremity is the town of Gallipoli (Callipolis) on the northern shore, and that of Lampsaki or Lampsacus (Lampsacus) on the southern. The two most famous castles of the Dardanelles

of Hero and Leander, and of Byron's successful attempt to rival Leander. The strategic importance of the strait has always been very great, since it is the gateway to Constantinople and the Black Sea from the Mediterranean. Although easily capable of defence, the strait was forced by the English admiral, Sir J. T. Duckworth, in 1807, and during World War I a British submarine under the command of Lieutenant commander Stoker penetrated through the Turkish minefields and sank a Turkish battleship off the Golden Horn. Its strategic importance has given to it an international political importance that has found expression in what is known as the Straits (Dardanelles and Bosphorus) Question (q.v.). (I F D M)

DARDANELLES CAMPAIGN This campaign, brought about by a desire on the part of the Allies that communications should be opened up from the Mediterranean into the Black sea with a view to assisting Russia, was begun in Feb. 1915 as a purely naval undertaking. (See World War I, Naval.)

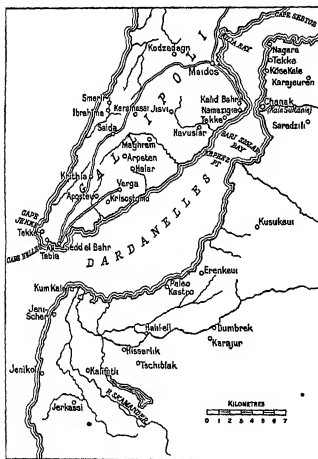
But it had been realized from the outset that, even should the warships succeed in attaining their object, land forces would sooner or later be required to aid in the campaign, if only to secure the communications of the fleet after it had passed into the Sea of Marmora. Before the failure of the naval attack of March 18, Allied troops had been set in motion for the Aegean. Some were already in Lemnos, and Sir Ian Hamilton, chosen as commander in chief of the military contingents, had arrived in time to witness the night of the 18th. In view of its result, the Allied Governments decided that from this time onwards the gathering army must assume the principal role in the effort to secure possession of the straits. Hamilton was unable to initiate land operations at once. The Turks were making preparations to repel landings on both sides of the straits, while the troops at his disposal were partly in Egypt, partly at Lemnos, and partly on the high seas, en route from their respective bases in England and France.

Organization in Egypt—He decided therefore that his army must in the first place be concentrated in Egypt, to be organized for the hazardous undertaking to which it was about to be committed, and that it must then be disposed in transports in accordance with tactical requirements in anticipation of a landing in face of the enemy. A month was lost in consequence. During that month the Turkish army was formed (March 24) to guard the straits. Marshal Liman von Sanders, head of the German military mission in Turkey, was appointed its commander in chief, and under his instructions the defence system, organized in consequence of the warning offered by the naval operations, was overhauled and developed.

The Allied force was composed of five divisions—two (the 29th and the Royal Naval) furnished by the United Kingdom, two formed of Australian and New Zealand troops, and one composed of French colonial troops. Against this force Liman von Sanders could pit six divisions, but these were perforce dispersed, two (3rd and 11th) were watching the coast on the Asiatic side, two (5th and 7th) were near Bulair to guard against a landing at the neck of the Gallipoli peninsula, while the remainder (9th and 19th) were disposed towards its southern end.

I THE FIRST LANDINGS

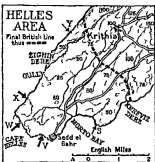
The expeditionary force concentrated in Mudros bay, Lemnos, in the third week of April. Hamilton contemplated two distinct major operations to secure a footing on the Gallipoli peninsula. The 29th Div., supported by the Royal Naval Div., was to be put ashore at its extremity, an area which it is convenient to designate as Helles, the Australian and New Zealand Divs. under Sir W. Birdwood (q.v.) were to land north of Gaba Tepe, where there are extensive beaches. But part of the one available French division was furthermore to effect a descent at Kum Kale, opposite Helles, as a subsidiary operation, subsequently being transferred to Helles. After a short delay, enforced by bad weather, the armada put to sea during the nights of April 23-24 and 24-25, so that the transports and the covering warships should arrive at their various rendezvous at or before dawn on the 25th, and the day broke calm after a placid night.



THE STRAIT OF THE DARDANELLES WHICH IN WAR TIME CAN BE MADE ALMOST IMPREGNABLE

are Chanak-Kalehst, Sultanieh-Kalehst, or the Old Castle of Anadoluh, and Kilit Bahr, or the Old Castle of Rumelia. The strait has long been famous in history since the passage of Xerxes' army by a bridge of boats. It is the scene of the story

Landing at Cape Helles—Five points had been selected in the Helles area for attack. Enumerating from right to left the beaches were "S" in Morto bay, "V" and "W" on either side of Cape Helles, and "X" and "Y" on the outer shore. The attacks at "S" and "Y" were intended to be subsidiary, but great importance was attached to "W" and "V," as those two beaches offered the most suitable landing places from the point of view of subsequent operations. Owing to its vicinity to "W," "X" was calculated to play a very prominent part in the affair as a whole. Covered by the fire of battleships and cruisers, the troops started in flotillas of boats soon after dawn for all points, and, as it turned out, the actual disembarkations at "S," "X" and "Y" were carried out without any great difficulty. But at "W" the troops gained a footing only after incurring heavy loss, while at "V" where a large part of the landing force was carried in the steamer "River Clyde" which was run ashore, the effort nearly failed altogether. After hard fighting all day the position at nightfall was that the troops landed at "W" and "X" beaches had joined hands and that a battalion was established at "S," while the situation at "Y" was critical, as also at "V," but during the night more troops were got ashore at "V," and those at "X" were safely withdrawn and re-embarked next morning. Losses had been severe.



MAP SHOWING THE LANDING BEACHES S V W X Y AT GALLI POLI

Landing at Kum Kale—In the meantime a French brigade had, after a tough struggle, effected a lodgement at Kum Kale (Qum Qale). The Turks were in strong force here, so that any advance by the French was out of the question, but their presence on the Asiatic side was being indirectly helpful to secure a footing on the further shore. Some little progress was made on the morrow in spite of determined resistance by the enemy, additional troops were landed, and during the night the French were withdrawn from Kum Kale and they were landed at "V" beach on the 27th. On that day the Allies' line was again advanced by a few hundreds of yards, but the Turks had received substantial reinforcements in this quarter, and but little ground was gained when Hamilton ordered a fresh attack on the 28th. The invaders had suffered very heavy losses during the initial landing and the subsequent strenuous encounters, and there were no reserves on the spot to fill the gaps that had been created in the ranks.

Landing at Anzac—Birdwood's divisions had in the meantime effected a lodgement to the north of Gaba Tepe. The actual disembarkation had in this case been started before dawn on the 25th at a point about a mile and a half north of the Gaba Tepe promontory, and at a spot where the hills rose abruptly from the actual beach which came to be known as Anzac. A haphazard line on the heights immediately above the beach had been secured at once, the Turks being in weak force at the moment when the advanced parties of invaders reached the shore, but the defenders were able to hurry reinforcements to the point of danger and the actual area secured was of limited extent. Won practically at the first blow, it provided but a scanty water supply, it presented great inconveniences and its beach was much exposed in the event of bad weather setting in, it was but slightly extended during the following three months, for Luman von Sanders realized that owing to its proximity to the narrows of the Dardanelles, it represented a very serious danger to the Turks, and he took steps accordingly. Although the Ottoman troops delivered vigorous counter attacks on the 26th, these were beaten off with loss to the assailants, and by the night of April 27-28 the position of which Birdwood had contrived to gain possession had come to be, tactically, fairly secure.

Hamilton thus gained a somewhat precarious footing at two points of the peninsula. But his two forces were some 15m

apart, and what amounted to little more than a patch of ground had been won in either case. His intentions were now completely exposed to the enemy, and the great advantage of surprise had passed away without his force having established itself in a dominating position capable of being turned to satisfactory account in subsequent operations. In both areas the Turks enjoyed the tactical command, they were at least equal in force to the Allies, their guns were able to hear with effect upon the beaches used as landing places and advanced bases, and, although at this time of the year the weather was generally calm, these beaches provided but inadequate facilities for the landing of ammunition, ammunitions stores.

Reinforcements—Early in May the Allies' contingents planted in the Helles area were strengthened by the arrival of the British 42nd Div., an Indian brigade, and the French 2nd Division. Some ground was gained on May 6, and during the next day or two determined counter attacks on the part of the enemy were effectually repulsed. The two French divisions were occupying the right of the line, next to the straits, and that arrangement held good up to the time when the Gallipoli peninsula was finally evacuated early in January in the following year. Both here and facing the Australasian troops at Anzac the Turks had dug themselves in, establishing elaborate defences, and trench warfare was becoming the order of the day.

During the month a state of stalemate set in, and although ground was gained by the Allies in attacks delivered in the Helles area on June 4, 21 and 28 and during the month of July the line was gradually pushed forward near Krithia, the situation was so unpromising that the British Government, decided to send five more divisions (10th, 11th, 13th, 53rd and 54th) to the Aegean. These arrived at the islands of Mytilene and Imbros during the closing days of July and the first days of August. Hamilton's artillery was at the same time strengthened, and his very inadequate ammunition supply somewhat improved. But Luman von Sanders was likewise receiving reinforcements, and, although the Ottoman maritime communications with the Gallipoli peninsula were from time to time impeded by the submarines of the Allies, the relative strength of the two opposing armies facing each other in the theatre of war was not, as it turned out, greatly affected by the appearance of the fresh troops sent out from England to these waters. The Allies, in view of the coming of reinforcements, treated July as a month of preparation, although a general attack was delivered by them in the Helles area by which a little ground was gained. A few days later the first of the reinforcing divisions, the 13th, arrived and was landed at Helles as a temporary measure.

II SARI SAIR AND SIVLA BAY

How to employ the fresh divisions coming out from home had to be decided by Hamilton. The French had from the outset favoured operations on the further side of the straits, and there was something to be said for such a plan of campaign. But a descent in that quarter must involve a disembarkation in face of opposition, the perils of which had been made apparent on April 25, moreover, granting the landing to be successful, the forces would start work much farther from the narrows of the Dardanelles, the objective, than were either Helles or Anzac. There were also not wanting inducements for the Allies to attempt a landing at Bulair, seeing that their presence at that point would carry with it the severance of the Turkish land communications with the peninsula. But this would likewise mean a landing in face of opposition, and the distance of Bulair from the Island of Imbros, the nearest base of operations for the peninsula, provided a strong argument, from the point of view of ship transport, against such an undertaking. Moreover, a landing either on the Asiatic side or at Bulair meant a dispersion of the Allies' forces as a whole, unless Helles or Anzac, or both of them, were to be abandoned, and the fact that the Ottoman commander-in-chief had to be prepared for his opponent adopting one of these two plans, offered a strong argument against selecting either of them, apart from any other considerations as to their tactical advantages or disadvantages.

British Plans—Hamilton decided that his great effort should be made at, and immediately north of, Anzac. The rugged bluff on which Birdwood's men had taken root since April were spurs of a tangled mountain mass known as Sari Barr, from the topmost ridges of which the narrows were visible four or five miles off. Anzac was moreover, situated almost at the narrowest point of the peninsula. The plan was to reinforce Birdwood secretly by a division and a half (the 13th and part of the 10th) and that thus strengthened, he should secure possession of Sari Barr by a night attack. A further force (the 11th Div and the rest of the 10th) was on that same night to effect a landing at an entirely new point—Suvla bay—a few miles north of Anzac, where the Turks were known to be few. This force was to assist the troops attacking Sari Barr in due course, and the possession of Suvla bay would furnish troops ashore in and about this area with a much more sheltered landing place than the beaches about Anzac offered. The last divisions to arrive, the 53rd and 54th, were to be employed wherever should seem best after the offensive had begun, to land the whole of the reinforcements simultaneously would not have been practicable with the amount of water transport available.

The utmost secrecy was observed by the Allies' staff. Steps were taken to mislead the Ottoman authorities by means of feints and of reconnaissances executed at localities other than those selected for operations. False reports were circulated as siduously by the intelligence department. Liman von Sanders was well aware of the arrival of large bodies of British troops in the islands, but he remained in complete ignorance of his rival's real design until this was actually in course of execution. He had organized his forces as a southern group watching Anzac, while two divisions were retained near Bulair, where he was disposed to anticipate that the blow would fall. There were also large bodies of Turkish troops in reserve about Chanaa, and others about Kum Kale and Besika bay. Numerically the contending armies at this critical juncture were about equal, but the Turks were necessarily much dispersed, so that the result of the impending clash of arms really hinged upon the speed with which the attacking side should gain ground before the defenders had time to concentrate.

The Allies' offensive started on Aug 6 with two preliminary enterprises. An onset was made upon part of the Turkish lines in the Helles area. Portions of Birdwood's force broke out of the southern end of the Anzac position and gained ground. But the real purpose of the two operations was to occupy the enemy's attention and to conceal a design of much greater moment.

Attack on Sari Barr—So dexterously had the assembling of the reinforcements in the Anzac area been effected that the Turks were entirely unaware that Birdwood's army had been nearly doubled. The plan for gaining possession of the Sari Barr mountain was that several columns were to move out from the northern end of the Anzac position at nightfall on Aug 6 and, on reaching their appointed stations, were to wheel to the right and to work their way in the dark up certain steep but well-defined gullies that led up to the summit. But although the Turks were to some extent surprised, and although the outlets of the gullies were in consequence in the assailants' hands by midnight, so stubborn a resistance was offered by the defenders that by daybreak the columns were not much more than half way up, and all attempts to win the upper ridges failed on the 7th in the face of the Turkish reinforcements.

After a rearrangement of the troops during the night the offensive was resumed on Aug 8, but except at one point very little progress was made. After a fresh reorganization during the dark hours another effort was made on the 9th, and on this occasion a small body of British and Indian troops actually fought their way to a commanding summit from which the narrows were seen but they were driven off again. Next day the Turks, now a great force, counterattacked and thrust those opposed to them back down the slopes all along the line whereupon tremendous fighting ceased. Both sides had lost heavily but victory for all practical purposes rested with the Ottomans, even if the Anzac position had been extended considerably in a northerly direction.

as a result of the operations

Landing at Suvla Bay—Stirring events had in the mean time been taking place around Suvla bay. The troops detailed for the landing in this quarter belonged to the British "New Army", they were not conversant with active service conditions, and they were being highly tried in being called upon to execute a landing in force at night in face of opposition. There was indeed no precedent for an undertaking of this kind under modern tactical conditions, but the Turks were known not to be in sufficient strength to offer serious resistance. As it was the whole of the 11th Div was ashore before dawn, but the urgent need of pressing forward at once was not realized by the local commanders, and some confusion arose when the 10th Div arrived and began to disembark. No organized advance in force took place until late in the afternoon, and at nightfall the attacking force had only reached the foot of the hills lying to the east of the landing places and captured one advanced spur. The troops had suffered greatly from thirst, the arrangements with regard to water having practically broken down, mainly owing to the inexperience of the troops themselves.

Attack in the Hills—When Liman von Sanders learned during the night of Aug 6-7 that the Allies were landing in force at Suvla and were attacking Sari Barr from Anzac, he ordered the two divisions at Bulair to proceed to Suvla with all speed. But this meant a two days' march along indifferent roads. Consequently there was still on Aug 8 a great opening left for the attacking side to complete the first part of its programme, i.e., to gain possession of the heights to the east of Suvla which dominated the landing places and a considerable area of level ground around Suvla bay. But no organized move took place. The opportunity was allowed to slip by, and that night Turkish reinforcements began to arrive from Bulair and to occupy the all important high ground. Next morning the 10th and 11th Divs, supported in a measure by the 53rd Div, which had arrived during the night, advanced to the attack. But the effort failed, and when it was renewed on the following day the Turks had been so effectively reinforced that the offensive enjoyed little chance of achieving success. That day, Aug 9, was the last on which there remained any hope either of the Sari Barr offensive achieving success or of the Suvla force establishing itself in a satisfactory position. This force, however, made a fresh attempt on the 10th to wrest the heights in front of it out of Osmanli keeping, but this failed completely, and further offensives in this quarter were abandoned for the time being.

Hamilton's carefully devised scheme of offensive operations had in fact come to nought in its most important features. The determined effort to secure possession of Sari Barr had miscarried. A footing had, it is true, been gained at Suvla, giving the Allies control of a fairly well sheltered inlet on the outer coast of the peninsula, but as the high ground within easy artillery range of the landing places, which overlooked the whole occupied area, remained in the hands of the Turks, much of the benefit hoped for from its acquisition was neutralized. Only a restricted patch of Ottoman territory had in fact been occupied, thanks to the new undertaking, and although the position at Anzac had been extended and improved it remained a very bad one. The Allies now occupied many miles of front in the peninsula, but there was scarcely a spot where the enemy did not enjoy the advantage in respect to ground, what the attacking forces needed from the outset was depth rather than breadth, and depth they had failed to secure. They had, moreover, incurred very heavy losses during the succession of combats lasting from Aug 6 to 10, and, except for a mounted division coming from Egypt to fight on foot, no reinforcements were on the way, the 54th Div had already been swallowed up at Suvla. The defending side had also, no doubt, suffered heavily in casualties, notably on Sari Barr, but Liman von Sanders could fairly claim that even if some valuable ground had been lost by the Turks, he had held his own in a contest in which his adversary had enjoyed the initiative and had been in a position to effect a surprise.

An effort was made by the troops on the extreme left of the

unceasing activity was material, food supplies, animals and finally large bodies of troops, were got away. During the daytime reliefs took place as usual, pretences were made of landing stores and animals, and the result was that the Turks remained in complete ignorance of what was passing close to their lines. On Dec. 18 only a meagre force, composed almost entirely of infantry and disposed almost entirely in the front trenches, was holding a front of 10 mi. face to face with an enemy incomparably stronger in numbers. At nightfall the very few guns not yet withdrawn were hurried off to the jetties, then the troops along the front were quietly withdrawn by successive detachments, finally the parties still in the trenches slipped away, and when dawn broke the Turks discovered that the invaders were gone. Practically nothing worth mentioning had been left behind at Suva, and at Anzac, where conditions were more difficult, only a very few worn out guns had to be abandoned and some valuable war material destroyed. The relaxing by the Allies of their frail hold upon a strip of the outer coast-line of the Gallipoli peninsula had been effected more successfully than the Gallies among them had permitted themselves to hope.

Yet, for a week subsequent to the receipt of the good news, the British government remained irresolute with regard to the policy to be pursued at Helles. Then, however, Monro received the expected sanction for evacuating that area likewise, and Birdwood promptly grappled with this fresh problem, a problem rendered more difficult than the last because Liman von Sanders had full warning of what might be expected and, moreover, he now enjoyed an enormous preponderance in force. He had 21 divisions available, while there were only four left to oppose him.

Evacuation of Cape Helles.—The same principles as had been adopted by Byng and Godley at Suva and Anzac were put into practice at Helles, the withdrawal of stores, war material, animals and personnel being carried out on successive nights. While the front trenches were to be held up to the last, the fighting force ashore was to be gradually reduced, and the detachments holding the front trenches were, at the given hour on the last night (fixed provisionally for that of Jan. 8-9), to vacate them and hurry straight off to the beaches. But the weather was none too favourable on several of the preliminary nights, and the enemy's guns gave a good deal of trouble on the beaches, causing many casualties. The Turks were aware that a withdrawal was gradually being carried out, but they could not tell which would be the final night, nor could they make sure how far the number of combatants within the British lines had been reduced. So, with the intention of ascertaining the strength of their opponents, on Jan. 7 they delivered a half-hearted attack upon the left of the British position. This was beaten off, and they came to the mistaken conclusion that the final evacuation was not imminent.

Shortly after dark set in on the night of Jan. 8-9 the wind rose ominously. Nevertheless the guns remaining to be embarked were got off, the infantry followed, and the last detachments quitted the front trenches at 11.45 P.M., without the Turks noting their departure. But when they reached the shore it was found, in the case of those detailed for Gully beach, that embarkation there was impracticable, so these had to march to "W" beach and they were not afloat till after 4 A.M., only being got off with great difficulty because of the surf. Several worn out guns had been intentionally left behind, besides much ordnance material and foodstuff, but practically all of this was rendered unserviceable, for, just as the last boats were lowered off, the masses of stores were set on fire, and only then did the Turks discover that their opponents had evaded them a second time. The withdrawal from Helles had been a masterly military and naval achievement.

Most authorities on war agree that the failure of the Allies in this memorable campaign was primarily due to the abortive naval effort to force the Dardanelles. This gave the Turk such warning of what was in store that, when Hamilton's army was ready to land, the defenders were in a position to bring it at once to a standstill. The only chance of success after that lay in very substantial reinforcements reaching the scene promptly. But neither the British nor the French would divert the requisite military resources from the main theatre of war at the moment, and when

some additional troops were sent later, their numbers were in sufficient and it was too late.

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DARDANUS, in Greek legend, son of Zeus and the Pleiad Electra, mythical founder of Dardanus on the Hellespont and ancestor of the Dardans of the Troad and, through Aeneas, of the Romans. His original home was supposed to have been Arcadia. Having slain his brother Iasus or Ixion (according to some legends, Iasus was struck by lightning), Dardanus fled across the sea. He first stopped at Samothrace, and, when the island was visited by a flood, crossed over to the Troad. Being hospitably received by Teucer, he married his daughter Bateia and became the founder of the royal house of Troy.

DARDIC LANGUAGES, the name of a family of languages spoken immediately to the south of the Hindu Kush, and north of the frontier of British India, includes the group of Kafir languages spoken in Kafirstan, Khovar, spoken in the Chitral country, and the group of Shina languages, which includes the Shina of Gilgit, Kohistan, spoken in the Kohistan of the Indus and Swat rivers, and Kashmiri. Of all these Kashmiri is the only one which has received any literary cultivation. The Dardic languages are Aryan by origin, but are neither Iranian nor Indo-Aryan. They have developed phonetic peculiarities, and possess, almost unaltered and in common use, words which in India are seldom found except in Vedic Sanskrit. In each there is a small but unimportant element of Burushaski. (See also **BURUSHASKI LANGUAGE**, **INDO-ARYAN LANGUAGES**, **KASHMIRI LANGUAGE**.)

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DARDISTAN, a conventional name for a tract of country on the northwest frontier of India. It comprises the whole of Chitral, Yasin, Panyal, the Gilgit valley, Hunza and Nagar, the Astor valley, the Indus valley from Bunji to Batera, the Kohistan Malazai, &c., the upper reaches of the Panjkora river, and the Kohistan of Swat. The so-called Dard races are referred to by Pliny and Ptolemy, and are supposed to be a people of Aryan origin who ascended the Indus valley from the plains of the Punjab, reaching as far north as Chitral, where they dispossessed the Khos. They have left their traces in the different dialects, Khoswar, Burishku and Shina, spoken in the Gilgit agency.

DARES PHRYGIUS, according to Homer (*Iliad*, v, 9), a Trojan priest of Hephaestus. He was supposed to have been the author of an account of the destruction of Troy, and to have lived before Homer (Aelian, *Var. Hist.* vi, 2). A work in Latin, purporting to be a translation of this and entitled *Dareti Phrygae de excidio Troiae historia*, was much read in the middle ages and was then ascribed to Cornelius Nepos, but the language is corrupt, and the work belongs to a period much later than the time of Nepos (probably the 9th century A.D.). It is doubtful whether the work as we have it is an abridgement of a Latin work or an adaptation of a Greek original. Together with the similar work of Dictys Cretensis (with which it is generally printed) the *De excidio Troiae* forms the chief source for the numerous middle age accounts of the Trojan legend. (See **Dictys Cretensis**.)

DAR ES SALAAM, "the Haven of Peace," a seaport of East Africa, in 6° 50' S., 39° 20' E., capital of Tanganyika Territory. Pop. (1937) about 35,000, including approximately 1,200 Europeans and 9,000 Asiatics. The harbour is small but perfectly sheltered (hence its name), the entrance to it is through a narrow opening in the palm-covered shore. The depth of water at the entrance is from 20 to 34 ft. according to the tides. Since 1927 a wharf 300 ft. long has been made where ships can berth, but

loading and unloading is chiefly by lighters. 593 steamers totalling 1,648,411 tons entered the port in 1935. A railway (built 1905-1914), starting from the harbour, goes via Tabora to Kigoma Ujiji on Lake Tanganyika, a distance of 772 mi. Motor roads connect with Morogoro, Bagamoyo, Sadani and Tanga. There is an aerodrome and it is a port of call on the London Durban service.

In 1862 Sayyed Majid, sultan of Zanzibar, decided to build a town on the shores of the bay, and began the erection of a palace, which was never finished. In 1871 Majid died and his scheme was abandoned. In 1876 the construction of a road from the harbour to Victoria Nyanza was begun. The project failed, but in 1928 the port came into railway connection with Victoria Nyanza by the completion of the Tabora Mwanza line. In 1887 Carl Peters occupied the bay for the German East Africa company and in 1891 Dar es Salaam was made the administrative centre for German East Africa. A town was laid out on an ambitious scale, and it has fine buildings and a good botanical garden, the native quarter is distinct from that of the Europeans. Dar es Salaam was occupied by the British forces in 1916, the wireless station was destroyed in 1914. There is electricity and a good water supply, three newspapers, two theatres and several clubs.

DARESTE DE LA CHAVANNE, CLEOPHAS (1820-1882), French historian, was born in Paris. Educated at the Ecole des Chartes, he became professor in the faculty of letters at Grenoble in 1844, and in 1849 at Lyons, where he remained nearly 30 years. His works comprise *Histoire de l'administration en France depuis Philippe Auguste* (2 vols., 1848), and *Histoire de France* (8 vols., 1865-73), completed by a *Histoire de la Restauration* (2 vols., 1880), and by a *Histoire du Gouvernement de Juillet*, a dry enumeration of dates and facts. Before the publication of Lavisse's great work, Dareste's general history of France was the best of its kind.

DARFUR is the westernmost province of the Anglo-Egyptian Sudan. It extends from about 10° N. to 16° N. and from 22° E. to 27° 30' E., has an area of 138,150 sq mi. and an estimated population (1941) of 715,543. It is bounded north by the Libyan desert, west by French Equatorial Africa, south by Equatoria and east by Kordofan. The last named are provinces of the Anglo-Egyptian Sudan. The greater part of the country is a plateau from 2,000 to 3,000 ft. above sea level. A range of mountains of volcanic origin, Jebel Marra, runs north and south about the line of 24° E., and forms the watershed between the basins of the Nile and Lake Chad. About 70 mi. long and 30 mi. thick, its highest point attains more than 10,000 ft. Eastward the mountains fall gradually into sandy, bush covered steppes. North-east of Jebel Marra lies Jebel Meidob (highest point 1,500 ft.), a range much distorted by volcanic action, and Malha, an extinct volcano with a crater 300 ft. deep and 1 mi. in diameter. South of Jebel Marra are open plains. Southwest is a plateau which reaches a height of between 3,000 and 4,000 ft. above sea level. The mountains are scored by numerous *khors*, whose lower courses across the tableland represent the beds of former rivers, dry except when scoured by torrents in the rainy season. In the west and south, water can always be obtained in the dry season by digging 5 or 6 ft. below the surface of the *khors*.

The climate, except in the south, where the rains are heavy and the soil is a damp clay, is healthful except after the rains. The rainy season lasts from the middle of May to the middle of September. In the neighbourhood of the *khors* the vegetation is fairly rich.

In the north and east the chief trees are various acacia, *Balanites aegyptiaca* and the baobab (*Adansonia digitata*) hollowed out by the inhabitants of this waterless area to serve as water tanks. In the south and southwest the density and variety of trees is greater and includes *Cordia abyssinica*, yielding valuable timber and mahogany. Cotton and tobacco are indigenous. Bulrush millet (*dukkin*) is the staple food crop but wheat, durra and other grains are grown. Other vegetable products are sesame, watermelons, onions and tomatoes, while the cattle owning Baggara produce large quantities of clarified butter (*semn*).

There are deposits of copper at Hofrat en Nahas in the south-

west and of rock salt in various places. Iron is also wrought in the southwest. Camels, cattle, horses and sheep are numerous and of good breed.

Inhabitants—The population is very mixed. The Negroid Fur (from whom the province takes its name) occupy Jebel Marra and the surrounding country. In the west are the Masalit, another non Arab tribe who, like the Fur, speak a language of their own, and in the north are the Zagahawa and Merdo, probably Hamitic immigrants of Mediterranean origin. The true Arabs are divided between the northern camel owners and the southern cattle owning sections. All are largely nomadic and move with their animals in search of water and grazing. In the east is the large Negroid tribe of the Berti, and there are also remnants of the Dagu and the Tunjur which were by tradition the early ruling houses of Darfur but were later driven out westward by the Fur.

Slaves, ostrich feathers, gum and ivory formerly were the chief articles of trade, a caravan going annually by the Arabian ("Forty Days") road to Asyut in Egypt and taking back cloth, firearms and other articles. The chief exports to the east are cattle, sheep, camels, tobacco, hides and skins, gum, melon seeds and semn. Much of the trade goes by truck to the railroad at El Obeid, four days away, but camels are extensively used. The principal imports are cotton goods, sugar, tea and coffee.

The capital and administrative headquarters of the province is El Fasher (population 1941 est., 14,171). It is some 350 mi. west of El Obeid and 500 mi. WSW of Khartoum. The province is divided into five districts with headquarters at El Fasher (central), Nyala (southern), Zalingei (western), Kutum (northern) and Geneina, the last named being also the headquarters of the Sultan of Dar Masalit. El Fasher and Geneina are airports on the main trans-African air route.

History—The Dagu Negroes, inhabitants of Jebel Marra, appear to have been the dominant race in Darfur in the earliest period to which the history of the country goes back. How long they ruled is uncertain, little being known of them save a list of kings. According to tradition the Dagu dynasty was displaced and Mohammedanism introduced, about the 14th century, by the Tunjur, who reached Darfur by way of Bornu and Wadai. The first Tunjur king was Ahmed el-Ma'fur, who married the daughter of the last Dagu monarch. His great grandson, the Sultan Dali, a celebrated figure in Darfur histories, was on his mother's side a Fur, and thus was affected a union between the Negro and Arab races. Dali divided the country into provinces, and established a penal code, which, under the title of *Kitab Dali* or *Dali's Book*, is still preserved, and shows principles essentially different from those of the Koran. His grandson Soleiman (usually distinguished by the Furan epithet *Solon*, the Arab or the Red) reigned from 1596 to 1637, and was a great warrior and a devoted Mohammedan. Soleiman's grandson, Ahmed Bahr (1632-1722), made Islam the religion of the state, and increased the prosperity of the country by encouraging immigration from Bornu and Bagirmi. His rule extended east of the Nile as far as the banks of the Atbara. Under succeeding monarchs the country, involved in wars with Sennar and Wadai, declined in importance.

In 1799 Abd er-Rahman, the then reigning sultan, wrote to congratulate General Bonaparte on his defeat of the Mamelukes in Egypt. To this Bonaparte replied by asking the sultan to send him by the next caravan 2,000 black slaves upwards of 16 years old, strong and vigorous. To Abd er-Rahman likewise is due the situation of El Fasher, or the royal township. Previously the capitals of the sultans had been in or near Jebel Marra and the commercial capital was until the mahdi at Koba about 30 mi. NW of El Fasher. Mohammed el-Fadhl, his son, whose reign lasted until 1836, devoted himself largely to the subjection of the semi-independent Arab tribes who lived in the country. In 1821 he lost the province of Kordofan to the Egyptians. Of his 40 sons, the third, Mohammed Hussein, was appointed his successor. In the latter part of his reign Hussein became involved in trouble with the Arab slave raiders who had seized the Bahr-el Ghazal, and upon by the Darfurians as their especial "slave preserve".

Negroes of Bahr el Ghazal paid tribute of ivory and slaves to Darfur, and these were the chief objects of merchandise sold by the Darfurians to the Egyptian traders along the Arburu road to Asyut. Hussein died in 1873, blind and advanced in years, and the succession passed to his youngest son Ibrahim, who soon found himself engaged in a conflict with Zobeir (q.v.), the chief of the Bahr el-Ghazal slave traders, and with an Egyptian force from Khartoum. The war resulted in the destruction of the kingdom. Ibrahim was slain in battle in the autumn of 1874 and his uncle Hassab Alla, who sought to maintain the independence of his country, was captured in 1875 by the troops of the khedive and removed to Cairo with his family. The Darfurians were re-entrained under Egyptian rule. Various revolts were suppressed, and in 1881 Slatin Bey (Sir Rudolf von Slatin) was made governor of the province. Slatin defended the province against the forces of the Mahdi but was obliged to surrender (Dec. 1883), and Darfur was incorporated in the Mahdi's dominions. Following the overthrow of the khalifa at Omdurman in 1898 the new (Anglo-Egyptian) Sudan government recognized (1899) Ali Dinar, a grandson of Mohammed-el Fadhil, as sultan of Darfur. A rising attempted by Ali Dinar in 1915 necessitated a punitive expedition in which he was killed (Nov. 1916), and Darfur then became a province of the Sudan. Into it was incorporated the small, hitherto independent state of Dar Masalit which still enjoys a measure of self-government under a Sultan, supported by a British resident.

The first European traveller known to have visited Darfur was William George Browne (q.v.), who spent two years (1793-95) at Kobbé. Gustav Nachtigal in 1873 spent some months in Darfur and since that time the country has become well known through the journeys of Gordon, Slatin and others.

BIBLIOGRAPHY.—Browne's account of Darfur will be found in his *Travels in Africa Egypt and Syria* (1799), another early traveller, Sheikh Nuhammad Bey Omar El Tunisi gives an interesting account of the country in his *Voyage à Darfour*, transl. Perron (Paris, 1846), Nachtigal's *Sokara und Sudan* gives the results of that traveller's observations. The first ten chapters of Slatin Pasha's book *Fire and Sword in the Sudan* (English edition, 1886) should be consulted. See also *The Anglo-Egyptian Sudan* (1905), edited by Lord Evelyn Gleichen, and the bibli. under *SUDAN*. (J. F. M., X.)

DARGAI (1) Mountain ridge of the Samana range, on the Kohat border, famous for the stand made there by the Afridis and Orakzais in the Tirah Campaign, 1897 (See *TIRAH*). (2) The terminus, on the Peshawar border, of the frontier railway running from Nowshera to the foot of the Malakand pass.

Attack on Dargai (1897).—During the British advance through Tirah in 1897 two attacks were made on the Dargai ridge, the first on Oct. 18, and the second on the 20th. The first failed, the second succeeded through British pluck, in spite of its tactics being of the meanest order.

Dargai is a spur of the Samana range of hills which flanks the Kuram valley, north of Thal, Shinawari and Hangu. It is clearly visible from near Fort Gulistan, whence on the 20th, it was seen that the tribesmen were holding the ridge in strength, and were throwing up sangars (stone breastworks). Major General Yeatman-Biggs decided to take the position by a frontal attack, and though he had 24 guns at his disposal no attempt was made to concentrate their fire on the tribesmen. The result was that the attack was brought to a standstill by a hail of bullets, and a second one had to be mounted. More wisdom was then displayed, the guns being ordered to bombard the position for three minutes prior to the assault. This bombardment demoralized the tribesmen, and the position was carried. The British losses were 37 officers and other ranks killed, and 156 wounded. The bulk of these losses could have been avoided had it at first been realised that frontal attacks must be prepared by gun fire.

See C. E. Callwell, *Tirah*, (1897), H. D. Hutchinson, *The Campaign in Tirah 1897-98*, (1898), L. J. Shadwell, *Lockhart's Advance Through Tirah*, (1898).

DARGOMJSKY, ALEXANDER SERGEIVICH (1813-1890), Russian composer, was born at Tula on Feb. 14, 1813, and educated in St. Petersburg (Leningrad). He was already known as a talented musical amateur when in 1833 he met Glinka and was encouraged to devote himself to composition. His light

opera *Esméralda* was written in 1839, and his *Roussalka* was performed in 1856, but he had little success or recognition either at home or abroad, except in Belgium, till the '60s, when he became one of Balakirev's circle. His opera *The Storm*, which then became famous among the progressive Russian school, though it was not performed till 1872. Dargomysky died at St. Petersburg (Leningrad) on Jan. 17, 1890. His compositions include a number of songs and some orchestral pieces.

DARGU see *NUBA*

DARIAL, a gorge in the Caucasus, on the east of Mt. Kasbek, pierced by the river Terek for 8 m. between vertical walls of rock (5,900 ft.). It is mentioned in the Georgian annals, by Strabo and by Ptolemy. Being the only available passage across the Caucasus, it has been fortified at least since 150 B.C. In Russian poetry it has been immortalized by Lermontov. The present Russian fort, Darial, which guards this section of the Georgian military road, is at the northern issue of the gorge, at an altitude of 4,746 feet.

DARIEN, a district covering the eastern part of the isthmus joining Central and South America. It is mainly within the republic of Panama, and gives its name to a gulf of the Caribbean Sea. Darién is of great interest in the history of geographical discovery. It was reconnoitred in the first year of the 16th century by Rodrigo Bastidas of Seville, and the first settlement was Santa Maria la Antigua, situated on the small Darién river, northwest of the mouth of the Atrato. In 1513 Vasco Núñez de Balboa stood "silent upon a peak in Darién," and saw the Pacific at his feet stretching inland in the Gulf of San Miguel, and for long this narrow neck of land seemed alternately to proffer and refuse a means of transit between the two oceans. The first serious attempt to turn the isthmus to permanent account as a trade route dates from the beginning of the 18th century, and forms an interesting chapter in Scottish history. In 1695 an act was passed by the Scottish parliament giving extensive powers to a company trading to Africa and the Indies, and this company, under the advice of one of the most remarkable economists of the period, William Paterson (q.v.), determined to establish a colony on the isthmus of Darién midway between Porto Bello and Cartagena, two of Spain's strongholds, and to gain a free trade route to the Pacific "whereby to Britain would be secured the key to the universe, enabling their possessors to give laws to both oceans and to become the arbiters of a commercial world." On July 26, 1698 the pioneers set sail from Leith amid the cheers of an almost envious multitude, and on Nov. 4, with the loss of only 15 out of 1,200 men, they arrived at Darién, and took up their quarters in a well-defended spot, with a good harbour and excellent outlook. The country they named New Caledonia, and two sites selected for future cities were designated respectively New Edinburgh and New St. Andrews. At first all seemed to go well, but by and by lack of provisions, sickness and anarchy reduced the settlers to the most miserable plight, and in June 1699 they re-embarked in three vessels, a weak and hopeless company. Meanwhile, a supplementary expedition had been prepared in Scotland, two vessels were despatched in May, and four others followed in August. But this venture proved even more unfortunate than the former. The last addition to the settlement was the company of Capt. Alexander Campbell of Fona, who arrived only to learn that a Spanish force of 1,500 or 1,600 men lay encamped at Tubacanti on the river Santa Maria, waiting for the appearance of a Spanish squadron in order to make a combined attack on the fort. Campbell was at first successful in a surprise attack but after the arrival of the Spanish fleet the garrison was forced to capitulate, and Darién colony was no more. Of those who had taken part in the enterprise only a miserable handful ever reached their native land.

See J. S. Barbour, *A History of William Paterson and the Darién Company* (1907), A. H. Vairill, *Panama, Past and Present* (1921), E. Collen, *Isthmus of Darien Ship Canal* etc. (2d ed. 1881), J. H. Burton, *The Darién Papers* (1849), and G. P. Inch, *Papers Relating to the Ships and Voyages of the Company of Scotland Trading to Africa and the Indies* (1924).

DARÍO, RUBÉN (1867-1916), South American poet, was born at Metapa (Nicaragua), and came to Madrid in 1892. In

his *Provas profanas* (1899) he revealed himself a symbolist, then, throwing off every trammel, ardent in the pursuit of all that was rare and new and beautiful, he astonished the Spanish-speaking world by his *Canto a la Argentina y otros Poemas* (1900), *Cantos de vida y Esperanza* (1905), and *Canto errante* (1907). Hired as of rules and schools, Dario followed his own path, trying the boldest innovations, especially in metre. His experiments were not always successful, nor did he succeed in founding a school, but he has left his mark on Castilian verse, infusing into it new life and enlarging its traditional forms. He writes a nervous poem in such works as *Los Raros* (1893), *Tierras solares* (1904) and *Todo al Vuelo* (1912).

DARIUS, the name of three Persian kings (Pers *Dariya* vanish, Old Test. *Darjavesch*).

1 **DARIUS THE GREAT**, the son of Hystaspes (*q.v.*). The principal source for his history is his own inscriptions, especially the great inscription of Behistun (*q.v.*), in which he relates how he gained the crown and put down the rebellions. In modern times his veracity has often been doubted, but without any sufficient reason, the whole tenor of his words shows that we can rely upon his account. The accounts given by Herodotus and Ctesias of his accession are in many points evidently dependent on this official version with many legendary stories interwoven, e.g., that Darius and his allies left the question as to which of them should become king to the decision of their horses, and that Darius won the crown by a trick of his groom.

Darius belonged to a younger branch of the royal family of the Achaemenidae. When, after the suicide of Cambyses (March 521), the usurper Gaumata ruled undisturbed over the whole empire under the name of Bardiya (Smerdis), son of Cyrus, and no one dared to ganssay him Darius, "with the help of Ahuramazda," attempted to regain the kingdom for the royal race. His father Hystaspes was then alive but evidently had not the courage to urge his claims. Assisted by six noble Persians, whose names he proclaims at the end of the Behistun inscription, he surprised and killed the usurper in a Median fortress (Oct. 521, for the chronology of these times cf. E. Meyer, *Forschungen zur alten Geschichte*, II, 472 ff.), and gained the crown. But this sudden change was the signal for an attempt on the part of all the eastern provinces to regain their independence. In Susiana, Babylon, Media, Sagartia, Margiana, usurpers arose, pretending to be of the old royal race, and gathered large armies around them, in Persia itself Vahyazdada imitated the example of Gaumata and was acknowledged by the majority of the people as the true Bardiya. Darius, with only a small army of Persians and Medes and some trustworthy generals, overcame all difficulties, and in 520 and 519 all the rebellions were put down (Babylon rebelled twice, Susiana even three times), and the authority of Darius was established throughout the empire.

Darius in his inscriptions appears as a fervent statesman and organizer. The time of conquests had come to an end, the wars which Darius undertook, like those of Augustus, only served the purpose of gaining strong natural frontiers for the empire and keeping down the barbarous tribes on its borders. Thus Darius subjugated the wild nations of the Pontic and Armenian mountains and extended the Persian dominion to the Caucasus, for the same reasons he fought against the Sacae and other Turanian tribes. But by the organization which he gave to the empire he became the true successor of the great Cyrus. His organization of the provinces and the fixing of the tributes are described by Herodotus in 90 ff., evidently from good official sources. He fixed the coin age and introduced the gold coinage of the Darius (which is not named after him, as the Greeks believed, but derived from a Persian word meaning "gold"; in Middle Persian it is called *sarg*). He tried to develop the commerce of the empire and sent an expedition down the Kabul and the Indus, led by the Carian captain Scylax of Caryanda, who explored the Indian Ocean from the mouth of the Indus to Suex. He dug a canal from the Nile to Suex, and, as the fragments of a hieroglyphic inscription found there show, his ships sailed from the Nile through the Red Sea by Saba to Persia. He had connections with Carthage (see the *Karka* of the Nakshu Rustam inscr.), and explored the shores of Sicily and Italy. At

the same time he attempted to gain the good will of the subject nations, and for this purpose promoted the aims of their priests. He allowed the Jews to build the Temple at Jerusalem. In Egypt his name appears on the temples which he built in Memphis, Edfu and the Great Oasis. He called the high priest of Sais Uzhor, to Susa (as we learn from his inscription in the Altun) and gave him full powers to reorganize the 'house of life,' the great medical school of the temple of Sais. In the Egyptian traditions he is considered as one of the great benefactors and lawgivers of the country (Herod. II, 110, Diod. I, 95). He stood in similar relations to the Greek sanctuaries (cf. his rescript to 'his slave' Goditis the inspector of a royal park near Magnesia on the Meander in which he grants freedom of tines and forced labour to the sacred territory of Apollo. See Cousin and Deschamps, *Bulletin du congrès hellénique*, XII (1889), 520 and Dittenberger, *Syllabe usque graecae*, 2), all the Greek oracles in Asia Minor therefore stood on the side of Persia in the Persian wars and admonished the Greeks to at least no resistance. Even Delphi was not entirely free from the taint of Medism.

About 512 Darius undertook a war against the Scythians. A great army crossed the Bosphorus, subjugated eastern Thrace, and crossed the Danube. The purpose of this war can only have been to attack the nomadic Turanian tribes in the rear and thus to secure peace on the northern frontier of the empire. It was used upon a wrong geographical conception, even Alexander and his Macedonians believed that on the Hindu Kush (which they called Caucasus) and on the shores of the Jivartes (which they called Tanais, i.e., Don) they were quite near to the Black Sea. Of course the expedition undertaken on these grounds could not but prove a failure, having advanced for some weeks into the Russian steppes Darius was forced to return. The details given by Herodotus (according to him Darius had reached the Volga) are quite fantastic, and the account which Darius himself had given on a tablet, which was added to his great inscriptions in Behistun, is destroyed with the exception of a few words (see R. W. Macan, *Herodotus*, vol. II, appendix 3, G. B. Grundy, *Griech. Persien*, W'at, pp. 48-64, J. B. Bury, in *Classical Review*, July 1897).

Although European Greece was intimately connected with the coasts of Asia Minor, and the opposing parties in the Greek towns were continually soliciting his intervention, Darius did not meddle with their affairs. The Persian wars were begun by the Greeks themselves. The support which Athens and Eretria gave to the rebellious Ionians and Carians made an attempt to punish them inevitable as soon as the rebellion had been put down. But the first expedition, that of Mardonius, failed on the cliffs of Mt. Athos (492), and the army which was led into Attica by Datis in 490 was beaten at Marathon. Before Darius had finished his preparations for a third expedition an insurrection broke out in Egypt (486). In the next year Darius died, probably in Oct. 485, after a reign of 36 years. He was one of the greatest rulers the East has produced.

2 **DARIUS II**, OCHUS Artaxerxes I, who died in the beginning of 424, was followed by his son Xerxes II. But before two months had elapsed he was murdered by his brother Sogdianus, or Sogdianus (the form of the name is uncertain). Against him rose a bastard brother, Ochus, satrap of Hyrcania, who after a short fight killed him and suppressed by treachery the attempt of his own brother Aristes to imitate his example (Ctesias ap. Phot. 44, Diod. XII, 71, 108, Pausan. VI, 5, 7). Ochus adopted the name Darius (in the chronicles called *Nothos*, the bastard). Neither Xerxes II. nor Sogdianus occurs in the dates of the numerous Babylonian tablets from Nippur, here the dates of Darius II. follow immediately on those of Artaxerxes I. Of Darius II.'s reign we know very little (a rebellion of the Medes in 409 is mentioned in Xenophon, *Hellen* I, 2, 10), except that he was quite dependent on his wife Parysatis. In the excerpts from Ctesias some harem intrigues are recorded, in which he played a disreputable part. As long as the power of Athens remained intact he did not meddle in Greek affairs, even the support which the Athenians in 413 gave to the rebel Amorges in Caria would not have touched him (Aeschylus, *Agamemnon*, 29, Thuc. VIII, 28, 54, Ctesias wrongly names his father Pisuthnes in his stead, an account of these wars is contained in

the great Lycian stele from Xanthus in the British Museum), had not the Athenian power broken down in the same year before Syracuse. He gave orders to his satraps in Asia Minor, Tissaphernes and Pharnabazus, to send in the overdue tribute of the Greek towns and to begin war with Athens, for this purpose they entered into an alliance with Sparta. In 408 he sent his son Cyrus to Asia Minor to carry on the war with greater energy. In 404 he died after a reign of 19 years, and was followed by Artaxerxes II.

3 DARIUS III, CODOMANNUS. The eunuch Bagoas (q.v.), having murdered Artaxerxes III in 338 and his son Sises in 336, raised to the throne a distant relation of the royal house, whose name, according to Justin 2.3, was Codomannus, and who had excelled in a war against the Cadusians (cf. Diod. xvii.5 f., where his father is called Arsames, son of Ostanes, a brother of Artaxerxes). The new king, who adopted the name of Darius, noted the fate of his predecessors and saved himself from it by forcing Bagoas to drink the contents of the cup himself. In 336 Philip II of Macedon had sent an army into Asia Minor and in the spring of 334 the campaign of Alexander began. In the following year Darius himself took the field against the Macedonian king, but was beaten at Issus and in 331 at Arbela. In his flight to the east he was disposed and killed by Bessus (July 330).

The name Darius was also borne by many later dynasts of Persian origin, among them Kings of Persia (q.v.), Darius of Media Atropatene who was defeated by Pompeius, and Darius, king of Pontus in the time of Antony. (Ed. M.)

DARJEELING, a town and district of India, in the Rajshahi division of Bengal. The town is a hill station and the hot weather headquarters of the Bengal government. In 1941 it had a population of 25,873. It occupies a long ridge with two projecting spurs, on which are the town proper and the cantonments of Kataphar, Jalapahar and Lebong. The total area is nearly 5 sq. m., and the difference between its highest and lowest points is about 2,000 feet, Kataphar being 7,886 ft. and Lebong 5,970 ft. above sea level. It enjoys a temperate climate, the average maximum and minimum temperatures being only slightly above those of London, but it has a heavy rainfall, over 100 in. falling from June to October, in these months it is often hidden in mist. On the other hand, snow rarely falls in the winter. Darjeeling commands one of the most beautiful views in the world, for the eye goes up from the valleys to a succession of ranges

Lepchas in 1931. In the *terai* the Bengali Rajbansis (originally Koch) predominate. Over a third of the district is occupied by forests, which cover the hills above 6,000 ft., and below 3,000 ft., these being the limits of cultivation of food crops and of tea. The principal cultivated products are tea and rice. There were 63,600 ac. in tea yielding 33,500,000 lb. in 1936-37, and 61,900 ac. in rice with an output of 73,400,000 lb. There were 2,700 ac. of cinchona trees and the factory at Mungpo is capable of manufacturing over 50,000 lb. of quinine annually. The Darjeeling Himalayan railway of 2 ft. gauge connects the town of Darjeeling with the Eastern Bengal State railway at Silghuri, from which a branch line runs up the Tista valley to Kalimpong road.

The British connection with Darjeeling dates from 1816, when, at the close of the war with Nepal, the British made over to the Sikkim rajah the *terai* tract, which had been wrested from him and annexed by Nepal. In 1835 the nucleus of the present district was created by a cession of a portion of the hills by the rajah of Sikkim to the British as a sanatorium. A military expedition against Sikkim, rendered necessary in 1850 by the imprisonment of Dr. A. Campbell, the superintendent of Darjeeling, and Sir Joseph Hooker, resulted in the annexation of the Sikkim *terai* at the foot of the hills and of a portion of the hills beyond. The hill territory east of the Tista was acquired as the result of the Bhutan war of 1864, and now forms the Kalimpong sub-division.

DARK AGES, a term formerly used to cover the whole period between the end of classical civilization and the revival of learning in the 15th century. The use of the term implied an exclusive respect for classical standards in literature and art and a corresponding disparagement of all that was achieved between the decline of ancient culture and the work of Renaissance scholars, writers and artists. With the progress of mediaeval studies in the 19th century it became impossible for historians to dismiss one of the great constructive periods in human activity with an epithet implying contempt for its achievements, and the phrase has now become obsolete. It remains, nevertheless, the fact that the six centuries following the collapse of the Roman empire are in an especial sense dark through the insufficiency of historical evidence. Even so, it is necessary to remember that intellectual work of the highest quality was done by exceptional individuals in ages when life was insecure and its environment very discouraging to thought. The ages which form the prelude to mediaeval history are dark when compared with the time which followed them, but the foundations of mediaeval civilization were laid in these obscure and troubled centuries.

64095 (F M S)

DARLEY, GEORGE (1795-1846), Irish poet, was born in Dublin and educated at Trinity college. He settled in London in 1821, where he contributed to *The London Magazine*, and became dramatic and art critic to the *Athenaeum*. His best known works are a fairy opera, *Sylvia* (1827), and a poem "Nepenthe" (1835).

See the *Selections from the Poems of George Darley*, with an introduction by R. A. Streetfield (1904), Claude Abbott, *Life and Letters of George Darley* (1903).

DARLING, CHARLES JOHN, 1ST BARON (1849-1936), English judge, was born on Dec. 6, 1849. At the age of 24 he was called to the bar, in 1885 he became a Q.C., and soon afterwards entered Parliament as Conservative member for Deptford. He sat in the House of Commons from 1888 until 1897 when he was knighted. His appointment in 1897 to a judgeship was not received with universal approval, but he later justified the choice by proving himself to be a man of acute understanding, with an unusual insight into human nature. In 1923 he retired, and in 1924 was granted a peerage. Among his published works are *Scintillae Juris* (1877), *Meditations in the Tea Room* (1879), *Seria Ludo* (1903), *On the Oxford Circuit* (1904), *Musings on Murder*, etc. (1925). *A Pensioner's Garden and other Verses* (1926).

See Evelyn Graham, *Lord Darling and his Fantastic Trials* (1920). **DARLING, GRACE HORSLEY** (1815-1842), British heroine, was born at Bamborough, Northumberland, on Nov. 24, 1815. Her father, William Darling, was the keeper of the Longstone (Farne Islands) lighthouse. On the morning of Sept. 7, 1838, the "Forfarshire," bound from Hull to Dundee, with 63

persons on board, struck on the Farne Island, 43 being drowned. The wreck was observed from the lighthouse, and Darling and his daughter determined to try to reach the survivors. By a combination of daring, strength and skill, the father and daughter reached the wreck in their cable and brought back four men and a woman to the lighthouse. Darling and two of the rescued men then returned to the wreck and brought off the four remaining survivors. Grace Darling and her father received the gold medal of the Humane society, the treasury made a grant, and a public subscription was organized. Grace Darling died of consumption on Oct. 20, 1842.

See *Grace Darling, her true story* (1880), *Grace Darling, The Maid of the Isles* (1839), E. Hope, *Grace Darling* (1873), T. Arthur, *Grace Darling* (1885).

DARLING, a river of Australia. (q.v.)

DARLINGTON, market town, county and parliamentary borough, Durham, England, 234 mi. NW of London, on the L.N.E. Ry. Pop. (1938) 75,930. Area 10.1 sq. mi. It lies on the river Skerne, a tributary of the Tees, not far from the main river. Its appearance is almost wholly modern, but there is a fine old parish church on the site of an earlier church, dedicated to St. Cuthbert. It is cruciform, and in style mainly transitional Norman, and has a central tower surmounted by a spire of the 14th century. Educational establishments include an Elizabethan grammar school, a training college and a technical school. There is a park of 44 ac. The industries include worsted spinning, coal and ironstone mining, quarrying and brickmaking, the manufacture of iron and steel into bridge castings, ships' engines, munitions, etc. The large locomotive works of the L.N.E. Ry. were removed there from Gateshead. The town was incorporated in 1867.

Before the 19th century Darlington was noted for the manufacture of linen, worsted and flax, but it owes its modern importance to the opening of the railway between Darlington and Stockton on September 27, 1825. "Locomotive No. 1," the first that ever ran on a public railway, stands in Bank Top station. Darlington sent no members to parliament until 1862, after which year it returned one member. The fairs and markets in Darlington were formerly held by the bishop and were in existence as early as the 11th century. The markets and fairs were finally in 1854 purchased by the local authority.

DARLINGTON, a town of northeastern South Carolina U.S., served by the Atlantic Coast Line and the Seaboard Air Line railways, county seat of Darlington county. It is on federal highway 32. Pop. (1950) 6,615. It has a cotton mill, a drinking cup factory, a chair factory, a flour and corn products mill, veneer mills, shingle mills, a cottonseed oil mill, ice and lumber manufacturing plants, tobacco warehouses and a tobacco stemming plant. It was founded about 1785. The Darlington international raceway is there.

DARLINGTONIA (named after Dr. William Darlington, an American botanist, 1782-1863), the Californian pitcher plant, belonging to the family Sarracenaceae. There is only one species, *D. californica*. According to Greene, the generic name should be *Chrysanthophora*. It grows in sphagnum swamps and springy hill sides in southwestern Oregon and northwestern California from near sea level to an altitude of 6000 ft in the Sierra Nevada Mts. The tall tubular leaves grow in a cluster arising from a stout horizontal stolon and have two forms. The juvenile leaf has the open top overhanging by a tapering lid like appendage, seen on the left of the illustration. Such leaves are found in seedlings and variously on small shoots. The leaf of maturity may reach a height of 3 ft, gradually expanding its diameter till at the top it expands suddenly into a bent over hood ending in a downward hanging appendage of the shape of a fistula. Beneath the hood is a rounded opening, the entrance, guarded on the inside by a low, returned flange having many nectar glands, which are common also to the fistula appendage, and to the interior surface of the hood. The roof of the hood is tessellated by white translucent patches, windows mullioned by green, eventually red bands of chlorophyll bearing tissues. To an insect approaching the entrance, attracted by the nectar on the fistula or elsewhere beneath the hood, the fenestrations doubtless suggest a way of

exit. When once inside, the insect feeds on the abundant nectar and gradually, impelled by downward pointing hairs, falls into the hollow tubular leaf. Since digestive glands are absent, the decay of the captured insect takes place through the agency of bacteria, the products of this sort of digestion being absorbed by the walls of the tube, from which cuticle is absent.

An interesting matter in this connection is the invariable presence of living insect larvae in the wet mass of decaying insects which are usually very plentiful. A few of these are obligate

commensals, not occurring elsewhere. Among these are two minute gnats, *Meloboris knabi* and *M. edwardsi*. So abundant is the dead prey that the odour of decay has often been remarked.

(F. E. L.)

DARLY, MATTHIAS or MATTHEW, (? -1781?)

English caricaturist, designer and engraver. This extremely versatile artist produced social and political caricatures, designed architectural and mobiliary accessories, made many engravings for Thomas Chippendale, and sold his own productions at his print shop in the Strand (and elsewhere) which was one of the first to stock prepared colours and materials for artists. His first known publication is a coloured caricature, "The Cricket Players of Europe" (1741). Darly was in partnership with one Edwards, with whom he published many political prints which were collected annually

into volumes under the title of *Political and Satirical History*. He published in 1754 *A New Book of Chinese Designs* and engraved many of the plates for the *Director* of Thomas Chippendale in 1770-71 appeared Darly's most important work—*The Ornamental Architect or Young Artists' Instructor*, the title of which became in the 1773 edition *A Complete Body of Architecture, embellished with a great Variety of Ornament*. His last caricature was published in October 1780, and as his shop, No. 39 Strand, was let to a new tenant in 1781, it is presumed that he had by then died or become incapable of further work.

See George Paxton, *Second Caricature in the 18th Century* (1905).

DARMESTER, ARSENE (1846-1888), elder brother of James Darmesteter (see below), was a distinguished philologist and man of letters. He studied under Gaston Paris at the École des Hautes Études, and became professor of old French language and literature at the Sorbonne. He collaborated with Adolphe Hatfield in a *Dictionnaire général de la langue française* (2 vols., 1895-1900). Among his most important work was the elucidation of old French by means of the many glosses in the mediaeval writings of Rashi and other French Jews. His scattered papers on romance and Jewish philology were collected by James Darmesteter as *Arsène Darmesteter, reliques scientifiques* (2 vols., 1890). His *Cours de grammaire historique de la langue française* was edited after his death by E. Muret and L. Sudre (1891-95, English edition, 1902).

DARMESTER, JAMES (1849-1894), French author and antiquarian, was born of Jewish parents at Château Salins, Alsace. The family name had originated in their earlier home at Darmstadt. He studied in Paris under Michel Bréal and Abel Bergaigne. In 1875 he published a thesis on the mythology of the *Zend Avesta*, and in 1877 became teacher of Zend at the École des Hautes Études. He followed up his researches with his *Études ramennées* (1883), and ten years later published a complete translation of the *Zend Avesta*, with historical and philological commentary (3 vols., 1892-93), in the *Annales du musée Guimet*. He



DARLINGTONIA CALIFORNICA SHOWING TWO OF THE PITCHERS (LEAVES) WITH CURVED TOPS ENDING IN FISTULAL FLAPS IN FRONT. A. Flower with floral leaves removed. B. Leaf cut across to show hollow interior.

also edited the *Zend Avesta* for Max Müller's *Sacred Books of the East*. Darmstetter regarded the extant texts as far more recent than was commonly believed, placing the earliest in the 1st century B.C., and the bulk in the 3rd century A.D. In 1885 he was appointed professor in the Collège de France, and was sent to India in 1886 on a mission to collect the popular songs of the Afghans, a translation of which, with a valuable essay on the Afghan language and literature, he published on his return. His impressions of English dominion in India were conveyed in *Lettres sur l'Inde* (1888). He married A. Mary F. Robinson (see DUCLAUX, AGNES MARY FRANCES). He died on Oct. 19, 1894.

There is an *éloge* of James Darmesteter in the *Journal asiatique* (1894, vol. IV, pp. 316-341), and a notice by Henri Cordier, with a list of his writings, in the *Royal Asiatic Society's Journal* (Jan. 1895); see also Gaston Paris, "James Darmesteter," in *Penseurs et poètes* (1896, pp. 1-26).

DARMSTADT, a city of Germany, capital of the Land of Hesse Darmstadt, on a plain gently sloping from the Odenwald to the Rhine, 21 mi. by rail S.E. from Mainz and 17 mi. S from Frankfurt on Main. Pop. (1939) 115,526.

Darmstadt is mentioned in the 11th century, but in the 14th century it was still a village, held by the counts of Katzenelnbogen. It came by marriage into the possession of the house of Hesse in 1479, the male line of the house of Katzenelnbogen having in that year become extinct. The imperial army took it in the Schmalkaldic War, and destroyed the old castle. In 1567, after the death of Philip the Magnanimous, his youngest son George received Darmstadt and chose it as his residence. He was the founder of the line of Hesse Darmstadt. Its most brilliant days were those of the reign of Louis X. (1790-1830), the first grand duke, under whom the new town was built.

Darmstadt consists of an old and a new town, the streets of the former being narrow. In the new town is the stately Lusenplatz, on which are the old house of parliament, the palace and the post office, and, in the centre, a statue of the grand-duke Louis I., the founder of the new town. The ducal palace is a complex of buildings of various centuries. Adjoining the palace gardens, are the theatre and armoury, and a little farther west the museum, a library of 600,000 volumes and 4,000 tape, a museum of Egyptian and German antiquities, a picture gallery with masterpieces of old German and Dutch schools, a natural history collection and the State archives. To the south of the castle lies the old town, with market square, town hall and town church. The town possesses a technical high school, having (after 1900) power to confer the degree of doctor of engineering, and attended by about 2,000 students, two gymnasia, a school of agriculture, an artisans' school and a botanical garden. The chemist, Justus von Liebig, was born in Darmstadt in 1803. The industries are very varied. The city was bombed by the British in World War II.

To the east of the town lies the Mathildenhöhe, formerly a park and now converted into villa residences. Here are the Alice hospital and the Russian church, built (1898-99) by the emperor Nicholas II. of Russia in memory of his Hessian wife.

See Walther, *Darmstadt von es war und wie es geworden* (Darmstadt 1865), and Zernin and Wornat, *Darmstadt und seine Umgebung* (Zürich, 1890).

DARMSTÄDTER UND NATIONALBANK The bank was a merger of the Bank für Handel und Industrie (generally known as the Darmstadter bank) with the Nationalbank für Deutschland. The amalgamation took place in 1922.

The Bank für Handel und Industrie was founded in 1853 in Darmstadt. It was in intimate relationship with the most important firms and possessed a large number of branches.

The Nationalbank für Deutschland was founded in 1881. In 1909, after having absorbed the Deutsche Nationalbank in Bremen and later the Holsten bank in Neumünster, it turned its attention to branch banking. The Nationalbank für Deutschland was, in its relationships with industrial enterprises, the main support of its business, and by founding, or collaborating in the founding, of many important German enterprises it established a basis for financial and syndicate investment business.

The capital of the Darmstadter und Nationalbank in 1928 was 60,000,000 reichsmarks, and the open reserves (which were

40,000,000 reichsmarks when the gold balance sheet was drawn up in 1924) were increased by 10,000,000 in 1927 and by an additional 5,000,000 in 1928, the reserves amounted to 55,000,000 reichsmarks. The Darmstadter und Nationalbank was represented in the management of the most important industrial enterprises in Germany and was on the board of approximately 1,000 companies. It founded together with an international group, the "Internationale Bank te Amsterdam" with the object of carrying out international financial transactions.

In 1928 the Darmstadter und Nationalbank owned 143 bank buildings, had branches in approximately 120 towns. The Darmstadter bank ceased to exist in 1931 on merging with the Dresdner bank.

DARNLEY, HENRY STEWART or STUART, Lord (1545-1567), earl of Ross and duke of Albany, second husband of Mary, queen of Scots, was the eldest son of Matthew Stewart, earl of Lennox (1516-1571), and through his mother Lady Margaret Douglas (1515-1578) was a great-grandson of the English king Henry VII. Born at Temple Newsam in Yorkshire on Dec. 7, 1545, he was educated in England. After the death of Francis II. in 1560 Darnley was sent to France by his mother, who hoped that he would become king of England on Elizabeth's death, and entertained the idea of his marriage with Mary, queen of Scots, the widow of Francis, as a means to this end. In 1561 both Lady Margaret and her son, who were English subjects, were imprisoned for a short time by Elizabeth, and Darnley spent some time at the English court before going to Scotland in Feb. 1565. The marriage of Mary and Darnley was now definitely proposed, and the queen, having nursed her new son through an attack of measles, decided to marry him. Elizabeth had permitted Darnley's journey to Scotland, but she and her council declared their dislike of the proposed marriage, and ordered Darnley and his father to repair to London, a command which was disobeyed. In March 1565 there were rumours that the marriage had already taken place, but the public marriage, at all events, was celebrated at Holyrood on July 29, 1565.

Although Mary had doubtless a short infatuation for Darnley, the union was mainly due to political motives, and trouble soon arose between them. Contrary to his expectations Darnley did not receive the crown matrimonial. He was on bad terms with the regent Murray and other powerful nobles, who disliked the marriage and were intriguing with Elizabeth. He was in addition soon estranged from his wife. He became jealous of David Rizzio, and was easily persuaded to assent to the murder of the Italian, a crime in which he took part. Immediately afterwards, however, flattered and cajoled by the queen, he betrayed his associates to her, and helped her to escape from Holyrood to Dunbar. Deserted and distrusted by his companions in the murder, he decided to leave Scotland, but a variety of causes prevented his departure, and meanwhile at Craigmillar a band of nobles undertook to free Mary from her husband, who refused to be present at the baptism of his son, James, at Stirling in Dec. 1566. The details of the conspiracy at Craigmillar are not clear, nor is it certain what part, if any, Mary took in these proceedings. The first intention may have been to obtain a divorce for the queen, but it was soon decided that Darnley must be killed. Rumours of the plot came to his ears, and he fled from Stirling to Glasgow, where he fell ill, possibly by poisoning, and where Mary came to visit him. Another reconciliation took place, and Darnley was persuaded to journey with Mary by easy stages to Edinburgh. They stayed for a few days at Kirk o' Field, a house just inside the city walls. On the evening of Feb. 9, 1567 Mary bade her husband farewell, and went to attend some guests in Edinburgh. A few hours later, on the morning of the 10th, Kirk o' Field was blown up with gunpowder. Darnley's body was found at some distance from the house, and it is supposed that he was strangled whilst making his escape. The remains were afterwards buried in the chapel at Holyrood.

As the father of King James I., Darnley is the direct ancestor of all the sovereigns of England since 1567.

For further information, and also for a list of the works bearing on his life, see the article MARY, QUEEN OF SCOTS.

DARRANG, a district of British India, in the province of Assam. It lies between the Bhutan and Daffa hills and the Brahmaputra, including many islands in the river. The administrative headquarters are at Tezpur, pop. (1941) 11,879, on the right bank of the Brahmaputra. Its area is 2,804 sq mi. Pop. (1941) 736,791. In 1914, 500 sq mi of almost uninhabited country were transferred to the Balpara Frontier tract, formed in that year. It is for the most part a level plain watered by many tributaries of the Brahmaputra. The district contains the two sub-divisions of Tezpur and Mangaldai, tea being the principal cultivation in the valley of Tezpur, and rice in Mangaldai. In Tezpur the population density rose to 303 per sq mi in 1931 from 42 in 1890, owing to large areas of wasteland being brought under cultivation. In Mangaldai the density in 1931 was 260 per sq mi. In 1936-37 there were 408,061 ac in rice with an output of 364,000,000 lb, and 61,479 acres in tea yielding about 37,300,000 lb. There were 568 sq mi of reserved forests, mostly at the foot of the hills along the northern boundary.

DARROW, CLARENCE SEWARD (1857-1938), American lawyer, was born at Kinsman, O., April 15, 1857. He received a public school education and was called to the bar in 1875, afterwards practising in Chicago. He appeared as counsel in a large number of important cases, many of which attracted wide attention, and he became recognized as one of the leading criminal lawyers in the United States. He was retained by the labour organizations in much of their litigation of recent years. Among the celebrated cases in which he appeared were the Debs strike case (1895), anthracite coal strike arbitration (1902), Stearnsburg murder (1907), *The Los Angeles Times* dynamite case (1911) and the Loeb Leopold case (1924). In July 1925 he defended J. T. Scopes at the Tennessee evolution trial. He wrote *Crime, Its Causes and Treatment* (1922), *Farmington, A Person Pearl and Other Essays, An Eye for an Eye, The Prohibition Mania*, and many other books and pamphlets on social, literary and economic questions.

For many years he was a well-known platform speaker and debater.

DARTER: see SNAKE BIRD

DARTFORD, a market town and municipal borough in the Dartford parliamentary division of Kent, England, 17 mi S.E. of London by the Southern railway. Pop. (1938) 35,680. Area 66 sq mi. Its most noteworthy building is the parish church, restored in 1863, which contains an old fresco and several interesting brasses, and has a Norman tower, restored in 1910. The grammar school dates from 1756.

Dartford was the scene, in 1235, of the marriage, celebrated by proxy, between Isabella, sister of Henry III, and the Emperor Frederick II, and in 1331 a famous tournament was held in the place by Edward III. The same monarch established a Dominican nunnery on West Hill in 1356, of which, however, little remains. After the Dissolution it was used as a private residence by Henry VIII, Anne of Cleves and Elizabeth. The chantry of St Edmund the Martyr on the opposite side of the town was a part of Edward III's endowment to the priory, and became famous as a place of pilgrimage on the way to Canterbury. The part of Watling street which crossed there towards London was sometimes called "St Edmund's Way." On Dartford heath is the mental home maintained by the London County Council. Greenhite, on the banks of the Thames, has large chalk quarries in its neighbourhood, from which lime and cement are manufactured. One of the first attempts at the manufacture of paper in England was made here by Sir John Spielman (d. 1607), jeweller to Queen Elizabeth. Papermaking is still important here as well as chemical, metal and leatherworking. From 1894 until 1933, when it was incorporated, Dartford was governed by an urban district council.

DARTMOOR, high plateau, in south-west Devonshire, England. It is 23 mi from north to south, 20 mi from east to west, 215 sq mi in area with a mean altitude of 1,500 feet. It is the highest and easternmost in a broken chain of granitic elevations which extends to the Scilly Isles. The higher parts are open, bleak and wild. Sloping heights rise from the main tableland, crested with broken masses of granite, locally named *tors*. The

highest of these are Yes Tor and High Willhays (2,028 and 2,029 feet). Large parts of the moor are covered with morasses, and head waters of all the principal streams of Devonshire are found there. Only two good roads cross the moor, one between Exeter and Plymouth, and the other between Ashburton and Tavistock, intersecting at Two Bridges. The central part of Dartmoor was a royal forest from a date unknown, probably before the Conquest. Its woods were formerly more extensive than now, but a few small tracts of dwarf oaks remain in the lower parts. Previous to 1337 the forest had been granted to Richard, earl of Cornwall, by Henry III, and from then has belonged to the Duchy of Cornwall. The districts immediately surrounding the moor are called the Venenile or Fenfield districts. The holders of land by Venenile tenure have rights of pasture, fishing, etc., in the forest. (For antiquarian remains see Devon.)

Princetown prison was built in 1806 to house French prisoners and was adapted for use as a convict station in 1850. A tract of moorland adjacent to the prison was brought under cultivation by the inmates.

DARTMOUTH, EARL OF, an English title borne by the family of Legge from 1710 to the present day.

WILLIAM LEGGE (c. 1609-1670), the eldest son of Edward Legge (d. 1616), vice-president of Munster, assisted Charles I in his war against the Scots in 1638. He was also very useful to the king during the months which preceded the outbreak of the Civil War, although his attempt to seize Hull in Jan. 1642 failed. During the war Legge distinguished himself at Chalgrove and at the first battle of Newbury, and in 1645 he became governor of Oxford. Legge helped Charles to escape from Hampton Court in 1647, and was arrested in May 1648. He was released, but was again captured in 1649, and remained in prison until 1652. He then spent some years abroad, but in 1659 was in England inciting the royalists to rise. The old royalist died on Oct. 13, 1670.

Legge's eldest son, **GEORGE, BARON DARTMOUTH** (1647-1691), served as a volunteer in the navy during the Dutch war of 1665-1667. He was a member of the household of the duke of York, afterwards James II, was governor of Portsmouth and master-general of the army. In 1678 he commanded as colonel the troop at Neuport, and in 1682 he was created Baron Dartmouth. In 1683 as "admiral of a fleet" he sailed to Tangiers, dismantled the fortifications and brought back the English troops. Under James II Dartmouth was master of the horse and governor of the Tower of London, and in 1688 when William of Orange was expected, James II made him commander-in-chief of his fleet. Although himself loyal to James, the same cannot be said of many of his officers, and an engagement with the Dutch fleet was purposely avoided. Dartmouth, however, refused to assist in getting James Edward, prince of Wales, out of the country, and even reproved the king for attempting this proceeding. He then left the fleet and took the oath of allegiance to William and Mary, but in July 1691 he was arrested for treason, and was charged with offering to hand over Portsmouth to France and to command a French fleet. Dartmouth protested his innocence. He died in the Tower of London on Oct. 25, 1691, before the question was investigated. (See *Dartmouth Papers* [Hist. MSS. Comm. and Report ix and x pp. 9-12, 1870-72].)

Lord Dartmouth's only son, **WILLIAM, 1ST EARL OF DARTMOUTH** (1672-1750), succeeded to his father's barony in 1691. He became secretary of state for the southern department and joint keeper of the signet for Scotland in 1710. In 1711 he was created viscount Lewisiam and earl of Dartmouth, in 1713 he exchanged his offices for that of keeper of the privy seal, which he held until the end of 1714. After a long period of retirement from public life he died on Dec. 15, 1750.

WILLIAM, 2ND EARL OF DARTMOUTH (1731-1801), grandson of the 1st earl, was lord privy seal at the beginning of the dispute with the American colonies. He advised them in 1777 to accept the conciliatory proposals put forward by Lord North, but in 1776 he opposed similar proposals and advocated the employment of force. In March 1782 he resigned his office, and in 1783 became lord steward of the household, he died on July 15, 1801. Dartmouth's piety and his intimacy with the early Methodists were

him the epithet of the *Psalmsinger*. Dartmouth College was named after him, and among his papers preserved at Patshall House, Wolverhampton, are many letters from America relating to the struggle for independence, printed in *Dartmouth Papers* (Hist. Mass Comm. 11th Rep. pp. 19-23 and spp. v. 1-500, 1887).

DARTMOUTH, a seaport and municipal borough in the Torquay parliamentary division of Devonshire, England, 27 mi E. of Plymouth. Pop. (1951) 5,842. Area, 3 sq. mi. It is near the mouth of the river Dart, which here forms an almost land-locked estuary, and is connected by ferry steamer with Kingswear on the opposite shore. The houses rise in tiers from the shore, beneath a range of hills. The parish church of St. Saviour is of the 14th and 15th centuries, and retains an oak road-screen and an ancient stone pulpit. The churches of St. Petrox and St. Clement, both Early English, represent respectively the ancient manors of Clifton and Hardness, which with Dartmouth gave the borough its official name of Clifton Dartmouth Hardness.

Dartmouth castle, partly Tudor, commands the river, the wooded castle estate was purchased by the corporation in 1904. Portions of the cottage of Thomas Newcomen, one of the inventors of the steam engine, are preserved. The Royal Naval Cadet college was opened in 1905 to take the place of the Britannia training ship, it occupies the site of a former seat called Mount Boone. Dartmouth is a yachting centre, and shipping and yacht and boat building are the chief industries. Coal is imported, and resold. River steamers ply to Totnes, 10 mi. up the Dart.

Probably owing its origin to Saxon invaders, Dartmouth was a seaport of importance when Earl Beorn was buried in its church in 1049. From its sheltered harbour William II. embarked in 1099 for the relief of Mans and Richard I.'s squadron set sail for the crusades in 1190, while John landed here in 1214. The borough, first claimed as such in the reign of Henry I., was in existence by the middle of the 13th century. In the 13th century Dartmouth was required to furnish ships for the king's service, an obligation maintained throughout the following century. In 1342 the town was incorporated by a charter frequently confirmed by later sovereigns. A French attack on the town was repulsed in 1404, and in 1485 the burgesses received a royal grant of £40 for walling the town and stretching a chain across the river mouth. Dartmouth fitted out two ships against the Armada, and was captured by both the Royalists and Parliamentarians in the Civil War. Manorial markets were granted for Dartmouth in 1231 and 1301. These were important, since as early as 1225 the fleet provisioned there. During the 14th and 15th centuries there was a regular trade with Bordeaux and Brittany, and complaints of piracy by Dartmouth men were frequent.

DARTMOUTH, a town in Halifax county, Nova Scotia, Canada, on the northeastern side of Halifax harbour, connected by a steam ferry with Halifax. Pop. (1951) 14,687. It contains a large sugar refinery, foundries, machine shops, sawmills, skate, rope, nail, soap and sash factories and also the Imperial Oil works. Though practically a suburb of Halifax, Dartmouth was separately founded in 1750, it was the first town incorporated in Nova Scotia.

DARTMOUTH COLLEGE, an American institution of higher education for men, in Hanover, New Hampshire. It is Congregational by origin but actually non-sectarian. Dartmouth embraces the original college, incorporated in 1769, a medical school, dating from 1798, the Thayer School of Civil Engineering, established in 1867 by the bequest of General Sylvanus Thayer, and the Amos Tuck School of Administration and Finance, established in 1900 by Edward Tuck—the first, and until the establishment at Harvard of a similar graduate school, the only commercial school in the country whose work is largely post-graduate. The Chandler School of Sciences and the Arts was founded by Abel Chandler in 1851 in connection with Dartmouth and incorporated in the collegiate department in 1893 as the Chandler scientific course in the college. From 1866 to 1893 the New Hampshire College of Agriculture and the Mechanic Arts, now at Durham, was connected with Dartmouth. The medical school granted the degree of M.D. until 1914, when the last two clinical years were discontinued. The Thayer school and the Tuck school maintain each a two years' course, the first year of

which may, under certain conditions, be counted as the senior year of the undergraduate college.

The college has a beautiful campus, 15 instruction halls, 22 residence halls, with accommodation for 1,650 students, a large gymnasium, built in 1911 by alumni, with the Spaulding swimming pool (1919), the Davis field house (1927) and the Davis Hockey Rink (1929) attached, and large athletic fields, an auditorium, Webster hall (1901), College hall (1901), a social headquarters, Rollins chapel (1885), an astronomical and meteorological observatory (Shattuck observatory, 1854). The Fisher Ames Baker Memorial Library (completed 1928) replaces Wilson hall (1885) and contains 420,000 volumes. This library, the gift of George F. Baker, cost \$1,000,000. With it are associated the Carpenter Fine Arts Building (1929) and the Sanborn English House (1929). The physical laboratory is housed in Wilder hall (1899). Instruction in chemistry is given in the Steele Chemistry Laboratory (1921), the natural sciences in Silsby hall (1928) where geological and ethnological collections are also maintained, while botany is taught in the Clement greenhouse (1928). Parkhurst hall (1911) contains the administrative offices, and Robinson hall (1914) is the home of all college organizations other than athletic. The Mary Hitchcock Memorial Hospital (1893) is associated with the Medical School, and Dick Hall's house (1927), adjoining the hospital, is a completely equipped infirmary for 50 students. The college owns the Hanover Inn with accommodation for 150 guests and maintains single or apartment houses for 50 faculty families. A new upper-class dining hall, seating some 300 students, was completed in 1937.

Dartmouth is the outgrowth of Moor's Indian Chanty School, founded by Eleazar Wheelock (1711-79) about 1750 at Lebanon, Connecticut. This school was named in 1755 in honour of Joshua Moor, who in this year gave to it lands and buildings. In 1765 Samson Occum (c. 1723-92), an Indian preacher and former student of the school, visited England and Scotland in its behalf and raised £10,000, whereupon plans were made for enlargement and for a change of site to Hanover. In 1769 the school was incorporated by a charter granted by George III. as Dartmouth College, being named after the earl of Dartmouth, president of the trustees of the funds raised in Great Britain. The first college building, Dartmouth hall, was built between 1784 and 1791. This building was twice destroyed by fire, in 1904 and 1935, and reproduced in its original external form, the second time with fireproof materials. During the War of Independence the support from Great Britain was mostly withdrawn. In 1815 President John Wheelock (1754-1817), who succeeded his father in 1779, and was a Presbyterian and a Republican, was removed by the majority of the board of trustees, who were Congregationalists and Federalists, and Francis Brown was chosen in his place. Wheelock, upon his appeal to the legislature, was reelected at the head of a new corporation, called Dartmouth University. The State courts upheld the legislature and the "university," but in 1819 after a famous argument of Daniel Webster (q.v.) in behalf of the "college" board of trustees as against the "university" board before the U. S. Supreme Court, that body decided that the private trust created by the charter of 1769 was inviolable, and Dr. Francis Brown and the old "college" board took possession of the institution's property. At the Webster centennial, celebrated in 1901, it was stated that the Dartmouth College Case had at that time been cited in judicial opinions more frequently than any other in the American reports—about 970 times.

The annals of the college have been tranquil with the exception of the disturbed years of the "university" controversy. During the Civil War Dartmouth College contributed 652 alumni and undergraduates to the Union armies. In World War I 3,319 graduates, undergraduates and faculty served in the military forces of the United States. Those dying in active service numbered 112. During most of the 19th century there was little variation in the numbers attending the college. With the administration of President William Jewett Tucker (1893-1909), however, a great expansion of equipment, endowment and enrolment took place which has continued during the present administration.

of Ernest Martin Hopkins, the 11th president. The enrolment increased from 256 students and 19 members of the faculty in 1890 to 2,400 students and more than 250 members of the faculty in 1936. In 1890 91% of the students came from New England. The constituency of the college gradually changed, until in 1936 less than 40% of the men came from homes within those States. The productive investment assets of the college also increased from approximately \$1,000,000 in 1890 to \$17,000,000 in 1936. The tuition cost in 1937 will be \$450 a year, provision is made through scholarships for assisting deserving students unable to pay this sum. The government is entrusted to a board of 12 trustees, five of whom are elected upon the nomination of the alumni. Applicants for the entering class are selected on a basis of character, scholarship and general promise of profiting by a college course. Out of more than 2,000 applicants who apply each year, an entering class of approximately 650 is selected.

During President Hopkins' administration several important features were introduced. A personnel department for advice on the curriculum and later occupation was organised. Outdoor recreation was made compulsory in the two lower classes. Experts in psychiatry and in nutrition were added to the college staff. In June 1925 certain major changes were made in the liberal arts curriculum providing *inter alia* for special treatment for students of higher grade and for the granting of but one degree, Bachelor of Arts. In 1929 senior fellowships were introduced, and more recently complete medical and surgical care without charge was adopted, and the curriculum was revised so as to insure greater study of modern social problems. One of the interesting influences of the college is promoted by the Dartmouth Outing Club, which maintains a chain of 23 cabins and shelters between Hanover and the White mountains and promotes winter sports.

See Frederick Chase, *A History of Dartmouth College and the Town of Hanover* (Cambridge, 1891); John K. Lord, *History of Dartmouth College 1815-1909* (Concord, 1913); Leon B. Richardson, *History of Dartmouth College* (Hanover, 1932); Wilder D. Quint, *The Story of Dartmouth* (Boston, 1916); *The Proceedings of the Webster Centennial of Dartmouth College* (1801), 150 Years of Dartmouth College (1919). For the Dartmouth College Case see Timothy Farrar, *Report of the Case of the Trustees of Dartmouth College against William H. Woodward* (Portsmouth, 1819); Shirley, *The Dartmouth College Cases* (St. Louis, Mo., 1879); Kent, *Commentaries on American Law* (vol. 1, Boston, 1884). (E. F. C.)

DARU, PIERRE ANTOINE, Count (1767-1829), French soldier, was born at Montpellier on Jan. 12, 1767. He was a great army administrator, and served as commissary to the army of defence of the Breton coast (1793), in Masséna's army in Switzerland (1, 99), in Berthier's army in Italy (1799), and again on the Breton coast (1803). He enjoyed the complete confidence of Napoleon, who employed him as chief commissary of the Grand Army in 1805, and made him intendant of his military household. In the campaigns of 1806-07 he served, in his usual capacity, in the army which overthrew the forces of Russia and Prussia, and he had a share in drawing up the treaty of Tilsit (July 7, 1807). After this he supervised the administrative and financial duties in connection with the French army which occupied the principal fortresses of Prussia. At the congress of Erfurt, Daru was present at the interview between Goethe and Napoleon, and interposed tactful references to the works of the great poet. Daru served again as commissary in the campaign of 1809 against Austria, and late in the year 1813 he took up the portfolio of military affairs. After

good judgment, a good intellect, a great power for work, and a body and mind of iron."

Among Daru's literary works are his *Histoire de Venise* (7 vols., 1819), *Histoire de Bretagne* (3 vols., 1826), a poetical translation of Horace, *Discours en vers sur les facultés de l'homme* (1825), and *Astronomie*, a didactic poem in six cantos (1820).

See the "Notice" by Vilnet prefixed to the fourth edition of Daru's *Histoire de la république de Venise* (9 vols., 1853) and three articles by Suinte Beuve in *Causeries de l'undi*, vol. ix. For many letters of Napoleon to Daru see the *Correspondance de Napoleon I^{er}* (32 vols., 1858-70).

His son, NAPOLEON DARU (1807-1890), created Count in 1837 was a liberal member of the National Assembly in 1848 and of the Legislative Assembly (1869) and foreign minister in 1870. He sat as a conservative in the National Assembly (1871-76), and in the senate from 1876 to 1879.

DARWEN, municipal borough, Darwen parliamentary division, Lancashire, England 20 mi. NW from Manchester by the L.M.S.R. Pop. (1938) 31,850. Area 9.2 sq. mi. It lies on the river Darwen, which traverses a densely populated manufacturing district. In the neighbourhood are collieries and stone quarries. Darwen manufactures cotton goods, paper, and has blast furnaces and fire clay works. It has a market hall, technical schools, a free library, and two public parks. A grammar school was opened in 1938. Darwen was incorporated in 1788.

DARWIN, CHARLES ROBERT (1809-1882), English naturalist, author of the *Origin of Species*, was born at Shrewsbury on Feb. 12, 1809, the grandson of Dr. Erasmus Darwin (qv). His mother, a daughter of Josiah Wedgwood (1730-1795), died in 1817. Charles's elder brother, Erasmus Alvey (1804-81), was interested in literature and art rather than science on the subject of the wide difference between the brothers. Charles wrote that he was "inclined to agree with Francis Galton in believing that education and environment produce only a small effect on the mind of anyone, and that most of our qualities are innate" (*Life and Letters*, London, 1887). Darwin considered that his own success was chiefly due to "the love of science, unbounded patience in long reflecting over any subject, industry in observing and collecting facts, and a fair share of invention as well as of common sense" (*ibid*). He also says "I have steadily endeavoured to keep my mind free so as to give up any hypothesis, however much beloved (and I cannot resist forming one on every subject), as soon as facts are shown to be opposed to it" (*ibid*). The essential causes of his success are to be found in this latter sentence, the creative genius ever inspired by existing knowledge to build hypotheses by whose aid further knowledge could be won, the calm unbiassed mind, the love of truth which enabled him to abandon or to modify his own creations when they ceased to be supported by observation. The great naturalist appeared in the ripeness of time, when the world was ready for his splendid generalizations. In the preparation for Darwin Sir Charles Lyell's *Principles of Geology* played an important part, accustoming men's minds to the vast changes brought about by natural processes, and lending them by its lucid and temperate discussion of Lamarck's and other views, to reflect upon evolution.

Darwin studied at Shrewsbury School under Dr. Samuel Butler (1774-1839), and in 1825 went to Edinburgh to prepare for the medical profession, for which he was unfitted by nature. In 1828 his father sent him to Christ's College, Cambridge with the idea that he should become a clergyman. He took his degree in 1831, tenth in the list of those who do not seek honours. Both at Edinburgh and at Cambridge he gained the friendship of older scientific men—Robert Edmond Grant and William Macgillivray at the former, John Stevens Henslow and Adam Sedgwick at the latter. From Dec. 1831 to Oct. 1836, Darwin was on the "Beagle" as naturalist for the surveying expedition. After visiting the Cape de Verde and other Atlantic islands, the expedition surveyed on the South American coasts and adjacent islands (including the Galapagos), afterwards visiting Tahiti, New Zealand, Australia, Tasmania, Keeling Island, Maldives, Mauritius, St. Helena, Ascension, and Brazil de Verdes and

Azores on the way home his work on the geology of these countries and that on coral islands became the subject of volumes which he published after his return, as well as his *Journal of a Naturalist*, and his other contributions to the official narrative. The voyage was the real preparation for his life work. His observations on the relation between animals in islands and those of the nearest continent and between living animals and those most recently extinct and found fossil in the same country, related but not the same, led him to reflect upon the modification of species. He had also been much impressed by "the manner in which closely allied animals replace one another in proceeding southwards" in South America. His pocket book for 1837 contains the words "In July opened first note book on Transmutation of Species. Had been greatly struck from about the month of previous March [while still on the voyage and just over twenty seven years old] on character of South American fossils, and species on Galapagos Archipelago. These facts (especially latter) origin of all my views." From 1838 to 1841 he was secretary of the Geological society, and saw a great deal of Sir Charles Lyell, to whom he dedicated the second edition of his *Journal*. In Jan 1839 he married his cousin, Emma Wedgwood. They lived in London until 1842, when they moved to Down, which was Darwin's home for the rest of his life. From 1846 to 1854 he was chiefly engaged upon four monographs on the recent and fossil crinoid Crustacea (*Ray Soc.*, 1851 and 1854, *Palaeontograph Soc.*, 1851 and 1854).

Soon after opening his note-book in 1837 he began to collect facts bearing upon the formation of the breeds of domestic animals and plants, and quickly saw "that selection was the keystone of man's success. But how selection could be applied to organisms living in a state of nature remained for some time a mystery to me." Various ideas as to the causes of evolution had to be successively abandoned. He hid the idea of "laws of change" which affected species and finally led to their extinction, to some extent analogous to the causes which bring about the development, maturity and finally death of an individual. He also had the conception that species must give rise to other species or else die out, just as an individual dies unrepresented if it bears no offspring. In Oct 1838 he read *Malthus on Population*, and his observations having long since convinced him of the struggle for existence, it at once struck him "that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had a theory by which to work." In June 1842 he wrote out a sketch, which in 1844 he expanded to an essay of 231 pages folio. The idea of progressive divergence as an advantage in itself, because the competition is most severe between organisms most closely related, did not occur to him until long after. In Jan 1844 he wrote to his friend, Sir Joseph Hooker "At last gleams of light have come, and I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable" (*ibid.*, n. 13). In 1857 he explained his views to the great American botanist Asa Gray in a letter which afterwards became classical. He had completed about half of a third and far more expanded treatise, when, in June 1858, he received a manuscript from A. R. Wallace, who was then at Ternate in the Moluccas. Wallace wanted Darwin's opinion on the manuscript, which he asked should be forwarded to Lyell. Darwin was much startled to find in the essay a complete abstract of his own theory of natural selection. He wrote to Lyell, "your words have come true with a vengeance—that I should be forestalled." He placed himself in the hands of Lyell and Hooker, who decided to send Wallace's essay to the Linnean society, together with an abstract of Darwin's work, which they asked him to prepare, the joint essay being accompanied by an explanatory letter to the secretary. The title of the joint communication was "On the Tendency of Species to form Varieties, and on the Perpetuation of Varieties and Species by Natural Means of Selection." It was read on July 1, 1858, and appears in the *Ann. Soc. Journal (Zoology)* for that year. In this statement of the theory of natural selection, Darwin's part consisted of two sections, the first being extracts

from his 1844 essay, including a brief account of sexual selection, and the second an abstract of his letter to Asa Gray dated Sept 5, 1857. Canon H. B. Tristram was the first to apply the new theory, explaining by its aid the colours of desert birds, etc. (*Ibis* Oct 1859).

Acting under the advice of Lyell and Hooker, Darwin published on Nov 24, 1859, his great work, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. The whole edition of 1,250 copies was exhausted on the day of issue. The first four chapters explain the operation of artificial selection by man and of natural selection in consequence of the struggle for existence. The fifth chapter deals with the laws of variation and causes of modification other than natural selection. The five succeeding chapters consider difficulties in the way of a belief in evolution generally as well as in natural selection. The three remaining chapters (omitting the final recapitulation), deal with the evidence for evolution. The theory which suggested a cause of evolution is thus given the foremost place and the evidence for the existence of evolution considered last. This evidence had never been thought out and marshalled in a manner which bears any comparison with that of Darwin, and the work would have been epoch making had it consisted of the later chapters alone. A storm of controversy arose over the book, reaching its height at the British Association at Oxford in 1860, when the celebrated duel between T. H. Huxley and Bishop Wilberforce of Oxford took place. Throughout these struggles Huxley was the foremost champion for evolution and for fair play to natural selection, although he never entirely accepted the latter theory, holding that until man by his selection had made his domestic breeds sterile *inter se*, there was no sufficient evidence that selection accounts for natural species which are thus separated by the barrier of sterility.

The Variation of Animals and Plants under Domestication—Probably the second in importance of Darwin's works was published in 1868, and may be looked upon as a complete account of the material condensed in the first chapter of the *Origin*. He finally brought together an immense number of apparently disconnected sets of observations under his "provisional hypothesis of pangenesis," which assumes that every cell in the body, at every stage of growth and in maturity, is represented in each germ-cell by a gemmule. The germ-cell is only the meeting place of gemmules, and the true reproductive power lies in the whole of the body-cells which despatch their representatives, hence "pangenesis." There are reasons for believing that this infinitely complex conception, in which, as his letters show, he had great confidence, was forced upon Darwin in order to explain the hereditary transmission of acquired characters involved in the small proportion of Lamarckian doctrine which he incorporated. If such transmission does not occur, a simpler hypothesis based on the lines of Weismann's "continuity of the germ plasma" is sufficient to account for the facts (see HEREDITY, LAMARCKISM).

The Descent of Man and Selection in Relation to Sex (1871), both fulfilled his statement in the *Origin* that "light would be thrown on the origin of man and his history," and collected the evidence in support of his hypothesis of sexual selection which he had briefly described in the 1858 essay. *The Expression of the Emotions* (1872) offered a natural explanation of phenomena which appeared to be a difficulty in the way of the acceptance of evolution. In 1876 Darwin brought out his two previously published geological works on *Volcanic Islands and South America* as a single volume. The widely read *Formation of Vegetable Mould through the Action of Worms* appeared in 1881, and the *Fertilisation of Orchids* in 1862. *The Effects of Cross- and Self-Fertilisation in the Vegetable Kingdom* (1876) proved that the offspring of cross-fertilized individuals are more vigorous as well as more numerous, than those produced by a self-fertilized parent. It demonstrates that each different form, although possessing both kinds of sexual organs, is specially adapted to be fertilized by the pollen of another form, and that when artificially fertilized by pollen from a plant of its own form, less vigorous offspring are produced. *Climbing Plants and Insectivorous Plants* were pub-

lished in 1875, and *The Power of Movement in Plants* in 1880.

Darwin died on April 19, 1882, and was buried in Westminster Abbey on the 26th.

Two daughters and five sons survived him, four of the latter becoming prominent in the scientific world.—Sir George Howard (1845–1912), who became professor of astronomy and experimental philosophy at Cambridge, Sir Francis (1848–1925), distinguished botanist, Leonard (1850–1943), a major in the royal engineers, and afterwards well known as an economist and eugenicist, and Sir Horace (1851–1928), civil engineer. See *Life and Letters of Darwin, including an autobiographical chapter*, ed. by his son Francis Darwin (3 vols., 1882) and *More Letters* (2 vols., 1901), E. B. Poulton *Darwin and the Theory of Natural Selection* (1896) and *Darwin and the Origin of Species* (1909), L. Huxley, *Life and Letters of T. H. Huxley* (2 vols., 1900) and *Charles Darwin* (1921), V. L. Kellogg, *Darwinism to Day* (1907), J. Marchant, *A. R. Wallace, Letters*, etc. (4 vols., 1916) and H. Ward, *C. Darwin* (1917). See also HUXLEY, T. H., WALLACE, A. R. and HOOKER, SIR JOSEPH (E. B. P.).

DARWIN, ERASMUS (1731–1802), English man of science and poet, was born at Elton, Nottinghamshire. Educated at Cambridge and Edinburgh, he settled in 1756 as a physician at Nottingham, but moved in 1757 to Lichfield, and in 1781 to Derby, where he died suddenly on April 18, 1802. His fame as a poet rests upon his *Botanic Garden*, though he also wrote *The Temple of Nature*, or *the Origin of Society* (1803), and *The Shrine of Nature* (posthumously published). *The Botanic Garden* (1792), the part entitled *The Loves of the Plants* was published anonymously in 1789 shows a genuine scientific enthusiasm and interest in nature, but has little other poetic quality. The artificial character of the diction renders it in emotional passages stilted, and the personification is carried to excess. Botanical notes are added to the poem, and its eulogies of scientific men are frequent. Darwin's most important scientific work is his *Zoonomia* (1794–96), which contains a system of pathology, and a treatise on generation, in which he, in the words of his famous grandson, Charles Darwin, "anticipated the views and erroneous grounds of opinions of Lamarck." The essence of his views is contained in the hypothesis that through millions of ages all warm-blooded animals may have arisen from one living filament which the First Cause endowed with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions and associations.

His *Phytologia*, or *the Philosophy of Agriculture and Gardening* (1799) claims that plants have sensation and volition. A paper on *Female Education in Boarding Schools* (1797) completes the list of his works.

ROBERT WARING DARWIN (1766–1848), his third son by his first marriage, a doctor at Shrewsbury, was the father of the famous Charles Darwin, and VIOLETTA, his eldest daughter by his second marriage, was the mother of Francis Galton.

See A. Seward, *Memoirs of the Life of Dr. Darwin* (1804), Charles Darwin, *Life of Erasmus Darwin, an introduction to an essay on his works by Ernst Krause* (1879), L. Brandt, "E. Darwin's Botanic Garden" in *Wiener Beiträge zur englischen Philologie* (1900).

DARWIN, SIR GEORGE HOWARD (1845–1912), British astronomer, was born at Down, Kent, on July 9, 1845, and was the second son of Charles Darwin (q.v.). He was educated at Trinity College, Cambridge (second wrangler and Smith's prizeman), of which he was elected a fellow in 1868, and where he became Plumian professor of astronomy and experimental philosophy in 1883. His work on the application of harmonic analysis and prediction to oceanic tides is monumental, as is his discussion of the influence of tidal friction in determining the evolution of binary systems, with special reference to the earth and moon. In an early paper he discussed the possibility of geological changes having altered considerably the inclination of the earth's axis to the plane of its orbit, and came to a negative conclusion. These works constituted the first attempt to apply thorough dynamical analysis to cosmogony and the major problems of geological evolution. He also carried out important work on periodic orbits of the problem of three bodies, figures of equilibrium of rotating masses of fluid and the stresses in the earth's crust produced by

continents and mountains. He was awarded the gold medal of the Royal Astronomical Society in 1892 and the Copley Medal of the Royal Society in 1911. In 1899 Darwin was made president of the Royal Astronomical Society, and of the British Association in 1905. He was made K.C.B. in 1905, and he died in Cambridge on Dec. 7, 1912. Among his works are *The Tides and Kindred Phenomena in the Solar System* (1880, 3rd ed., 1911) and *Scientific Papers* (5 vols., Cambridge University Press, 1907–16), which has a supplementary volume edited by F. J. M. Stratton and J. Jackson, containing biographical memoirs.

DARWIN GLASS See TEXTITE

DAS, CHITTA RANJAN (1870–1925), Indian politician and leader of the Swaraj party in Bengal, was born at Calcutta on Nov. 5, 1870. His father, Bhuvan Mohan Das, an attorney of the Calcutta High Court, joined the Brahma Samaj, and edited the *Brahmo* (afterwards the *Bengal*) *Public Opinion*. Chitta Ranjan was educated at the London Missionary College, Bhowanipore, and at the Presidency College, Calcutta. He was called to the bar at the Middle Temple on June 26, 1894. Joining the Calcutta bar, he won his reputation by his successful defence of Arabinda Ghosh in the Manicktollah bomb conspiracy case. He defended relays of young political offenders, and assisted in keeping extremist papers, such as *Bande Mataram*, going, until they were checked by the Press Act, 1910.

In 1895 Das had published a volume of Bengali lyrics, *Malancha*, and two volumes of verse were issued during the World War. In 1915 Das started the Bengali monthly *Narayan*, but his chief journalistic work was the founding and conduct of the aggressive Swarajist daily, *Forward*. "His dominating note was hatred—and dread—of everything that savoured of the West."

It was the pursuit of these false gods that had converted Bengal from a smiling land of happiness and plenty into a salt waste over which brooded stagnation and death" (Lord Ronaldshay's *Heart of Aryavarta* [1925]). Yet he was sufficiently interested in the shaping of political reforms on western lines to participate in discussions leading to a joint address of Europeans and Indians to the Secretary of State and the Viceroy in Nov. 1917 (see Lionel Curtis, *Durley*, 1920).

Das became an influential though not always tractable supporter of M. K. Gandhi in the non-cooperation movement launched in the autumn of 1918. He abandoned general practice, though he continued to defend political offenders, took to the wearing of *khaddar* (homespun cloth) and lived in the utmost simplicity. Late in 1921 the "volunteer" movement was proscribed in Bengal, as in other provinces. On Dec. 10, some days before Das was due to preside at the Indian National Congress at Ahmadabad he was arrested for issuing a public appeal for the proscribed organization, and was sentenced to six months' imprisonment. Mrs. Das, who was in thorough sympathy with her husband's views, was arrested, but by order of the governor, Lord Ronaldshay, was speedily released. Das presided at the National Congress at Gaya in Dec. 1922, and endeavoured to secure revocation of previous resolutions against entering the Legislatures, suggesting obstructive tactics in place of boycott. The controversy sharply divided the non-cooperationists, but with the decline of Gandhi's influence the Das policy gained ground, and influenced the second general election (1923) under the Reforms. Das was elected to the Bengal Council by more than one constituency. In the following April Das was elected the first mayor of Calcutta.

In the Bengal Legislature Das did not command a clear majority, but he was able to bring pressure both on the Independents and the Mohammedans, to whom he suggested a pact by which a substantial proportion of elective seats and public appointments would be reserved for them in the event of Swarajist success. He secured a bare majority on March 24, 1924, for refusal of the salaries of Ministers appointed provisionally by Lord Lytton. Lord Lytton's offer of a membership to Das was refused after some hesitation. Das offered vehement opposition to the Bengal Criminal Law Amendment Ordinance (Oct. 25, 1924) subsequently embodied in a certified Act under which 110 persons, some of them associates of Das, were kept in imprisonment for terrorist conspiracy. His refusal of office and command of votes in the Legis-

lature led to the suspension of the diarchal system in Bengal, all transferred subjects being taken over by the executive government.

At the Bengal Provincial conference at Faridpur, early in May 1925, Das modified his position, and a resolution was passed condemning revolutionary tactics. There can be no doubt that the connection between the Terrorists and the Swarajists under Das was more than mere sympathy of the latter for the former. While each party had its own separate aims, each was working to use and assist the other in so far as it was useful for the attainment of its own ends.

The secretary for India in the first Labour government, Lord Oliver, stated in debate (July 21, 1924) that he was informed by a high authority in Indian politics that Das had "the reputation of being a particularly upright and scrupulous politician second only to Gandhi himself in saintliness of character."

Undoubtedly, the Ind in mind was impressed by the great personal sacrifices of Das for the Swaraj cause, and by his courage in act and utterance.

In resource and driving power he stood high above his associates. He was skilful in swaying Bengali audiences and individuals, being capable both of playing upon their weaknesses and appealing to what was best in them.

But his vision of India under Swaraj as a conglomeration of semi-autonomous villages had no relation to the hard facts that make centralization inevitable.

There is reason to believe that Chitta Das was gaining a fresh outlook, more tolerant of western ideas, in the closing months of his life.

He was at Darjeeling for his health when he died on June 16, 1925.

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DASEHRA (DUSSEHRA), the "ten days" (or nine nights) festival of the modern Hindus, also called in Bengal the Durga puja. It celebrated the close of the rainy season and the opening of the season for warlike activities, but is now observed merely as a festival.

DASHKOVA, CATHERINA ROMANOVNA VORONTSOVA, PRINCESS (1744-1810), Russian *litterateur*, was the third daughter of Count Roman Vorontsov. (For the family see VORONTSOV.) She studied mathematics at the University of Moscow, and became one of the leaders of the party that attached itself to the grand duchess (afterwards empress) Catherine. Before she was 16 she married Prince Mikhail Dashkov and went to reside with him at Moscow. In 1762 she was at St Petersburg (Leningrad) and took a leading part, according to her own account the leading part, in the coup d'état by which Catherine was raised to the throne. (See CATHERINE II.) Another course of events would probably have resulted in the elevation of the Princess Dashkova's elder sister, Elizabeth, who was the emperor's mistress, and in whose favour he made no secret of his intention to depose Catherine. Her relations with the new empress were not cordial and she set out in 1768 on an extended tour through Europe. In Paris she secured the warm friendship and admiration of Diderot and Voltaire. She corresponded with Garrick, Dr Blair and Principal Robertson. In 1782 she returned to the Russian capital, where she was appointed *directeur* of the Academy of Arts.

At the death of her husband she devoted herself to literary and scientific pursuits. She was a member of the Academy of Sciences, and her works, which were published in 1791, 1792, 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1808, 1809, 1810, 1811, 1812, 1813, 1814, 1815, 1816, 1817, 1818, 1819, 1820, 1821, 1822, 1823, 1824, 1825, 1826, 1827, 1828, 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1837, 1838, 1839, 1840, 1841, 1842, 1843, 1844, 1845, 1846, 1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 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2773, 2774, 2775, 2776, 2777, 2778, 2779, 2780, 2781, 2782, 2783, 2784, 2785, 2786, 2787, 2788, 2789, 2790, 2791, 2792, 2793, 2794, 2795, 2796, 2797, 2798, 2799, 2800, 2801, 2802, 2803, 2804, 2805, 2806, 2807, 2808, 2809, 2810, 2811, 2812, 2813, 2814, 2815, 2816, 2817, 2818, 2819, 2820, 2821, 2822, 2823, 2824, 2825, 2826, 2827, 2828, 2829, 2830, 2831, 2832, 2833, 2834, 2835, 2836, 2837, 2838, 2839, 2840, 2841, 2842, 2843, 2844, 2845, 2846, 2847, 2848, 2849, 2850, 2851, 2852, 2853, 2854, 2855, 2856, 2857, 2858, 2859, 2860, 2861, 2862, 2863, 2864, 2865, 2866, 2867, 2868, 2869, 2870, 2871, 2872, 2873, 2874, 2875, 2876, 2877, 2878, 2879, 2880, 2881, 2882, 2883, 2884, 2885, 2886, 2887, 2888, 2889, 2890, 2891, 2892, 2893, 2894, 2895, 2896, 2897, 2898, 2899, 2900, 2901, 2902, 2903, 2904, 2905, 2906, 2907, 2908, 2909, 2910, 2911, 2912, 2913, 2914, 2915, 2916, 2917, 2918, 2919, 2920, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2928, 2929, 2930, 2931, 2932, 2933, 2934, 2935, 2936, 2937, 2938, 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3603, 3604, 3605, 3606, 3607, 3608, 3609, 3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3618, 3619, 3620, 3621,

Algeria, Sady from Egypt, and Khadrawy, Zahidi and Halawy from Iraq

The date palm is a beautiful tree, growing to a height of from 60 ft to 80 ft and its stem, which is strongly marked with the pruned stubs of old leaf bases, terminates in a crown of graceful shining, pinnate leaves, 10 ft to 20 ft long. The flowers are on separate sexes borne on different palms in branching spadices from the axils of leaves which emerged the previous year. Under cultivation it is necessary to pollinate the female flowers by artificial means. The fruit is a one seeded berry, usually more or less oblong, but varying much in shape, size, colour, quality and consistency of flesh according to variety and cultural conditions. A single large bunch may carry over 1000 fruits weighing 20 lbs or more. The dried fruit so widely exported contains more than half its weight of sugar and about 2% each of protein, fat and mineral matter.

Propagation is either from seeds or from suckers or offshoots which arise chiefly near the base of the stem in the early years of the palm's life.

Palms grown from seed are a source of new varieties but extremely variable and about equally divided as to number of males and females.

Offshoots reproduce the sex and character of the parent palm and are used for commercial plantings. When offshoots are 3-6 yrs old and have formed roots of their own they are removed and planted. Palms are spaced about 30 x 30 ft, they begin to bear in 5 or 6 yrs and reach full bearing at 10 to 15 yrs, yielding 100 to 200 lbs or more each. Although palms are known to live as long as 150 yrs, fruit production declines, and in commercial culture palms are replaced at a much earlier age.

All parts of the date palm yield products of economic value to the old world areas where it is grown. Its trunk furnishes timber for house building, the midribs of the leaves supply material for crates and furniture, the leaflets for basketry, the leaf bases for fuel, the fruit stalks for rope and fuel, the fibre for cordage and packing material, the seeds are sometimes ground and used for stock feed, vinegar and a strong liquor are made from the fermented fruit.

Date sugar is a valuable commercial product of India, obtained from the sap or toddy of *Phoenix sylvestris*, another species very closely related to the date palm. The juice, when not boiled down to form sugar, is either drunk fresh, or fermented and distilled to form an alcoholic drink. Date palm meal is obtained from the stem of a small species, *Phoenix farinifera*, growing in the hill country of southern India.

For further details see Sir G. Watt, *Dictionary of the Economic Products of India* (1892), *The Date Palm*, U.S. Department of Agriculture, Bureau of Plant Industry, Bulletin No. 53 (W. T. Swingle), 1904, and Reports of the Annual Date Growers' Institutes, Indio, Calif., yearly since 1914. (R. W. N.)

DATIA, an Indian state in the Bundelkhand agency. It lies in the extreme northwest of Bundelkhand, near Gwalior, and is surrounded on all sides by other states of central India, except on the east where it meets the United Provinces. The state came under the British government after the treaty of Bassein in 1802, and was settled with the present family by treaties in 1804, and 1818. Area, 846 sq mi., pop. (1941) 174,072. The chief, whose title is maharaja is a rajput of the Bundela clan, being descended from a younger son of a former chief of Orchha, his salute is 15 guns. The town of Datia (pop. 18,292 in 1931) is surrounded by a stone wall, enclosing handsome palaces, with gardens, the palace of Bir Singh Deo, of the 17th century, is "one of the finest examples of Hindu domestic architecture in India" and is now untenanted.

DATIVE, the name, in grammar, of the case of the "indirect object," the person or thing to or for whom or which anything is given or done (Lat. *dativus*, giving or given, from *dare*, to give). In law, the word signifies something, such as an office which may be disposed of at will. In Scots law the term signifies "appointed or granted by a court." In Roman law, a *tutor* was either *dativus*, if expressly nominated in a testament, or *optivus*, if a power of selection was given.

DATO, EDUARDO (1856-1921), Spanish politician was

born at Corunna on Aug. 12, 1856. He graduated in law at Madrid university and was elected deputy in 1884. Under secretary for the home department in 1892, he became minister for the department in 1899, and promoted bills regarding accidents, insurance and women's labour. In Dec. 1902 he became minister of justice, in 1907 mayor of Madrid and then president of the chamber. He belonged to the "liberal conservative" variety of the conservative party, with his friend and political chief Silvela had represented, and after Silvela's death continued to maintain this attitude. When in 1913 Señor Maura refused to take power, Señor Dato dissented from his chief, carrying with him the majority of his party, which elected him as its leader. When World War I broke out, he was responsible for Spain's declaration of neutrality. Becoming prime minister again in June 1917, he faced with determination the revolutionary outbreaks and disturbances of that summer. He resigned in October, but in 1920 resumed office, and while prime minister was murdered in Madrid on March 8, 1921.

DATOLITE, a mineral species consisting of basic calcium and boron orthosilicate, $\text{Ca}(\text{BOH})_2\text{SiO}_4$. It is white or colourless, often with a greenish tinge, and may be either transparent or opaque, it usually occurs as well developed monoclinic crystals bounded by numerous bright faces, many of which often have a more or less pentagonal outline, but also in masses with a granular to compact texture, the fractured surfaces having the appearance of porcelain when the mineral is compact. Hardness 5-5½, specific gravity 3.0.

Datolite is a mineral of secondary origin, and in its mode of occurrence it resembles the zeolites, being found with them in the amygdaloidal cavities of basic igneous rocks such as basalt, it is also found in gneiss and serpentine, and in metalliferous veins and in beds of iron ore. At Arendal in Norway, the original locality for both the crystallized and botryoidal, or fibrous variety (known also as botryolite), it is found in a bed of magnetite. In amygdaloidal basaltic rocks it is found at Bishopton in Renfrewshire and near Edinburgh, and as excellent crystallized specimens at several localities in the United States.

DATURA see STRAMONTIUM

DAUB, KARL (1765-1836), German Protestant theologian was born at Cassel on March 20, 1765. He studied at Marburg and in 1795 became professor ordinarius of theology at Heidelberg, where he died on Nov. 22, 1836. Daub sought to bring about a speculative reconstruction of orthodox dogma, but he unfortunately ignored historical criticism. His *Lehrbuch der Katechetik* (1801) was written under the spell of Kant, his *Theologumena* (1806), his *Einleitung in das Studium der christl. Dogmatik* (1810), and his *Judas Ischarioth* (2 vols. 1816), in the spirit of Schelling, while *Die dogmatische Theologie jetziger Zeit* (1833) and *Vorlesungen über die Prolegomena zur Dogmatik* (1839) are Hegelian in principle.

See Rosenkranz, *Erinnerungen an Karl Daub* (1837), F. Lichtenberger, *History of German Theology* (1889), O. Pfänder, *Development of Theology* (1890).

DAUBENTON, LOUIS-JEAN-MARIE (1716-1800), French naturalist, was born at Montbar (Cote d'Or). In 1741 he graduated in medicine at Reims, and returned to his native town with the intention of practising, but Buffon invited him to provide the anatomical descriptions for his treatise on natural history. His details of the dissection of 182 species of quadrupeds in Buffon's work brought him great reputation, but a feeling of jealousy induced Buffon to dispense with his services in the remainder of the treatise. Daubenton now occupied himself with zoological descriptions and dissections, the comparative anatomy of recent and fossil animals, vegetable physiology, mineralogy, experiments in agriculture, and the introduction of the merino sheep into France. In 1744 he was appointed keeper and demonstrator of the cabinet of natural history in Paris and from 1775 lectured on natural history in the college of medicine, and in 1783 on rural economy at the Alfort school. He was also professor of zoology at the Jardin du Roi. In Dec. 1799 he was a member of the senate.

Daubenton died in Paris on Jan. 1, 1800.

DAUBENY, CHARLES GILES (1795-1867), English scientist born at Stratton, Gloucestershire on Feb. 11, 1795, studied medicine. He was professor of chemistry (1822-55), and of botany (1834-67) at Oxford, and earned out numerous experiments on the effect of change in soil, light, etc., on plants. He also made an extensive survey of the volcanoes of Europe, the results of which are embodied in his *Description of Active and Extinct Volcanoes* (1826, 2nd ed., 1848). He died at Oxford on Dec. 12, 1867.

DAUBIGNY, CHARLES FRANÇOIS (1817-1878), French landscape painter, allied in several ways with the Barbizon school, was born in Paris, on Feb. 15, 1817, but spent much time as a child at Valmondois, a village on the Oise to the north west of Paris. Daubigny was the son of an artist, and most of his family were painters. He studied in Italy and painted for nearly two years, he then returned to Paris, not to leave it again until, in 1860, he took a house at Auvers on the Oise. By 1837 Daubigny had become famous as a river and landscape painter, although he had been devoting himself as well to drawing in black and white, to etching, wood engraving and lithography. In 1855 his picture, "Lock at Optevoz," in the Louvre, was purchased by the State. He visited London more than once, and spent some time in Holland. He died in Paris on Feb. 19, 1878. Daubigny is chiefly preferred in his riverside pictures, of which he painted a great number, but although there are two landscapes by Daubigny in the Louvre, neither is a river view. They are for that reason not so typical as many of his smaller Oise and Seine pictures. Among his most ambitious canvases are "Springtime" (1857), in the Louvre, "Borde de la Cure, Morvan" (1864), "Villerville sur Mer" (1864), "Moonlight" (1865), "André sur Oise" (1868), and "Return of the Flock—Moonlight" (1878).

His followers and pupils included his son Karl (who painted so well that his works are occasionally mistaken for those of his father, though in few cases do they equal his father's mastery), Oudnot, Delpy and Damoye. The works of Daubigny are, like Corot's, to be found in many modern collections.

See Fred Henriet, *C. Daubigny et son oeuvre* (1878), J. Albert Wolff, *La Capitale de Paris Ch. François Daubigny* (1881), J. Claretie, *Peintres et sculpteurs contemporains Daubigny* (1882), D. Croal Thomson, *The Barbizon School of Painters* (1890), J. W. Mollett, *Daubigny* (1890).

DAUBLER, THEODORE (1876-1934), German writer, was born in Trieste on Aug. 17, 1876, of a merchant family. With the appearance of *Das Nordlicht* (1910) Daubler took his place at the head of the German expressionist movement. *Das Nordlicht* is a massive religious allegory showing the author's own path from agnosticism to mystic religion, under an epic-heroic disguise. Other characteristic poetical works are *Der Sternhelle Weg* (1913), *Das Sternenkind* (1916) and *Die Treppe zum Nordlicht* (1920), *Altische Sonette* (1924), prose works, *Mit silberner Sichel* (1921), *Wir wollen nicht verweilen* (autobiographical fragment, 1916), *Der neue Standpunkt* (artistic criticism, 1916), *Lucidarium in arte musica* (musical criticism, 1917), *Ein Kampf um die moderne Kunst*. Daubler was remarkably successful in giving his thought clear and often melodious expression, but his original work, possibly owing to its Latin forms, was slow in achieving wide popularity in Germany. His influence as a critic of expressionist music and poetry was, however, very great. In 1928 he was elected a member of the German Academy of Letters.

DAUDET, ALPHONSE (1840-1897), French novelist, was born at Nîmes on May 13, 1840, the son of a silk manufacturer. The lad, amid much truancy, had but a depressing boyhood. In 1856 he left Lyons, where his school days had been mainly spent, and began life as an usher at Alais, in the south. The position proved to be intolerable. On Nov. 1, 1857, he abandoned teaching, and took refuge with his brother Ernest in Paris. Alphonsus wrote poems, shortly collected into a small volume *Les Amoureux* (1858), which met with a fair reception, obtained employment on the *Figaro*, and wrote two or three plays. The duc de Morny appointed him to be one of his secretaries—a post which he held till Morny's death in 1865.

In 1866 appeared *Lettres de mon moulin*. The first of his longer books, *Le petit chapeau* (1868), the pathetic story of his own earlier years, is told with much grace and pathos. The year 1872 produced the famous *Aventures prodigieuses de Tartarin de Tarascon*, and the three act piece *L'Arlesienne*. *Fromont jeune et Risler aîné* (1874) struck a note, not new certainly in English literature, but comparatively new in French. Here was a writer who possessed the gift of laughter and tears, a writer not only sensible to pathos and sorrow, but also to moral beauty. Jack, the story of an illegitimate child, a maitry to his mother's selfishness, followed in 1876. Other novels followed: *Le Nabab* (1877), *Les Rois en exil* (1879), *Numa Roumestan* (1881), *Sapho* (1884) and *L'Immortel* (1888). Daudet then wrote his own reminiscences in *Trente ans de Paris* (1887) and *Souvenirs d'un homme de lettres* (1888). These, with the three *Tartarins*—*Tartarin le mighty hunter*, *Tartarin le mountaineer*, *Tartarin le colonist*—and the admirable short stories, written for the most part before he had acquired fame and fortune, constitute his life work.

Though Daudet defended himself from the charge of imitating Dickens, it is difficult altogether to believe that so many similarities of spirit and manner were quite unsought. What, however, was purely his own was his style. It is a style that may rightly be called "impressionist," full of light and colour, not descriptive after the old fashion, but flashing its intended effect by a masterly juxtaposition of words that are like pigments. Nor does it convey, like the style of the Goncourts, to whose work it owed something, a constant feeling of effort. It is full of felicity and charm—as *charmeur* Zola has called him. An intimate friend of Edmond de Goncourt (who died in his house), of Flaubert, of Zola, Daudet belonged essentially to the naturalist school of fiction. His own experiences, his surroundings, the men with whom he had been brought into contact, various persons who had played a part, more or less public, in Paris life—all passed into his art. But he vivified the material supplied by his memory. His world has the great gift of life. *L'Immortel* is a bitter attack on the French Academy, to which august body Daudet never belonged.

Daudet wrote some charming stories for children, among which may be mentioned *La Belle Nivernaise*, the story of an old boat and her crew. His married life—he married in 1867 Julia Allard—seems to have been singularly happy. There was perfect intellectual harmony, and Madame Daudet herself is known by her *Impressions de nature et d'art* (1879), *L'enfance d'une Parisienne* (1883), and by some literary studies written under the pseudonym of Karl Steen. In his later years Daudet suffered from insomnia, failure of health and consequent use of chloral. He died in Paris on Dec. 17, 1897.

The above of the date another year is told in the book *Fromont*

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reared for 20 years. He was elected to the Chamber as a deputy for Paris in 1919, but was defeated in 1924. With the establishment of peace his influence declined. In the summer of 1925 the death of his young son, Philippe, caused a great sensation. The finding of the judicial enquiry was that he had committed suicide, but Leon Daudet conducted a long and violent campaign to prove that he had, in fact, been murdered. He accused the chauffeur, in whose taxi his son had been found dead from a bullet wound, of complicity. The chauffeur prosecuted him, and Daudet was condemned to prison and ordered to pay heavy compensation. He was imprisoned in the *Santé* at Paris, from which he was rescued in 1927 by a ruse of royalists, who made the governor of the prison believe he had been pardoned. Daudet fled to Belgium.

The best of Daudet's novels are *L'astre noir* (1893), *Les Morticoles* (1894), *Le voyage de Shakespeare and Sylla et son destin* (1922). Among his philosophical and controversial works may be mentioned *L'Hérédité* (1916), *Le monde des images* (1919), *L'avant guerre* (1913), *Le stupide XIX^e siècle* (1922), and *Souvenirs* (1914). Daudet died July 1, 1922.

DAUGAVPILS (Dvinsk), a town of Latvia in 55° 53' N, 26° 32' E on the Daugava (Western Dvina). Pop. (1939) 41,160. Formerly a Russian fortress, it was later the training centre for the Lettish army. The Livonian Knights of the Sword founded a fort 12 m farther up the river, which was removed to its present site by Stephen Bathori, King of Poland, in 1582. Poland, Sweden and Russia alternately occupied this strategic border fort until the partition of Poland gave it to Russia in 1772. The French occupied it in 1812 and it was a centre of strife in both World Wars I and II. The population and industry (particularly timber) were diminished as a result of war and political shifts. (See LATVIA.)

DAULATABAD, hill fortress, Hyderabad State, India, about 10 m N.W. of the city of Aurangabad. The former city of Daulatabad (Deogiri) has shrunk to a village though its magnificent fortress and remains of public buildings survive. The fortress, on a conical rock, crowns a hill rising steeply from the plain to a height of some 600 ft. The outer wall, 22 m in circumference, once enclosed the ancient city of Deogiri (Devagiri), and between this and the base of the upper fort are three lines of defences. The only access to the summit is by a narrow bridge, with passage for two men abreast, and a long gallery, excavated in the rock, with a steep stair midway, the top of which is covered by a grating destined in time of war to form the hearth of a huge fire kept burning by the garrison above. The remarkable Chand Minar in Daulatabad, a tower 210 ft high and originally covered with Persian glazed tiles, was erected in 1445 by Ala ud-din Bahmani to commemorate his capture of the fort. The Chini Mahal, or China Palace, is the ruin of a building in which Abul Hasan, the last of the Kutb Shahi kings of Golconda, was imprisoned by Aurangzeb in 1687.

Deogiri is said to have been founded c. A.D. 1187 by Bhillama I who renounced his allegiance to the Chalukyas and established the power of the Yadava dynasty in the west. In 1294 the fort was captured by Ala ud-din Khilji, and the rajahs were reduced to pay tribute. The tribute falling into arrears, Deogiri was again occupied by the Mohammedans, and in 1318 the last rajah, Harpal, was flayed alive. Deogiri now became an important base for Muslim expeditions southwards, and in 1339 Mohammed ben Tughlak Shah made it his capital as Daulatabad ("Abode of Prosperity"), and made arrangements for transferring to it the population of Delhi, but troubles summoned him north, during his absence the Muslim governors of the Deccan revolted, and Daulatabad itself was taken by Zafar Khan, governor of Gulbarga. Later it fell into the hands successively of the Nizam Shahis, the emperor Akbar, the Shah of Ahmednagar, the Nizam Shahi usurper, Malik Ambar, Shah Jehan, the Mogul emperor and the Nizam of Hyderabad, who took it after the death of Aurangzeb. Its glory, however, had already decayed owing to the removal of the seat of government by the emperors to Aurangabad.

DAUMER, GEORG FRIEDRICH (1800-1875), German writer on religion, was born on March 5, 1800, at Nuremberg and died on Dec. 13, 1875, at Würzburg. He was educated at

Erlangen and Leipzig, and, forsaking his early pietism, violently opposed Christianity, especially in his *Die Geheimnisse des christlichen Aberglaubens* (1847). After the publication of *Religion des neuen Weltalters*, 3 vols. (1850), Daumer approached Mohammedanism in his poems, *Mohomet* (1848) and *Liederbluten der Hafs* (1846-51). He became a Catholic in 1859, and wrote *Das Wunder* (1874) and *Kaspar Hauser, sein Wesen, seine Unschuld* (1873).

DAUMET, PIERRE JÉRÔME HONORE (1826-1911), French architect, member of the Académie des Beaux-Arts, was born on Oct. 23, 1826, in Paris. He entered the École des Beaux-Arts in 1846, and in 1855 was awarded the Prix de Rome. In 1861 he was sent on an archaeological expedition to Macedonia, and published, in collaboration with Léon Henze, an important work on the researches in Thessaly, Thrace and Myria. He was entrusted with the restoration of many monuments of French architecture, in particular the castle of Chantilly, the Palais de Justice, Paris, and the theatre at Orange. In Nov. 1884 Daumer undertook the construction of the Église du Sacre-Cœur on Montmartre, which had already been begun by the architect Abadie, but the following year he abandoned the task, after a dispute with the ecclesiastical authorities. He died in Paris on Dec. 15, 1911.

DAUMIER, HONORÉ (1808-1879), French caricaturist and painter, was born at Marseilles on Feb. 20, 1808, and died at Valmondois on Feb. 11, 1879. Daumer started his artistic career by producing plates for music publishers and illustrations for advertisements, these were followed by anonymous work for publishers, in which he followed the style of Charlet and displayed considerable enthusiasm for the Napoleonic legend. When, in the reign of Louis Philippe, Philipon launched the comic journal, *La Caricature*, Daumer joined its staff, which included Devéria, Raffet and Grandville, and started upon his pictorial campaign of scathing satire upon the foibles of the bourgeoisie, the corruption of the law and the incompetence of a blundering Government. His caricature of the king as "Gargantua" led to imprisonment for six months at Ste. Pélagie in 1832. The publication of *La Caricature* was discontinued soon after, but Philipon provided a new field for Daumer's activity when he founded the *Charivari*. For this journal Daumer produced his famous social caricatures in which bourgeois society is held up to ridicule in the figure of Robert Macaire, the hero of a then popular melodrama. Another series, "L'histoire ancienne," was directed against the pseudo-classicism which held the art of the period in fetters. In 1848 Daumer embarked again on his political campaign still in the service of *Charivari*, which he left in 1866 and rejoined in 1864. In spite of his prodigious activity in the field of caricature—the list of Daumer's lithographed plates compiled in 1904 numbers no fewer than 3,958—he found time for flight in the higher sphere of painting. Except for the searching truthfulness of his vision and the powerful directness of his brushwork, it would be difficult to recognize the creator of "Robert Macaire," of "Les Bas bleus," "Les Bohémiens de Paris," and the "Masques," in the paintings of "Christ and His Apostles" at the Ryks Museum in Amsterdam, or in his "Good Samaritan," "Don Quixote and Sancho Panza," "Christ Mocked," or even in the sketches in the Ionides Collection at South Kensington. But as a painter, Daumer, one of the pioneers of naturalism, was before his time, and had little success until 1873, a year before his death, when M. Durand-Ruel collected his works for exhibition at his galleries and demonstrated the full range of the genius of the man who has been well called the Michelangelo of caricature. At the time of this exhibition Daumer, totally blind, was living in a cottage at Valmondois which was placed at his disposal by Corot, and where he breathed his last in 1879. An important exhibition of his works was held at the École des Beaux-Arts in 1900.

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DAUN (DHAUN), LEOPOLD JOSEF, COUNT VON (1705-1766), prince of Thano, Austrian field marshal, was born at Vienna on Sept. 24, 1705. He served in Sicily (1718), in Italy and on the Rhine in the War of the Polish Succession (1734-35), against the Turks (1737-39) and in the War of the Austrians Succession (1740-42). He was present at Chotusitz and Prague, and led the advanced guard of Khevenhüller's army in the victorious Danube campaign of 1743. Field Marshal Traun, who succeeded Khevenhüller in 1744, thought equally highly of Daun, and entrusted him with the rearguard of the Austrian army when it escaped from the French to attack Frederick the Great. He held important commands in the battles of Hohenfriedberg and Soor and in the same year (1745) was promoted to the rank of *Feldzeugmeister*. After this he served in the Low Countries, and was present at the battle of Val. Maria Theresa made him commandant of Vienna and a knight of the Golden Fleece, and in 1754 he was elevated to the rank of field marshal.

During the interval of peace that preceded the Seven Years' War he began the reorganization of the Austrian army. He was not actively employed in the first campaigns of the war, but in 1757 he commanded the army raised to relieve Prague. On June 18, 1757, Daun defeated Frederick for the first time in his career in the desperately fought battle of Kolin (q.v.). The union of the relieving army with the forces of Prince Charles at Prague reduced Daun to the position of second in command, and as such he took part in the pursuit of the Prussians and the victory of Breslau. Frederick now reappeared and won the most brilliant victory of the war at Leuthen. Daun was not held accountable for the disaster and when Prince Charles resigned his command, Daun was appointed in his place. With the campaign of 1758 began the war of manoeuvre in which Daun, if he missed, through over caution, many opportunities of crushing the Prussians at least maintained a steady and cool resistance to the fiery strategy of Frederick. In 1758 Major General Loudon, acting under Daun's instructions, forced the king to raise the siege of Olmutz and later in the same year Daun himself surprised Frederick at Hochkirch and inflicted a severe defeat upon him (Oct. 14). On Nov. 20-21, 1759, he surrounded the entire corps of General Finck at Maxen, forcing the Prussians to surrender. These successes were counterbalanced in the following year by the defeat of Loudon at Liegnitz, which was attributed to the dilatoriness of Daun, and Daun's own defeat in the great battle of Torgau (q.v.). In this engagement Daun was severely wounded.

He continued to command until the end of the war, and afterwards worked with the greatest energy at the reorganization of the imperial forces. In 1762 he had been appointed president of the *Hofkriegsrat*. He died on Feb. 5, 1766.

See *Der deutsche Fabius Cunctator, oder Leben u. Thaten v. Thaten S. E. des H. Leopold Reichsgrafen v. Daun K. K. F. M.* (Frankfurt and Leipzig, 1759-60), and works dealing with the wars of the period.

DAUNOU, PIERRE CLAUDE FRANÇOIS (1761-1840), French statesman and historian, born at Boulogne-sur-Mer on Aug. 18, 1761, was educated in the school of the Oratorians and then joined the order in Paris in 1777. He was professor in various seminaries from 1780 till 1787, when he was ordained priest. Elected to the Convention by Pas de Calais, he associated himself with the Girondists, but strongly opposed the death sentence on the king. He took little part in the struggle against the Mountain, but was involved in the overthrow of his friends, and was imprisoned for a year. In December 1794 he returned to the Convention and was the principal author of the Constitution of the year III. It seems to have been due to his Girondist ideas that the Ancients were given the right of convoking the *corps législatif* outside Paris, an expedient which made possible Napoleon's *coup d'état* of the 18th and 19th Brumaire. The creation of the Institute was also due to Daunou, who drew up the plan for its organization. His energy was largely responsible for the suppression of the royalist insurrection of the 13th Vendémiaire, and the important place he occupied at the beginning of the Directory is indicated by the fact that he was elected by twenty seven departments as member of the Council of Five Hundred, and became its first president. He himself had set the age qualification of the directors at forty, and thus debarred himself as candidate, as he

was only thirty four. The direction of affairs having passed into the hands of Talleyrand and his associates, Daunou turned once more to literature but in 1798 he was sent to Rome to organize the republic there, and again, almost against his will, he lent his aid to Napoleon in the preparation of the Constitution of the year VIII. He supported Napoleon's policy in the controversy with the Vatican in his *Sur la puissance temporelle du Pape* (1809). Still, he took little part in the new regime, with which at heart he had no sympathy, and turned more and more to literature. At the Restoration he was deprived of the post of archivist of the Empire, which he had held from 1807 but from 1819 to 1830 (when he again became archivist of the kingdom) he held the chair of history and ethics at the College de France. In 1839 he was made a peer. He died in 1840.

In politics Daunou was a Girondist without combativeness, he was a confirmed republican who lent himself always to the policy of conciliation, but whose probity remained unchallenged. He belonged essentially to the centre and lacked both the genius and the temperament which might have secured for him a commanding place in a revolutionary era. As a historian he had a breadth of view remarkable for his time, for although thoroughly imbued with the classical spirit of the 18th century, he was able to do justice to the middle ages. His *Discours sur l'état des lettres en France au XIII^e siècle*, in the 16th volume of the *Histoire littéraire de la France*, is a remarkable contribution to that vast collection, especially as coming from an author so profoundly learned in the ancient classics. Daunou's lectures at the College de France, collected and published after his death, fill 20 volumes (*Cours d'études historiques*, 1842-1846). They treat principally of the criticism of sources and the proper method of writing history, and occupy an important place in the evolution of the scientific study of history in France. Personally Daunou was reserved and somewhat austere, preserving in his habits a strange mixture of bourgeois and monk. His indefatigable work as archivist in the time when Napoleon was transferring so many treasures to Paris is not his least claim to the gratitude of scholars.

See François Auguste Marie Miguet, *Notice historique sur la vie et les travaux de Daunou* (1843), Saint René Taillander, *Documents biographiques sur Daunou* (1847), including a full list of his works. Charles Augustin Sainte Beuve, *Daunou* in vol. vi of his *Portraits contemporains* (1869-71) (unfavourable and somewhat unfair).

DAUPHIN, an ancient title in France, borne only by the counts and dauphins of Vienne, the dauphins of Auvergne and, from 1364, by the eldest son of the king of France. The origin of this curious title is obscure. It was an old custom in the family of the counts of Albon that members should be given more than one name, i.e., a Christian name and a personal surname. Moreover, the eldest son of the count always took holy orders, a younger son succeeding his father as ruler of the county.

These counts of Albon became counts also of Viennois in the 12th century. Guigue VIII of Albon (III of Viennois) had three sons by his wife Mahaud the English. Humbert, who became archbishop of Vienne, Guigue the Old, and Guigue Dauphin, who succeeded his father as Guigue IX (IV). This name Dauphin first appears in texts in 1110. It probably had a religious significance according to the Greek poets the dolphin carried the souls of the just to the Fortunate Islands, and the dolphin figures on early Christian sarcophagi as an emblem of immortality. Guigue IX's descendants were thereafter given all the same surname. But by the beginning of the 13th century it came to be mistaken for a title (in 1222 the count of Albon wrote "ego Andreas, Delphinus et comes Albionis"), and Humbert de la Tour du Pin, son in law of John Dauphin of Albon, made it official, styling himself "dauphin of the Viennois" (*delphinus Viennensis*).

The county then became Dauphiné (*Delphinatus*, 1285). Humbert II, however, sold Dauphiné in 1349 to Charles of Valois, who on becoming king of France as Charles V transferred it to his eldest son, after which the eldest son of the French was always either actual or titular dauphin of the Viennois.

The eldest son of the French king was sometimes called "the king dauphin" (*le roy dauphin*), to distinguish him from the dauphin of Auvergne, who was known, since Auvergne became an appanage of the royal house, as "the prince dauphin." The dau-

phinat of Auvergne, which is to be distinguished from the county, dates from 1155, when William VII, count of Auvergne was deposed by his uncle William VIII. William VII had married a daughter of Guigue IX, Dauphin, after whom their son was named Dauphin (Delphinus).

The name, as in the Viennois, appears first as a title in the 13th century (1281). In 1288 the dauphinat was brought into the French royal house by marriage. It was annexed to the crown in 1693.

See G. de Manteyer, *Les Origines du Dauphin de Viennois* (Gap, 1925) (M. PAC, X).

DAUPHINÉ, one of the old provinces (the name being still in current use in the country) of prerevolutionary France, in the southeast portion of France, between Provence and Savoy, after 1790 it formed the departments of the Isère, the Drome and the Hautes Alpes. For the origin of the name see DAUPHIN.

After the death of the last king of Burgundy, Rudolph III, in 1032, the territories known later as Dauphiné (as part of his realm) reverted to the far distant emperor Henry III. Much confusion followed, out of which the counts of Albon (between Valence and Vienne) gradually came to the front (see DAUPHIN). The first dynasty ended in 1162 with Guigue X (V as count of Viennois), whose daughter and heiress, Beatrice, carried the possessions of her house to her husband, Hugh III, duke of Burgundy. Their son, Andre, continued the race, this second dynasty making many territorial acquisitions, among them (by marriage) the Embrunais and the Gapençais in 1232. In 1282 the second dynasty ended in another heiress, Anne, who carried everything to her husband, Humbert, lord of La Tour du Pin (between Lyons and Grenoble). The title of the chief of the house was count (later dauphin) of the Viennois, not of Dauphiné. Humbert II (1335-49), grandson of the heiress Anne, was the last independent dauphin, selling his dominions in 1349 to Charles of Valois, who on his accession to the throne of France as Charles V bestowed Dauphiné on his eldest son, and the title was borne by all succeeding eldest sons of the kings of France. In 1421 the Diod and the Valentinois, by the will of the last count, passed to the eldest son of Charles VI and in 1424 were annexed to the Dauphiné Louis (1440-61), later Louis XI of France, was the last dauphin to occupy a semi-independent position, Dauphiné being annexed to the crown in 1456. The suzerainty of the emperor (who in 1378 had named the dauphin "imperial vicar" within Dauphiné and Provence) gradually died out. In the 16th century Dauphiné was much affected by the wars of religion, Protestantism having been spread first by the teaching of Guillaume Farel, then by the resistance of armed leaders. Of the latter the best known were the baron des Adrets and duc de Lesdigueres (1543-1626), whom Henry IV appointed governors of the country once religious peace had been restored. The "estates" of Dauphiné were suspended by Louis XIII in 1628, but their unauthorized meeting (on July 21, 1788) in the castle of Vizille, near Grenoble, was one of the earliest premonitory signs of the great French Revolution of 1789. It was at Laffrey, near Grenoble, that Napoleon Bonaparte was first acclaimed (March 7, 1815) by his old soldiers sent to arrest him.

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(W A B C, X)

DAURAT or DORAT, JEAN (in Lat. AURATUS) (1508-1588), French poet and scholar, and member of the Pleiade, was born at Limoges. His name was originally Dinemand. He belonged to a noble family, and, after studying at the college of Limoges, went to Paris to be presented to Francis I, who made him tutor to his pages. As a private tutor in the house of Lazare de Baif, he had J. A. de Baif for his pupil. His son, Louis, showed great precocity, and at the age of ten translated into French verse one of his father's Latin pieces, his poems were published

with his father's. After the death of Lazare de Baif in 1547 Jean Daurat became the director of the Collège de Coqueret, where he had among his pupils, besides Baif, Ronsard, Remy Belleu and Pontus de Tyard. Joachim du Bellay was added by Ronsard to this group, and these five young poets, under the direction of Daurat, formed a society for the reformation of the French language and literature. They increased their number to seven by the initiation of the dramatist Etienne Jodelle, and thereupon they named themselves La Pleiade, in emulation of the seven Greek poets of Alexandria. The election of Daurat as their president proved the weight of his personal influence, and the value his pupils set on the learning to which he introduced them, but as a writer of French verse he is the least important of the seven. Meanwhile he collected around him a sort of academy, and stimulated the students on all sides to a passionate study of Greek and Latin poetry. He himself wrote incessantly in both those languages, and was styled the Modern Pindar. His influence extended beyond the bounds of his own country, and he was famous as a scholar in England, Italy and Germany. In 1556 he was appointed professor of Greek at the Collège Royal, a post which he continued to hold until, in 1567, he resigned it in favour of his nephew, Nicolas Goulu. Charles IX gave him the title of *poeta regius*. His flow of language was the wonder of his time, he is said to have composed more than 15,000 Greek and Latin verses. The best of these he published at Paris in 1586 as *J. Aurat Lemovicus poetæ et interpretis regii poemata*. He died in Paris on Nov. 1, 1588, having survived all his illustrious pupils of the Pleiade, except Pontus de Tyard. He was a little, restless man, of untiring energy, rustic in manner and appearance. His unequalled personal influence over the poets of his age gives him an importance for which his own writings do not fully account.

The *Oeuvres poétiques* in the vernacular of Jean Daurat were edited (1875) with biographical notice and bibliography by Ch. Marty Laveaux in his *Pleiade française*.

DAVAO, a well laid out chartered city (with administrative centre and 7 barrios or districts), and capital of the Province of Davao, Mindanao, Philippine Islands, located on the Gulf of Davao, at the mouth of the Davao river, about 800 mi. from Manila. Pop. (1939), 95,546, of whom 170 were whites, 14,181 Japanese and 2,234 Chinese. An unusually high grade of abaca (Manila hemp) is produced and exported from the surrounding country, as well as copra, but it was the former which attracted the Japanese when its price rose to new levels during World War I. Concentrating there and then, they were by 1939 dominating the city, the hemp market, pearl fishing and other industries. It was quite natural, therefore, for the Japanese to make Davao one of their landing places in their invasion of December 1941. The native population consists of Bissayans, Mandayans, Bagobos and Moros. Of those aged 6 to 19, 32.1% in 1939 attended school and of those ten years old and over 55.8% were literate.

DAVENANT, CHARLES (1656-1714), English economist, eldest son of Sir William Davenant, the poet, was born in London, and educated at Chesham grammar school and Balliol college, Oxford. He was member of parliament successively for St. Ives, Cornwall, and for Great Bedwyn. He held the post of commissioner of excise from 1683 to 1689, and that of inspector-general of exports and imports from 1705 till his death in 1714. He was also secretary to the commission appointed to treat for the union with Scotland. His most important works were *Ways and Means of supplying the War* (1695), *An Essay on the East India Trade* (1697), *Two Discourses on the Public Revenues and Trade of England* (1698), *An Essay on the probable means of making the people gamers in the balance of Trade* (1699), *A Discourse on Grants and Resumptions and Essays on the Balance of Power* (1701).

See his *Works* ed. by C. Whitworth (1771).

DAVENANT or D'AVENANT, SIR WILLIAM (1606-1668), English poet and dramatist, was baptized on March 3, 1606, he was born at the Crown Inn, Oxford, of which his father, a wealthy vintner, was proprietor. It was stated that Shakespeare always stopped at this house in passing through the city of Oxford, and out of his known or rumoured admiration of the hostess, a

very fine woman, there sprang a story which attributed Davenant's paternity to Shakespeare, a legend which there is reason to believe. Davenant himself encouraged. After a brief stay at Lincoln college, Oxford, Davenant became a page to the duchess of Richmond, and then entered the household of Fulke Greville, Lord Brooke. After Brooke's death he turned to the stage, his first play, *Albion, King of the Lombards*, being produced in 1629. Other plays and masques followed, the most important of which was *The Wits*, licensed in 1633 and published in 1636. Davenant was high in favour at court, and succeeded Ben Jonson as poet laureate. Throughout the civil war Davenant supported the king. He joined Henrietta Maria in France, and was sent by her on more than one mission to England. He fought at the siege of Gloucester (1643), after which he was knighted, and returned to Paris after the battle of Naseby. He was captured by the Parliamentarians more than once. In 1650 he was at the head of a colonizing expedition to Virginia which was intercepted in the Channel. He was interned at Cowes until 1651 and was sent to the Tower to await trial for high treason. He solaced his imprisonment by the composition of his epic poem, *Gondibert*, and was released, it is said, on the personal intercession of Milton, for whom he interceded in his turn after the Restoration.

Davenant had been manager of the Drury Lane theatre when the Puritan regime put an end to dramatic performances. In 1656 he contrived to evade the law by giving semi-private representations in private houses. The first of these productions was *The First Day's Entertainment at Rutland House* (May 21, 1656), speeches for and against the drama with declamation and music. The famous *Siege of Rhodes* (Aug. 1656) followed. This was not, as sometimes stated, the first occasion in which changes of scenery were employed and women appeared on the stage, but it does mark the beginning of the change from the ancient simplicity of the English stage. To this performance was given the name "opera." In 1658 Davenant was permitted to open the Cockpit theatre in Drury Lane for historical drama, though not without some protest from Puritan sources. In 1659 he was imprisoned for complicity in the rising of Sir George Booth. At the Restoration Davenant and Killgrew received a patent to set up two companies of players, and Davenant's company became known as the duke of York's players, housed at first in Lincoln's Inn Fields. There were performed many "musical plays," and the theatre became known as the "opera."

The duke of York's players produced some of Davenant's pre-Commonwealth plays in a revised form, notably *Love and Honour* (1649), *The Wits* and *The Platonic Lovers* (1656), but many plays of Shakespeare, Jonson and Fletcher were "adapted," with considerable freedom, by Davenant for the Restoration stage. He also produced versions of various French plays. Davenant died on April 7, 1668, and was buried in Westminster abbey.

His works were collected in folio in 1672. See the edition of his *Dramatic Works*, with prefatory memoir and notes, by J. Maidment and Logan (1872-74).

DAVENPORT, CHARLES BENEDICT (1866-1944), American zoologist, was born at Stamford, Conn., on June 1, 1866. He graduated in 1886 at Brooklyn Polytechnic institute and, in 1889, at Harvard, from which in 1892 he received the degree of doctor of philosophy. After serving as assistant and instructor in zoology at Harvard in 1888-99, he was assistant and associate professor of zoology and embryology in the University of Chicago from 1899 to 1904 when he was made director of the station (at Cold Spring Harbor, L.I., N.Y.) for experimental evolution of the Carnegie Institution of Washington, in which he became the director of the eugenics record office and of the department of genetics (1904-34). He made valuable investigations in the breeding of animals, and in the heredity of eye, hair and skin color, and of temperament, stature and build in man. Among his published works are *Experimental Morphology* (1897-99), *Statistical Methods in Biological Variations* (2nd ed. 1904), *Inheritance in Poultry* (1906), *Eugenics* (1910), *Heredity in Relation to Eugenics* (1911), *Heredity of Skin Color in Negro-White Crosses* (1913), *The Feebly-Inhibited—Nomadism and Temperament* (1915), *Defects Found in Drafted*

Men (1920), *Body Build and Its Inheritance* (1923), and *How We Came by Our Bodies* (1936). He died Feb. 18, 1944, at Huntington, L.I.

DAVENPORT, EDWARD LOOMIS (1816-1877), American actor, born in Boston, made his first appearance on the stage in Providence in support of Junius Brutus Booth. Afterwards he went to England, where he supported Mrs. Anna Cora Mowatt (Ritchie) (1819-70), Macready and others. In 1854 he was again in the United States, appearing in Shakespearean plays and in dramatizations of Dickens's novels. As Bill Sikes he was especially successful and his Sir Giles Overreach and Brutus were also greatly admired. He died at Canton, Pa., on Sept. 1, 1877. In 1849 he had married Fanny Vining (Mrs. Charles Gill) (d. 1891), an English actress also in Mrs. Mowatt's company.

Their daughter FANNY (LILY GIPSY) DAVENPORT (1850-1898) appeared in America at the age of 12 as the king of Spain in *Faint Heart Never Won Fair Lady*. Later (1859) she was a member of Daly's company, and afterwards, with a company of her own, acted with especial success in Sardou's *Pedra* (1883), *Cleopatra* (1890) and similar plays. Her last appearance was on March 25, 1898, shortly before her death.

DAVENPORT, ROBERT (fl. 1623-1639), English dramatist, of whose life nothing is known. Three plays of his have survived, *King John* and *Matilda* (printed 1655), and two comedies, *The City Nightcap*, (licensed in 1624, but not printed until 1661), and *A New Trick to Cheat the Devil* (printed 1639). Other plays entered in the Stationers' Register as Davenport's are lost, including one called *Henry I* and *Henry II* (1653), the second part of which was said to be the work of Davenport and Shakespeare.

Davenport's plays were reprinted by A. H. Bullen in *Old English Plays* (new series, 1890). The volume includes two didactic poems, which first saw the light in 1623.

DAVENPORT, the third largest city of Iowa, U.S.A., on the Mississippi river, opposite Rock Island and Moline, Ill., the county seat of Scott county. It is on federal highways 6, 61 and 67, and is served by the Chicago, Burlington and Quincy, the Chicago, Milwaukee, St. Paul and Pacific, the Chicago, Rock Island and Pacific, and the Davenport, Rock Island and Northwestern railways, and by bus lines and barges. Land area 18.1 sq. mi. Pop. (1950) 73,640. Davenport has a beautiful location on the slope of a bluff, rising to an altitude of 561 ft. above sea level, and commanding extensive views of landscape and river scenery. There are 18 parks (one along the river front), covering 820 ac., and including two municipal golf courses, a bathing beach, tennis courts, baseball diamonds and a zoological garden. The assessed valuation of property in 1949 was \$66,745,055. Davenport has ten public grade schools, three junior high, one senior high and 11 parochial schools, St. Ambrose college for young men, Marycrest college for young women, the American Institute of Commerce and the Palmer School of Chiropractic. Davenport is an Episcopal see of the Roman Catholic and the Protestant Episcopal churches. It has a large commerce, by rail and by water, shipping especially great quantities of grain and oil, and has important manufactures, including freight cars, gondolas, ready-cut houses, flour, cereal products, candy, bakery goods, cement, washing machines and agricultural implements. The output of its factories in 1949 was valued at \$62,000,000.

On an island in the Mississippi river opposite the city, Rock Island Arsenal is the largest government arsenal in the world, with 1,000 ac. Davenport was founded in 1835, under the leadership of Col. George Davenport. It was incorporated as a town in 1839 and as a city in 1851. The first bridge across the Mississippi was built at this point in 1853.

DAVENTRY (pronounced dān'trī or dāv'ēn-trī), a market town and municipal borough in the Daventry parliamentary division of Northamptonshire, England, 73½ mi. NW from London on a branch of the LMSR from Weedon. Population (1938) 3,703. Area 5 sq. mi. Daventry is situated on a sloping site in a rich unglulating country. The parish church of Holy Cross was rebuilt in 1752. Borough hill, adjoining Daventry, is the site of a vast ancient earthwork, more than two miles in circumference and en-

closing a superficial area of 150 ac. Other remains have been found at Burnt Walls in the vicinity. Watling street passes close by Daventry grammar school (1576), enlarged and modernized, is a mixed secondary school under the county council. The chief industry of the town is the manufacture of boots and shoes. The making of whips is an extinct craft. Daventry became an important wireless centre after 1925, when the British Broadcasting corporation established on Borough hill a high power station (5 XX) which assumed the functions formerly performed through Chelmsford. In 1927 a second station (5 GB), largely for experimental purposes was installed, but it also took the place of an earlier Birmingham station (IT) for the broadcasting of alternative programs. These two stations were superseded by others, including a high power short wave station for overseas broadcasts. The outbreak of World War II, with a consequent increase in the amount of overseas broadcasts, accelerated the steady development of this wireless centre. Power is derived from Northampton through an electricity substation built in 1925 to supply Daventry.

The large commercial post office station at Hillmorton, near Rugby, is visible from Borough hill. The borough of Daventry is under a mayor, 4 aldermen, 12 councillors, and has a court of summary jurisdiction.

Nothing is known of Daventry until the time of the Domesday Survey, when the manor consisting of eight hides was held by the countess Judith, the Conqueror's niece, as the widow of Walthof, the last native earl of Northumbria, who at the Conquest held the great midland earldom of Huntingdonshire and Northamptonshire. Before the end of the century it had passed to Simon de St. Liz, whose grandson, WALTER FITZ ROBERT, held 'of the fee of the king of Scotland,' who had become possessed of the earldom of Huntingdon (see HUNTINGDONSHIRE and NORTHAMPTONSHIRE). Daventry was created a borough by King John, who granted to Simon, son of Walter, a market on Wednesday and a fair on St. Augustine's day. But there is no extant charter before that of Elizabeth in 1576, by which the town was incorporated under the name of the bailiff, burgesses and commonalty of the borough of Daventry. James I confirmed this charter in 1605-06, and Charles II in 1674-75 granted a new charter. The corporation was reconstituted in 1835. During the civil wars Daventry was the headquarters of Charles I immediately before the battle of Naseby. He is supposed to have slept at the Wheat Sheaf inn. The last remains of the Cistercian priory endowed by Simon de St. Liz were removed during the 19th century.

The pronunciation of Daventry as "Dane-tree," which is sanctioned by ancient local usage (cf. Shakespeare's "Daintry," *Henry VI*, pt. II, act V), is referred by tradition to the building of the town by the Danes. Though the written element affords no definite proof of early pronunciation, the spelling "Daventree" in Domesday is explicit, and in the legend of a seal of the Prior Nicholas (1231-64) reads "Davitree" (*Victoria County History, Northampton*, vol. II).

DAVEY OF FERNHURST, HORACE DAVEY, BARON (1833-1907), English judge, son of Peter Davey, of Horton, Bucks, was born on Aug. 30, 1833, and educated at Rugby and University College, Oxford. In 1861 he was called to the bar, and in 1875 became a Q.C. In 1880 he was returned to parliament as a Liberal, but lost his seat in 1885. On Gladstone's return to power in 1886 he was appointed solicitor general and was knighted, but had no seat in the House, being defeated at both Ipswich and Stockport in 1886, in 1888 he found a seat at Stockton-on-Tees, but lost it in 1892. As an equity lawyer Sir Horace Davey ranked among the finest intellects and the most subtle pleaders ever known at the English bar. He was standing counsel to the University of Oxford, and senior counsel to the Charity Commissioners. Among the cases in which he was engaged were the *Mogul Steamship Case* (1892), the trial of the bishop of Lincoln, and the *Berkeley Peerage Case*. In 1862 he married Miss Louisa Donkin, who, with two sons and four daughters, survived him. In 1893 he was raised to the bench as a lord justice of appeal, and in the next year was made a lord of appeal in ordinary and a life peer. He died in London on Feb. 20, 1907.

DAVID, ST., the patron saint of Wales, whose feast falls on March 1. Few historical facts are known regarding the saint, although there is reason to suppose he was born c. 500 and died c. 600. According to his various biographers he was the son of Sandde, a prince of the line of Cunedda, his mother being Non, who ranks as a Cymric saint. He seems to have taken a prominent part in the celebrated synod of Llanddewi Brefi (see CAPDIGANSHIRE), and to have presided at the so-called "Synod of Victory" held later at Caerleon on-Usk. At some date unknown, St. David, as *pen escol*, or primate of South Wales, moved the seat of ecclesiastical government from Caerleon to the remote headland of Mynyw or M. n. v. i. a, which is still under the name of St. David's (*Ty Dewi*). The cathedral city of the western sea. St. David founded numerous churches throughout South Wales (53 still recall his name) but apparently he never penetrated farther north than the region of Powys, although he seems to have visited Cornwall. His shrine at St. David's became a notable place of pilgrimage, and at Henry I's request he was formally canonized by Calixtus II about 1120.

The earliest known biography is that of Rhigyfarch (d. 1090), one of the last British bishops of St. David's, from whose work Giraldus Cambrensis (q.v.) chiefly compiled an extravagant life. Rhigyfarch's *Life* has been edited with a translation by A. W. Wade Evans (1914). See also *Catalogue of MSS.*, books, etc., relating to St. David, the cathedral church of St. David's, etc. (Cardiff, 1927).

DAVID, king of Judah and Israel, was the founder of the Judaean dynasty at Jerusalem. The exact date of his reign is uncertain. It was at one time reckoned from 1055-1015 B.C., but is now generally fixed at about 1010-970 B.C. Our principal source for his history is 1 Sam. xvi-xxix. Its very extent shows how deep was the impression he made upon the mind of his people, indeed, his popularity as a national hero is one cause of the difficulty we find in reconstructing his history. Stories of exploits and incidents in his career were repeated with delight from generation to generation. Groups of these stories were collected together, and from several such sources the history of his doings was compiled. The editors have pieced their material so well together, however, that it is impossible for us to separate it with accuracy into its constituent sources. But the harmonizing has not been perfectly carried out, and the inconsistencies and duplications have enabled the critics to separate more or less clearly at least two main sources. The Greek text, again, varies very considerably from the Hebrew, offering a different collection of the narratives. For detailed discussion of these problems the commentaries on Samuel, and SAMUEL (BOOKS OF) should be consulted. Another history of David is to be found in 1 Chron. vi-xxix, which is to some extent parallel to that in Samuel but omits many of the narratives. On the other hand it contains much additional material, which is, however, of inferior historical value. It is much fuller on subjects which were the special concern of the editor of Chronicles, such as details of temple arrangements and lists of officers. It is particularly interesting because of its obvious tendency to idealize the character of David, and in this respect was the late stage of a process which must have begun soon after the death of the national hero, and of which we find traces even in Samuel.

The history in Samuel opens with an account of the anointing of David by Samuel as successor to Saul, whom Yahweh had rejected from the throne of Israel (1 Sam. xvi. 1-13). Samuel is instructed that the new king is to be found among the sons of Jesse, who dwells at Bethlehem, 5 m. south of Jerusalem. A sacrifice is celebrated there, to which, beside Jesse and his sons, the elders of the town are invited. David, busy in tending the sheep, is apparently too young to be summoned with his older brothers. But when the oracle rejects each of the seven elder brothers Samuel asks whether there is no other son, and David is summoned. It is made clear that he is the chosen one, and Samuel anoints him. This narrative, which is seemingly rather the conclusion of Samuel's history than the beginning of David's, raises suspicions. It will be noted that in 1 Sam. xvi. 13 *seg* the brothers of David are three in number (v. 12 is harmonistic), not seven, and in 1 Chron. ii. 13-15, six. It is highly improbable that the ceremony could have been performed without some news of it to the ears of Saul, and the later narratives seem to ignore

Introduction to Saul—1 Sam xvi 14-23 gives an account of David's introduction to the court of Saul. One of the king's attendants, when a man is sought who can play the harp to charm the moods of melancholy which have fallen upon Saul, recommends David, whom he describes not merely as a good harpist, but as 'a mighty man of valour, and a man of war'—a description difficult to reconcile with the preceding narrative unless a considerable number of years be supposed to intervene. David is summoned, and his manly beauty appeals to Saul, who makes him not only court harpist but also his own armour bearer.

The next section of the history in Samuel (xvi 1-xxviii 5) records the most famous exploit of David, his victory in single combat over the Philistine giant Goliath, and its consequences. This account, however, raises several serious difficulties. First of all there is the fact that in 2 Sam xxi 19 the slaying of Goliath is attributed to Elhanan, one of David's heroes. An attempt to reconcile these contradictory statements is found in 1 Chron xx 5 where the victim of Elhanan's valour is described as 'Lahmi, the brother of Goliath.' David's exploit is not referred to in 1 Sam xxi 10-15, or in xxix, where some reference to it would have been expected, and on these and other grounds the simpler tradition of 2 Samuel is usually preferred. On the other hand, it may well have been some such valiant deed that first attracted Saul's attention to David (cf xiv 52), and accounted for the popularity of the latter which made him an object of jealousy to Saul. Hence the narrative of 1 Sam xvii, though legendary, may be the expanded version of some historic combat in which David's opponent was not Goliath. Much more serious is the impossibility of reconciling the narrative with what precedes. Although according to xvi Saul has already appointed David to be his musician and armour bearer, now David appears as an untired shepherd lad, sent by his father with provisions for his brothers in the Israelite camp. His brothers treat him with a petulance hardly conceivable if he already stood well at court, and vv 55-58 show that neither Saul nor his captain Abner had ever heard of David before. Some light is thrown upon this difficult problem by a study of the Greek versions, in one group of which, represented by the Vatican text, xvi 12-31, 41, 50, and xvii 55-xxviii 5 are missing. This shorter form of the tradition is much more intelligible, and more easy to reconcile with xvi. It will be seen at once that xvi 32 follows xvi 11 much more naturally than does v 12. Whether the Greek or the Hebrew text is original is a much-debated problem, but on the whole it is more likely that the additional verses in the latter are expansions, taken from another biography of David, than that the Greek is an abbreviated form of the Hebrew. In xviii 1-4 we have the first notice of the friendship that grew up between Jonathan, Saul's son, and David. The investment of David in the apparel of Jonathan may be an alternative to the exchange of blood as a symbol of brotherhood, for the clothes of a man were regarded as in a sense part of his personality. Otto Lussfeldt, however, has argued plausibly (*Theologische Blätter*, Oct 1927) that this is part of a parallel tradition according to which David was armour-bearer and favourite, not of Saul, but of Jonathan, a theory which would explain some difficulties in the later narratives.

Conflicts with Saul—But now Saul becomes jealous of David, because he is the popular idol and his exploits are extolled beyond those of the king. The development of this jealousy is described in 1 Sam xix in the shorter Greek version of x xiii according to which Saul removes David from his court attendance at the court and makes him captain of a thousand soldiers. In his new position David is very successful and his popularity increases, so that Saul becomes more alarmed than ever. Michal, Saul's daughter, falls in love with David and Saul promises him her hand if he will attempt an almost impossible feat of valour, hoping that he may be killed in the attempt. David succeeds brilliantly and slays the king's daughter. Saul's anger now becomes a fierce hatred, and he proposes to Jonathan and the court the assassination of David (xix 1). The additional matter in the Hebrew, which includes the incident—a double account of xix 9 seq—of Saul's attempt to murder David, and his unfulfilled promise to give his daughter Merab to him, destroys the psychological truth of the narrative. The breach between Saul and David was made up, for a time, by Jonathan

(xix 2-7), but further successes of David in war reawaken the dormant hatred of Saul, who hurls a spear at David, which the latter evades. The story of Saul's attempt to have David assassinated in the house where he dwelt with Michal (xix 11-17), which bears all the marks of truth, is out of place here, when David has already fled (v 10), and may possibly be connected with xviii 27 (see H. P. Smith in the *International Critical Commentary*).

Chapter xv, which records the covenant made by Jonathan with David and prepares the way for the story of David's kindness to Jonathan's son Merab, seems to be independent of the traditions in which it is embedded, and has been expanded by the additional interview between the two friends, vv 40-42. It certainly cannot follow on xix 18-24, the story of David's attempt to find sanctuary with Samuel at Ramah, for it supposes David to be still at court and Jonathan to be unaware that David stands in peril. This fight of David's may possibly be fitted in after xix 9, xxi 1 as an ineffective attempt to remove the difficulty. Next David goes to the sanctuary at Nob, where he had been wont to consult the priestly oracle (xvii 15), and, pretending that he is engaged on a secret expedition in Saul's behalf, obtains of Ahimelech the priest bread from the sacred table and the sword of Goliath. This narrative may well follow xxi 10, the incident of David's escape from the spear hurled at him by Saul. The story goes on to relate the flight of David to the court of the Philistine king of Gath, Achish, where he escapes from the revenge which might otherwise have been taken upon him by feigning madness (xvi 10-15). This anticipates xxvii, and is out of place at this point of the history, surely David would not go to the very city of Goliath flaunting the sword of the giant!

Outlaw Life—For years after his escape David lived the life of an outlaw. He made his headquarters first at the stronghold—the traditional "cave"—is a mistake—of Adullam, a Canaanite town said to have been captured by Joshua (Josh xi 15), probably on the western border of Judah, and about 12 miles from Bethlehem. Here he was joined by his clansmen and by others who were in a desperate position, such as those who feared to be sold into slavery for failure to pay their debts, until his band numbered 400 men. A probably secondary tradition xxi 3 seq., relates that he placed his father and mother under the protection of the king of Moab. The following verse, which speaks of the seer Gad as in the company of David, is also probably a later tradition. Saul was discontented at this new development. His hated rival had escaped his clutches, largely through the connivance of his son. An Edomite, Doeg, who had been a concealed witness of the interview at Nob between Ahimelech and David, reported what had happened there, and Saul sent for Ahimelech. In spite of Ahimelech's protest that he had acted in all good faith with Saul, the king commanded that he and all the other priests of the sanctuary should be slaughtered. His bodyguard refusing to carry out this command, he ordered the informer to act as executioner, and Doeg slew 85 priests of Nob—a suspiciously large number. All living creatures in that town were also put to death, save Abiathar, one of Ahimelech's sons, who escaped and took refuge with David.

Presently word was brought to David that the Philistines were raiding Keilah, south of Adullam, and, despite the reluctance of his followers to undertake so desperate an enterprise, the outlaw chief, encouraged by a priestly oracle, defeated the Philistines and delivered Keilah. Probably he manacled his hand by acting at all, as a protest against the divine oracle's such outlawing of camps on the part of the Philistines and his own Saul. In an opportunity of capturing David which he was away from the protection of his stronghold and prepared to besiege him in Keilah but David ascertained by the oracle that the Philistines of Keilah would deliver him up to Saul if he remained within them if he dispersed his band. This he did not go in to do. Saul, however, David lived now in the hunted outlaw, wandering from stronghold to stronghold in the border country. Popular tradition tells in xxii, xxix, xxxi, of a visit of consolation from Jonathan, the attempt of the men of Ziph to betray David to Saul, and of David's magnanimity in sparing Saul's life when it was in his power to kill him, the two latter incidents appearing in duplicate. The incident of David's marriage to Abigail, the wife of a rich farmer who died a few days after he

had churlishly refused to pay David the levy for protection afforded him (xxv), is important as showing how David maintained his band, and how he strengthened his position by matrimonial alliances (cf. xxv 43).

Wearied at last of his precarious life he decided to place himself under the protection of Achish, the Philistine ruler of Gath, from whom he obtained permission to establish himself and his band at Ziklag, which probably lay to the south of Judah. Here for more than a year he maintained his troop by raids upon the Amalekites and other marauding Bedouins. According to the rather improbable story of xxvi 10-12 he represented these to Achish as raids upon Judah, as though to give proof of his permanent alienation from his own people. In any case Achish was convinced of David's loyalty and took him and his band as part of the army which he led in an important campaign against Saul. But on the eve of battle the Philistine captains, more distrustful than their leader, persuaded Achish to order David's return to Ziklag. David reached Ziklag to find that in his absence the Amalekites had raided and burned the town, carrying off with other booty David's wives. Pursuing the marauders he inflicted upon them a signal defeat, recovering all that had been carried off and much spoil in addition. By distributing a part of his spoil among the rulers of the various towns in the south country and of the old haunts of his freebooting days he strengthened his hold upon the affections of that countryside. In the meantime the Philistine campaign against Israel had been successful, and Saul and his sons, including Jonathan, lay dead upon the slopes of Mt. Gilboa. The fertile lowlands of Jezreel and the Jordan fell into the possession of the victors, and Saul's son Ishbaal, who had escaped the fate of his brothers, maintained a shadowy sovereignty in the remote city of Mahanaim, the force behind his throne being Abner, Saul's commander-in-chief. The news of Israel's defeat and Saul's death is brought (2 Sam. i) to Ziklag by an Amalekite, who claims—in contradiction to the account in 1 Sam. xxxi 4—to have slain the wounded king, and offers to David the crown and bracelet which he had taken from the corpse. Instead of receiving the reward which he doubtless looked for the messenger is slain at the command of David, who utters the noble dirge on Saul and Jonathan, 2 Sam. i 19-27. The compiler avowedly takes the poem from the "Book of Jashar," but there appears to be no cogent reason for denying that David is its author.

King at Hebron—David now takes a further step in his advance towards the throne, for, in response to a Divine oracle, he establishes his household and his band in Hebron, where, at the age of 30 (if 2 Sam. v 4 may be trusted), he is anointed king by the Judean clans. There he reigned, according to the statement of ii 11, seven and a half years. His position as established ruler of an important town, on friendly terms with the neighbouring sheikhs, and allied by marriage with the families of Caleb and Jezreel (in Judah), was well secured. Further such marriages are recorded in iii 3-5. It is quite in keeping with the constant tradition of David's chivalrous treatment of Saul that he should have sent a message of appreciation to the men of Jabesh Gilead for their pious act in burying the bodies of Saul and his sons, ii 46 seq., and with his skillful diplomacy that the messengers should hint that Jabesh Gilead might do well to transfer its allegiance to himself—a hint which was for the time being ignored.

A conflict between the forces of Ishbaal, under Abner, and those of David, under Joab, which developed out of a contest between 12 picked men on either side, ended greatly to the advantage of David's men. In the course of the struggle Abner slew Asahel, Joab's brother, thus creating a blood feud which had serious consequences in the subsequent history. Abner, recognizing that the cause of Ishbaal was hopeless, took to himself one of Saul's concubines, an infringement of Ishbaal's prerogative as Saul's successor, with deliberate intent to raise a quarrel with his lord which might provide him with a pretext for transferring his allegiance to David. When Ishbaal protested Abner sent him an embassy to David offering to bring the northern clans over to him. According to one story (iii 12-16), David demanded the return of Michal to him, as an evidence of good faith but this story is consistent neither with itself nor with its context. In any case Abner, returning

from Hebron after arranging terms with David, was summoned back by Joab and treacherously slain in pursuance of the blood-feud. David was indignant, and showed his indignation by according burial to Abner and proclaiming a fast. Apparently Joab was both too strong and too useful for the king to punish him, so David handed over that task to his God. The position of Ishbaal, deprived of Abner's help, went from bad to worse, and he was eventually assassinated by two of his own followers. They brought his head to David, but received the same reward as the Amalekite who thought to have found favour with David by his claim to have killed Saul. Following this the northern tribes swore allegiance to David at Hebron, and he became king of the united peoples. Here we may place the two successes over the Philistines narrated in v 17-25.

Capture of Jerusalem—Another important stage in David's career was marked by the capture of Jerusalem, an ancient Jebusite stronghold which had never been in Hebrew hands. Regarded as impregnable by its inhabitants, who treated David's threat with derision, it was captured by the ascent of a shaft which had been pierced through the rock to afford the city a water supply. The stronghold was further fortified by David, who built himself a cedarwood palace, the materials and artificers for which were furnished by Hiram, king of Tyre—another indication of David's growing importance. David also enlarged his harem.

The king now turned his attention to the ark of Yahweh, which had remained in obscurity since its return from the Philistines in the early youth of Samuel. It was brought up from Baal of Judah, and, after having been temporarily housed with Obed Edom owing to an untoward incident during its progress, was placed in a specially prepared pavilion in the citadel, amid great rejoicings. That the king should have proposed to build a temple worthy to stand beside his palace is quite natural, and ch. vii, which relates how Nathan the prophet, after first sanctioning the project, forbade it in the name of Yahweh, may, though comparatively late, be based on a historical foundation. There follows in viii a summary of military successes achieved by David and Joab, his commander-in-chief. The concluding verses show that the court had been properly organized and a bodyguard of mercenaries provided for the king. The lame Mephibosheth (Meribai), Jonathan's son, was admitted to the royal table as the king's pensioner, and his family estates were restored to his use.

A friendly embassy from David to the newly crowned king of Ammon was treated with insult, and a war ensued, in which the Ammonites, who succeeded in gaining considerable Aramean support, were completely defeated, and their chief city was captured by David after a siege. It was during this campaign that David in order to obtain for himself the beautiful Bathsheba, caused Joab deliberately to abandon her husband, Uriah the Hittite mercenary, to an Aramite assault. Not only were the Syrian allies of Ammon reduced to submission, but Edom was completely subjugated by Joab.

Internal Troubles—From this time on David's reign was undisturbed by foreign attack, but, in the absence of necessity for standing together against a common foe, internal troubles developed. In part these proceeded from the king's own household. Absalom, his third son, having contrived the murder of Amnon the eldest, in revenge for an assault upon Absalom's sister Tamar, fled the country and took refuge with his mother's father, Talmai king of Geshur. After three years Joab satisfied the unexpressed longing of David for his son's return, for which he secured permission by a stratagem. Absalom was excluded from the court for two years, and when David was fully reconciled to receive him began to plot against his father. He succeeded in creating a party for himself, and after some four (so read in xiv 7) years raised the standard of revolt in Hebron. David was compelled to flee in haste to Gilead, abandoning Jerusalem to Absalom. The first battle between the forces resulted in the total defeat of Absalom, who was slain, against the express command of David, by Joab. David was welcomed back by the people, but the northern tribes resented the precedence which was claimed by Judah on the ground of kinship to the king. This discontent manifested itself in a rebellion headed by Sheba, a Benjamite, who eventually threw

self into the walled city of Abel of Beth-Maacah. There he was besieged by David's army under Joab. To avoid the disastrous consequences of a prolonged siege the inhabitants slew Sheba and threw out his head to Joab, who had agreed to draw off his forces on that condition. It should be said that some scholars, e.g., Winckler and S. A. Cook (*Notes on Old Testament History*, pp. 3-17), have argued forcibly that the revolts of Absalom and Sheba should be dated in a much earlier period of David's reign. The remaining chapters of 2 Samuel interrupt the history of David, which is resumed in 1 Kings i. They contain fragments relative to David which have been inserted here by different editors. The two poetical pieces, 2 Sam xxii 1-xxiii 7, are not Davidic; it will be recognized at once that they interrupt the catalogue of David's heroes and their exploits, which xxiii 8 resumes from xxii 22. The story of xxi 1-14, relating how David delivered over to the men of Gibeon seven of Saul's descendants to be impaled, and how, moved by the pathetic fidelity of Rizpah, he gathered the bones of these men and of Saul and Jonathan to be decently interred, is probably historic, though not in its proper chronological order. The story of the census and its disastrous results, xxv, may possibly come from the same source, though some parts of it may be later insertions.

The closing scenes of David's life, 1 Kings i-ii 11, show the old warrior enfeebled by age, and the succession to his throne the subject of intrigue. His eldest surviving son, Adonijah, regarded himself as the heir. Like Absalom, he was of great personal charm and a favourite with numbers of the people, his outstanding supporters being Joab and Abiathar. Like Absalom, too, he sought to make his position secure by assuming the state suitable to the heir-apparent. He made a great feast for the men of Judah, inviting the king's sons but deliberately ignoring Solomon, Bathsheba's son, the prophet Nathan, and David's "mighty men," who evidently constituted a party in favour of Solomon's succession. Bathsheba and Nathan contrived to secure from David the ratification of an old promise that Solomon should succeed to the throne, and the aged king roused himself to make arrangements for the formal proclamation of Bathsheba's son. Adonijah's followers were seized with panic, and he himself sought sanctuary by taking hold of the horns of the altar, whence he suffered himself to be removed upon a rather equivocal promise by Solomon that his life should be spared. The remainder of the story records, with some later expansion by a Deuteronomist editor, how David left instructions to Solomon that Joab and Shimei should be put to death, but kindness shown to the family of Barzillai. This ungenerous treatment of Joab, to whom more than to any man he owed the success of his career, and the virtual recantation of his promise to spare Shimei strike an unpleasant note in our ears. Nor does the consideration of the king's failing powers and of his possible fear that Solomon's position might be endangered by adversaries whom he himself had felt free to spare completely mellow his harshness. And so, after a reign of 40 years, David slept with his fathers.

David's Character and Work.—Rightly to estimate the character and work of David we must judge him by the standards of his own day. His military capacity is proved by the uniform success he achieved as commander. Even though the story of his conflict with Goliath may be legendary it undoubtedly gives us the measure of his reputation for personal bravery. To these qualities he added astute diplomacy and far-seeing statesmanship. That at times he resorted to deceit—as, for example, in the employment of Hushai to spy upon the movements of Absalom—is true, but this would be commended by his own age and is reputable even to-day. He knew well how to wait his opportunity, and instead of snatching at the kingship in haste allowed the fruit to ripen until it fell into his hands, all the while strengthening his hold upon his fellow countrymen. His choice of Jerusalem as capital is an excellent example of his wisdom. In seizing it he furnished himself not only with a secure citadel, whose natural strength was shown later by its desperate resistance to Babylonians and Romans, but also with a centre of government not so closely associated with his own tribe of Judah as was Hebron, and one therefore less likely to cause jealousy on the part of northern Israel. His real monument was the united kingdom which he established, its influence stretching

right up into Syria, it was the most powerful empire that ever Palestine produced. True, his opportunity was exceptional, because neither Egypt, Assyria, nor Babylon was at the time in a position to challenge his progress, but to have achieved it at all was wonderful. We can readily understand that the Jews of later days looked back to David as the ideal king and pictured the ruler of the happy day for which they hoped as a second David.

David may be charged with harshness in the treatment of conquered peoples—though the true meaning of 2 Sam xii 31 is that he set the people of Rabbah to menial labour, not that he tortured them, but in this respect he compares favourably with his contemporaries. His delivery of Saul's descendants to be impaled was but obedience to the will of Yahweh as he understood it. And on the other hand his record is marked by chivalrous treatment of his foes on several occasions. Even his outstanding faults, the murder of Uriah that he might obtain Bathsheba, and his weakness in dealing with his sons, though we need not palliate them, were less heinous a thousand years before Christ than they would be to-day. He was a sincerely religious man, a devout worshipper of Yahweh, as may be seen from his care for the Ark. Though his relationships with the prophets Gad and Nathan may have been idealized by later editors he certainly was more amenable to prophetic guidance than was Saul. He was assuredly not the soldier-saint of Chronicles, or the Psalmist of profound religious experience. But while it is improbable that he was the author of any of the Hebrew hymns he was undoubtedly a musician and a poet. The dancer of 2 Sam vi would naturally be the singer, too, and there is good reason for believing the elegy on Saul and Jonathan and the little dirge on Ahner, 2 Sam ii seg 33, are of David's composition. Moreover, the attribution of Psalms to David, though mistaken, is most easily understood if he was really a minstrel (cf. also Amos vi 5).

Greatly loved in his day, deeply revered by those who came after him, David was perhaps the most winsome character in Hebrew story, lovable, because so human, even in his faults. A great warrior and a great statesman, his importance as the real constructor of the Hebrew Kingdom can hardly be overestimated.

BIBLIOGRAPHY.—See the articles *David* in Hastings' *Diet Bible* and the *Ency Bibl*, the Commentaries on Samuel by H. P. Smith, Dornum and Caspari, S. A. Cook, *Critical Notes on Old Testament History*, R. Kittel, *Geschichte des Volkes Israels*, ii pp. 108-187, *Gestalten und Gedanken in Israel*, pp. 120-137. (W. R. S., W. L. W.)

DAVID I. (1084-1153), king of Scotland, the youngest son of Malcolm Canmore and (Saint) Margaret, sister of Edgar Aetheling, married in 1113 Matilda, daughter and heiress of Walthof, earl of Northumbria, and thus became possessed of the earldom of Huntingdon. On the death of Edgar, king of Scotland, in 1107, the territories of the Scottish crown were divided in accordance with the terms of his will between his two brothers, Alexander and David. Alexander, together with the crown, received Scotland north of the Forth of Clyde, David the southern district with the title of earl of Cumbria. The death of Alexander I in 1124 gave David possession of the whole. In 1127, in the character of an English baron, he swore fealty to Matilda as heiress to her father Henry I, and when the usurper Stephen ousted her in 1135 David vindicated her cause in arms and invaded England. But Stephen marched north with a great army, whereupon David made peace. The peace, however, was not kept. After threatening an invasion in 1137, David marched into England in 1138, but sustained a crushing defeat on Cutton Moor in the engagement known as the battle of the Standard. He returned to Carlisle, and soon afterwards concluded peace. In 1141 he joined Matilda in London and accompanied her to Winchester, but after a narrow escape from capture he returned to Scotland. Henceforth he remained in his own kingdom and devoted himself to its political and ecclesiastical reorganization. A devoted son of the church, he founded five bishoprics and many monasteries. In secular politics he energetically forwarded the process of feudalization which had been initiated by his immediate predecessors. He died at Carlisle on May 24, 1153.

DAVID II. (1324-1371), king of Scotland, son of King Robert the Bruce by his second wife, Elizabeth de Burgh (d. 1327), was born at Dunfermline on March 5, 1324. In accordance with

the terms of the treaty of Northampton he was married in July 1328 to Joanna (d. 1363), daughter of the English king, Edward II, and became king of Scotland on his father's death in June 1329, being crowned at Scone in November 1331. Owing to the victory of Edward III of England and his protégé, Edward Balliol, at Halidon Hill in July 1333, David and his queen were sent for safety into France, reaching Boulogne in May 1334, and being received very graciously by the French king, Philip VI. Little is known about the life of the Scottish king in France, except that Chateau Gaillard was given to him for a residence, and that he was present at the bloodless meeting of the English and French armies at Vironfosse in October 1339. Meanwhile his representatives had obtained the upper hand in Scotland, and David was thus enabled to return to his kingdom in June 1341, when he took the reins of government into his own hands. In 1346 he invaded England in the interests of France, but was defeated and taken prisoner at the battle of Neville's Cross in October of this year, and remained in England for eleven years, living principally in London and at Odham in Hampshire. His imprisonment was not a rigorous one, and negotiations for his release were soon begun. Eventually, in October 1357, after several interruptions, a treaty was signed at Berwick by which the Scottish estates undertook to pay 100,000 marks as a ransom for their king. David, who had probably recognized Edward III as his feudal superior, returned at once to Scotland, but owing to the poverty of the kingdom it was found impossible to raise the ransom. A few instalments were paid, but the king sought to get rid of the liability by offering to make Edward III, or one of his sons, his successor in Scotland. In 1364 the Scottish parliament indignantly rejected a proposal to make Lionel, duke of Clarence, the next king, but David treated secretly with Edward III over this matter, after he had suppressed a rising of some of his unruly nobles. The king died in Edinburgh Castle on Feb. 22, 1371. His second wife was Margaret, widow of Sir John Logie, whom he divorced in 1369, but he left no children, and was succeeded by his nephew, Robert II. David was a weak and incapable ruler, without his father's patriotic spirit. (See SCOTLAND, History.)

DAVID, the name of three Welsh princes

DAVID I (d. 1203), a son of Prince Owen Gwynedd (d. 1169), came into prominence as a leader of the Welsh during the expedition of Henry II in 1157. In 1170 he became lord of Gwynedd (i.e., the district around Snowdon), but some regarded him as a bastard, and Gwynedd was also claimed by other members of his family. After fighting with varying fortunes he sought an ally in the English king, whom he supported during the baronial rising in 1173, after this event he married Henry's half sister Emma. But his enemies increased in power, and about 1194 he was driven from Wales by the partisans of his half-brother Llewelyn ap Iorwerth. The chronicler Benedictus Abbas calls David *rex*, and Rhuddlan castle was probably the centre of his vague authority.

DAVID II (c. 1208–1246) was a son of the great Welsh prince, Llewelyn ap Iorwerth, and through his mother Joanna was a grandson of King John. He married an English lady, Isabella de Braose, and, having been recognized as his father's heir both by Henry III and by the Welsh lords, he had to face the hostility of his half-brother Gruffydd, whom he seized and imprisoned in 1239. When Llewelyn died in April 1240, David, who had already taken some part in the duties of government, was acknowledged as a prince of North Wales, doing homage to Henry III at Gloucester. He was soon at variance with the English king, who appears to have espoused the cause of the captive Gruffydd. Henry's Welsh campaign in 1241 was bloodless but decisive. Gruffydd was surrendered to him, David went to London and made a full submission, but two or three years later he was warring against some English barons on the borders. To check the English king he opened negotiations with Innocent IV, doubtless hoping that the pope would recognize Wales as an independent state, but here, as on the field of battle, Henry III was too strong for him. Just after Henry's second campaign in Wales the prince died in March 1246.

DAVID III (d. 1283) was a son of Gruffydd and thus a nephew of David II. His life was mainly spent in fighting against his

brother, the reigning prince, Llewelyn ap Gruffydd. His first revolt took place in 1254 or 1255, and after a second about eight years later he took refuge in England, returning to Wales when Henry III made peace with Llewelyn in 1267. Then about 1274 the same process was repeated. David attended Edward I during the Welsh expedition of 1277, receiving from the English king lands in North Wales, but in 1282 he made peace with Llewelyn and suddenly attacked the English garrisons, a proceeding which led to Edward's final conquest of Wales. After Llewelyn's death in December 1282 David maintained the last struggle of the Welsh for independence. All his efforts, however, were vain, in June 1283 he was betrayed to Edward, was tried by a special court and sentenced to death, and was executed with great barbarity at Shrewsbury in October 1283. As the last native prince of Wales, David's praises have been sung by the Welsh bards, but his character was not attractive, and a Welsh historian says "his life was the bane of Wales." (See WALES, History.)

DAVID, FÉLICIE (1810–1876), French composer, was born on April 13, 1810, at Cadénet (Vaucluse). He was a precocious child, and composed a string quartet at the age of 12. He was educated at the Jesuit college at Aix, and became choirmaster at St. Sauveur at Aix for a year. He then studied for a while at the Paris Conservatoire. In 1831 he joined the sect of Saint Simonians, and in 1833 travelled in the Near East in order to preach the new doctrine. After three years' absence he returned to France and published a collection of *Oriental Mélodies* for the pianoforte. For several years he worked in retirement, and wrote two symphonies, some chamber music and songs. On Dec. 8, 1844, he suddenly leapt into fame with his symphonic ode *Le Désert*, produced at the Conservatoire. In this work David attempted in simple strains to evoke the majestic stillness of the desert. Notwithstanding its title of "symphonic ode," *Le Désert*, has little in common with the symphonic style. What distinguishes it is a certain naïveté of expression and an effective oriental colouring. His succeeding works, *Mosé au Sinai* (1846), *Christophe Colomb* (1847), *L'Eden* (1848), scarcely bore out the promise shown in *Le Désert*. David produced several operas: *La Perle du Brésil* (1851), *Herculanum* (1859), *Lalla-Roukh* (1862), *Le Saphir* (1865). He died at Saint-Germain-en-Laye on Aug. 29, 1876. At a time when the works of Berlioz were still unappreciated by the majority of people, David succeeded in making the public take interest in music of a picturesque and descriptive kind. Thus he may be considered as one of the pioneers of modern French musical art.

See R. Brancourt, *Félicien David* (1911), with full bibliography.

DAVID, GERARD [GHEERAERT DAVIT] (?–1523), Netherlands painter, born at Oudewater, in Holland, was the last great master of the Bruges school. He was only rescued from complete oblivion in 1860–63 by W. J. H. Weale, whose researches in the archives of Bruges brought to light the main facts of the master's life. David came to Bruges in 1483, presumably from Haarlem, where he had formed his early style under the tuition of Ouwater, he joined the guild of St. Luke at Bruges in 1484, and became dean of the guild in 1501; he married, in 1496, Cornelia Cnoop, daughter of the dean of the Goldsmiths' guild, became one of the leading citizens of the town, died on Aug. 13, 1523, and was buried in the Church of Our Lady at Bruges.

In his early work he had followed the Haarlem tradition as represented by Dirck Bouts, Ouwater and Geertgen of Haarlem, but already gave evidence of his superior power as colourist. To this early period belong the "St. John" of the Kaufmann collection in Berlin, and "St. Jerome" in the Salting collection (National Gallery, London). In Bruges he studied and copied masterpieces by the Van Eycks, Van der Weyden, and Van der Goes, and came under the direct influence of Hans Memling. From him he acquired the intensity of expression, the increased realism in the rendering of the human form and the orderly architectonic arrangement of the figures. In 1515 he visited Antwerp, and became impressed with the life and movement in the work of Quentin Matsys, who had introduced a more intimate and more human conception of sacred themes. David's "Piety" in the National Gallery, and the "Descent from the Cross," in the

Cavallo collection, Paris, were painted under this influence and are remarkable for their dramatic movement. But the works on which David's fame rests most securely are the great altar pieces executed by him before his visit to Antwerp—the "Marriage of St. Catherine," at the National Gallery, the triptych of the "Madonna Enthroned, and Saints" of the Brignole-Sale collection in Genoa, the "Annunciation" of the Sigmaringen collection, and, above all, the "Madonna with Angels and Saints" at Rouen. Of David's pupils in Bruges, only Isenbrandt, A. Cornelis and Ambrosius Benson achieved importance. Among other Flemish painters, Joachim Patinir and Mabuse were to some degree influenced by him.

Eberhard Freiherr von Bodenhausen published in 1905 a very comprehensive monograph on *Gerard David and his School* (Munich, F. Bruckmann), together with a *catalogue raisonné* of his works, which, after careful sifting, are reduced to 43.

DAVID, JACQUES LOUIS (1748-1825), French painter, was born in Paris on April 30, 1748. His father was killed in a duel, when the boy was but nine years old. His education was begun at the Collège des Quatre Nations, but he was soon placed by his guardian in the studio of François Boucher. Boucher recommended him to J. M. Vien, the pioneer of the classical reaction in painting. Under him David studied for some years, and, after several attempts to win the *prix de Rome*, at last succeeded in 1775, with his "Loves of Antiochus and Stratonice." He then accompanied Vien, who had just been appointed director of the French academy at Rome. The classical reaction was now in full tide, Winkelmann was writing, Raphael Mengs painting, and the treasures of the Vatican galleries helped to confirm David in a taste already moulded by so many kindred influences. This severely classical spirit inspired his first important painting, "*Date obolum Belsario*," exhibited at Paris in 1780. The picture exactly suited the temper of the times, and was an immense success. It was followed by "The Grief of Andromache" (1783), "The Oath of the Horatii" (Salon, 1785), "The Death of Socrates," "Love of Paris and Helen" (1788), "Brutus" (1789). In the first years of the revolutionary movement the fashion of imitating the ancients even in dress and manners went to the most extravagant length and it was at this time that David returned to Paris.

The success of his sketch for the picture of the "Oath of the Tennis Court," and his pronounced republicanism, secured David's election to the Convention in Sept. 1792, by the *Section du Museum*, and in the January following his election into the Convention his vote was given for the king's death. David's revolutionary ideas, which led to his election to the presidency of the Convention and to the committee of general security, inspired his pictures "Last Moments of Lepelletier de Saint-Fargeau" and "Marat Assassinated." He also arranged the programme of the principal republican festivals. When Napoleon rose to power David became his enthusiastic admirer. His picture of Napoleon on horseback pointing the way to Italy is now in Berlin. During this period he also painted the "Rape of the Sabines," and "Leonidas at Thermopylae." Appointed painter to the emperor, David produced the two notable pictures "The Coronation" (of Josephine), and the "Distribution of the Eagles."

On the return of the Bourbons the painter was exiled with other regicides, and retired to Brussels, where he again returned to classical subjects "Amor quitting Psyche," "Mars disarmed by Venus," etc. He rejected the offer, made through Baron Humboldt, of the office of minister of fine arts at Berlin, and remained at Brussels till his death on Dec. 29, 1825.

It is difficult for a generation which has witnessed another complete revolution in the standards of artistic taste to realize the secret of David's immense popularity in his own day. Yet he exercised a powerful influence on a great influence. His pictures are magnificent in their composition and draughtsmanship, and his keen observation of the most vivid characters is evident, especially in his portraits of Louis XVI and of Madame Recamier, of the Convention, and of David and Angélique d'Angoulême.

See E. F. Bénédict, *David, son école et son temps* (1881), and *Le Peintre Louis David, son œuvre et documents inédits*, by J. L. Jules David, the painter's grandson (1880), I. Rosenthal, *David* (1904).

DAVID, PIERRE JEAN (1789-1856), usually called David d'Angers, French sculptor, was born at Angers on March 12, 1789, and died in Paris on Jan. 4, 1856. The son of a carver, he went to Paris at 17 with 12 francs in his pocket to study under Roland. After a year and a half's struggle he received a small annuity from the municipality of Angers and in 1811 won the *prix de Rome*, and was sent to Italy, where he worked for some time in Canova's studio. Returning to Paris in 1816, after a short visit to London, he received many important commissions. He was in revolt against the prevailing classical style, and one of his first works in Paris, the "Conde" at Versailles, shows the new tendency towards a more realistic method. In 1827 he visited England, and in 1828 and 1834, Germany. Always a Radical in politics, he had to leave France for a short period after the *Coup d'état* of Dec. 1851. Many of the most famous men and women of his time sat to David for busts or medallions. A nearly complete collection, originals or copies, is to be seen in the Musée David at Angers. Among David's most important works are the sculptures on the pediment of the Pantheon, showing the principal personages in France since the Revolution grouped round a figure of "La Patrie"; the Gutenberg monument at Strasbourg, the monument to General Gobert in Père Lachaise, the "Philopomen" in the Louvre, and the bust of Goethe, presented by him to the poet in 1831, in the public library at Weimar.

See H. Jouin, *David d'Angers et ses relations littéraires* (1890), *Lettres de P. J. David d'Angers à Louis Dupré* (1891), *Collection de portraits des contemporains d'après les médaillons de P. J. David* (1838).

DAVIDISTS, a fancy name rather than a recognized designation for three religious sects. It has been applied (1) to the followers (if he had any) of David of Dinant, in Belgium, the teacher or pupil of Amalric (Amaury) of Bena, both of whom taught apparently a species of pantheism. David's *Quaterni*, or *Quaterni*, condemned and burnt at Paris (1209), is a lost book, known only by references in Albertus Magnus and Thomas Aquinas, its author would have been burnt but he had not fled. (2) To the followers of David George or Joris (qv). (3) To the followers of Francis David (1510-79), the apostle of Transylvanian unitarianism (see SOCIUS, UNITARIANISM).

DAVIDOVIC, LJUBOMIR (1863-1940), Yugoslav politician, was born at Vlasica in Serbia. In 1901 he entered parliament and, the next year, with Lubomir Stojanović, founded the Independent Radical party. In 1904 he became Minister of Education, in 1905 President of the Skupština and in 1909 mayor of Belgrade. In that year he was one of the Serbian witnesses at the Friedjung trial in Vienna, and soon afterwards Prof. Masaryk laid before the Austrian delegation the papers on which the forgers had practised Davidovic's signature. In the Serbian Coalition cabinet, formed during the Austrian invasion in Nov. 1914, Davidovic again became Minister of Education, but in 1917 he resigned office and remained in active opposition to Pašić throughout the remainder of the World War. In 1919 he was elected chief of the newly formed Democratic party and was Yugoslav premier from August of that year until Feb. 1920. In July 1924 he again became Prime Minister at the head of a coalition of Democrats, Slovene Clericals and Bosnian Moslems, supported by the Croat peasants. He was, however, replaced, in 1924, by a purely Radical Government under Pašić. Not active in the succeeding governments, Davidovic, however, led the democratic party against the Government party in the elections of 1935 and 1938.

DAVIDSON, ANDREW BRUCE (1831-1902), Scottish divine, was born in 1831 at Kirkhill, Aberdeenshire, where his father, Andrew Davidson, had a farm. During his four years at Aberdeen university his mother supplied him fortuitously with provisions from the farm and sometimes walked the whole 20 miles from Kirkhill, handing the coach fee to her son. He graduated in 1849. In 1852, after three years as a schoolmaster, he entered New College, Edinburgh, and was licensed to preach in 1856. For two years he preached occasionally and took vacancies. In 1858 he became assistant professor of Hebrew at New College. He taught during the winter, and in the long vacation continued his

preparation for his life work. One year he worked in Germany under Ewald, another year he went to Syria to study Arabic. In 1862 he published the first part of a commentary on Job. It was never finished and deals only with one third of the book but it is recognized as the first really scientific commentary on the Old Testament in the English language. In 1863 he was appointed by the general assembly professor of oriental languages at New College. He was junior colleague of John Duncan (Rabbi Duncan) till 1870 and then for 30 years sole professor. He was a member of the Old Testament revision committee. He died on Jan. 26, 1902.

Besides the commentary on Job he published a book on the *Hebrew Accent*, the only Scottish performance of the kind since the days of Thomas Boston. His *Introductory Hebrew Grammar* has been widely adopted as a class-book in theological colleges. His *Hebrew Syntax* has the same admirable clearness, precision and teaching quality. His *Commentary on the Epistle to the Hebrews* is one of a series of handbooks on Bible classes. These were followed by commentaries on Job, Ezekiel, Nahum, Habakkuk and Zephaniah in the Cambridge series, and a Bible class primer on *The Exile and Restoration*. His lectures on *Old Testament Prophecy* were published after his death by J. A. Paterson. *The Theology of the Old Testament in the 'International Theological Library'* is a posthumous volume edited by Salmond. *'Isaiah' in the Temple Bible* was finished, but not revised, when he died, and he also had in hand the volume on Isaiah for the *International Critical Commentary*, to which must be added a mass of articles contributed to the *Imperial Bible Dictionary*, the *Encyclopaedia Britannica* and the chief religious reviews. Various articles in *Hastings' Bible Dictionary* were by Davidson, including the article "God." Two volumes of sermons, *The Called of God* (with biographical introduction) and *Waiting upon God*, were published after his death.

DAVIDSON, JOHN (1857-1909), British poet, playwright and novelist, son of the Rev. Alexander Davidson, a minister of the Evangelical Union, was born at Barrhead, Renfrewshire, Scot., on April 11, 1857. In 1876 he studied for a session at Edinburgh university, and then went as a master to various Scottish schools till 1890, varying his experiences in 1884 by being a clerk in a Glasgow thread firm. He had married in 1885 and meanwhile he had published his poetical and fantastic plays, *Bruce* (1886), *Smith, a Tragic Farce* (1888) and *Scaramouch in Noxos* (1889). Determining at all costs to follow his literary vocation, he went to London in 1890. *Fleet Street Eclogues* (1893) at once established Davidson's position among the younger generation of British poets. He produced other books in prose but his most important work is found in his *Ballads and Songs* (1894), *Second Series of Fleet Street Eclogues* (1895), *New Ballads* (1897), *The Last Ballad*, etc. (1898) all full of remarkably fresh and unconventional beauty. Meanwhile, in 1896, he produced an English verse adaptation in *For the Crown* (acted by Forbes Robertson and Mrs. Patrick Campbell) of François Coppée's drama *Pour la couronne*, and he wrote several other literary plays. In later years he lived at Penzance, provided with a small civil list pension, but otherwise badly off, for his writings brought in very little money. On March 23, 1909, he disappeared, in circumstances pointing to suicide, and six months later his body was found in the sea.

DAVIDSON OF LAMBETH, RANDALL THOMAS DAVIDSON, 1ST BARON (1848-1930), English divine, archbishop of Canterbury, 1903-28, was with King Edward VII. at his death in 1910 and crowned King George V. in 1911. He was one of the four counsellors of state who acted as his majesty's commission when the king went to India in 1911, and again in 1925 when the king went to the Mediterranean after illness during the whole of this period he took a leading part as spokesman of the national church in the house of lords. Lord Morley bore public witness to the effectiveness of his intervention in the critical debate on the Parliament act in 1914. He made important contributions in debates on temperance, divorce and various social and moral questions. His influence was also constantly and successfully exerted in matters affecting the welfare of native races, e.g., in Kenya, and he made notable appeals on behalf of Christian minorities in the east. In his educational policy he has steadily supported definite religious instruction in all schools, by teachers willing to give it.

Trusted by Englishmen of all classes for his wisdom and good-

ness, the archbishop commanded the confidence of Free Churchmen to a greater degree than any of his predecessors. He had a peculiarly anxious task during World War I. On more than one occasion he lifted up his voice against reprisals which had "as a deliberate object the killing and wounding of noncombatants." Twice he visited the troops in France. In 1916 he placed himself at the head of a national mission which aimed at the deepening of religious life at home. At an early date he gave public support to the proposals for a League of Nations, and it was recognized as specially fitting that he should preach the sermon at the opening of the third assembly in Geneva, 1922. In 1922 Davidson took the lead in issuing a vigorous protest, signed by the leaders of the Anglican, Roman Free Church and Jewish communions, against religious persecution in Russia. In 1923 he made a successful public appeal for the retention of the ecumenical patriarchate at Constantinople.

The archbishop also took a deep interest in the work of the church overseas. He presided over the sixth Lambeth conference in 1907 attended by 252 out of the 368 bishops of the Anglican communion, and throughout the deliberations adopted a strong forward looking attitude. After the issue of the appeal to all Christian people by that conference he took a prominent part in securing widespread consideration of the proposals for the reunion of Christendom which it contained. He actively forwarded conferences with the Free Church representatives in England, a series of important meetings being held at Lambeth palace. He further expounded the appeal to the general assemblies of the Church of Scotland, and the United Free Church of Scotland in 1921. In addition, the archbishop markedly developed friendly relations between the Anglican and Orthodox churches, and it was to him that the patriarch (Meletios IV) of Constantinople communicated his synod's acceptance of the validity of Anglican ordinations in 1922. He also took "cognizance" of the conversations between Anglican and Roman Catholic theologians held at Malines (1921-25) under the presidency of Cardinal Mercier, Pope Pius XI taking a similar "cognizance."

He was instrumental in securing the passage of the Church Assembly (Powers) act 1919, and from 1920 to 1928 presided over the church assembly with wisdom and courage. During this period a large number of measures were passed. The principal measure, dealing with Prayer Book revision, was rejected by the house of commons on Dec. 15, 1927. This situation, however, afforded an opportunity for an extraordinary outburst of admiration for the archbishop personally in all sections of the community. In Feb. 1928 he completed the 75th year of his primacy—a primacy longer than any since Archbishop Warham. He displayed a remarkable combination of sincere piety, common sense, loyalty to truth and sympathy with modern movements. He resigned Nov. 1928, was succeeded by Cosmo Lang, and was created a baron. He died May 25, 1930. (G. K. A. B.)

DAVIDSON, SAMUEL (1807-1898), Irish biblical scholar, was born near Ballymena. He became in 1842 professor of biblical criticism, literature and oriental languages at the Lancashire Independent college, Manchester, but was obliged to resign in 1857 on account of *The Text of the Old Testament*, and the *Interpretation of the Bible*, written for a new edition of Horne's *Introduction to the Sacred Scripture*. In 1862 he removed to London to become scripture examiner in London university, and he spent the rest of his life in literary work. He died on April 1, 1898. Davidson was a member of the Old Testament revision committee.

Among Davidson's principal works are *The Hebrew Text of the Old Testament Revised* (1855), *Introduction to the Old Testament* (1862), *On a Fresh Revision of the Old Testament* (1873), *The Doctrine of Last Things in the New Testament* (1883), besides translations of the New Testament from Tischendorf's text, Geseler's *Ecclesiastical History* (1846) and Furst's *Hebrew and Chaldean Lexicon*.

DAVIDSON, THOMAS (1817-1885), British palaeontologist, born in Edinburgh on May 17, 1817, was educated partly in the Edinburgh university and partly in France, Italy and Switzerland. His *Monograph of British Fossil Brachiopoda* was published by the Palaeontographical society (6 vol. with 200 plates, 1850-86). He also prepared an exhaustive memoir on "Recent

Brachiopoda," published by the Linnean Society. He was elected F.R.S. in 1857. He died at Brighton on Oct. 14, 1885.

See biography with portrait and list of papers in *Geol. Mag.* for 1871, p. 245.

DAVIES, ARTHUR B. (1862-1928), American painter, was born at Utica, N.Y., on Sept. 26, 1862. He was a pupil of Dwight Williams at Utica, afterwards studying in New York and Chicago. He became an adherent of the Romantic school of painting and made notable contributions in the fields of etching and colour lithography. Among his more important works are "Dream" and "The Girdle of Ares," in the Metropolitan Museum, New York City; "Maya, Mirror of Illusions," in the Art Institute, Chicago; "Spring in a Valley" and "Night Overture," in the Minneapolis Institute of Art; and "The Place of the Mother" and "Children of Yesterday," in the Brooklyn Museum. In 1923 his picture, "After-Thoughts of Earth," procured for him from the Carnegie Trust a medal of the first class and \$1,500. He died in Italy on Oct. 24, 1928.

DAVIES, SIR HENRY WALFORD (1860-1941), knighted 1922, English organist and composer, was born at Oswestry, Salop, on Sept. 6, 1860, and educated privately. In 1882 he became a chorister at St. George's chapel, Windsor, and in 1885 assistant organist to Sir Walter Parratt there. From 1890-94 he was pupil and scholar at the Royal College of Music, where, in 1895, he became a teacher of counterpoint. In 1898 he was appointed organist to the Temple church, a post which he held until 1923. From 1903-07 he was conductor of the London Bach choir in succession to Stanford, and from 1919-26 professor of music in the University College of Wales, at Aberystwyth. During the World War, with the rank of major, he worked for the organization of music among the troops, and in 1918 was made director of music to the R.A.F. In 1919 he was appointed director of music and chairman of the National Council of Music, University of Wales, in 1924, Gresham professor of music. He was organist of St. George's chapel, Windsor, 1927-32.

His compositions include two symphonies, and in the way of choral works, *Everyman*, a felicitous setting for chorus and orchestra of the old morality play, which enjoyed wide favour; "Ode on Time" (1908), *The Sayings of Jesus* (1911), "Dante Fantasy" (1914), and *Heaven's Gate*, in addition to a quantity of church music, chamber music, part songs, etc. Over and above his creative work, Walford Davies was for many years one of the most potent and stimulating forces (not least by means of his immensely popular radio talks) in musical education in England. He wrote *Music and Worship* (1935), with Harvey Grace, and *The Pursuit of Music* (1936), and edited several song books. In 1937 he was created K.C.V.O.

DAVIES, HUBERT HENRY (1869-1917), English playwright, was born in Cheshire on March 17, 1869. After some years of journalism in San Francisco, where he also produced a few vaudeville, he returned to England and made a success in London with *Cousin Kate* and *Mrs. Gorrings's Necklace*. Among his other comedies were *The Mollusc* (1907) and *Doormats* (1912). He produced *The Outcast* (1914). His health broke down as the result of overwork in France as a hospital orderly during the World War, and he was found dead at Robin Hood's bay, Yorks, on Aug. 17, 1917.

DAVIES, SIR JOHN (1569-1626), English poet, was baptized on April 16, 1569, at Tisbury, Wiltshire. He was educated at Winchester college, and became a commoner of Queen's college, Oxford, in 1585. In 1588 he entered the Middle Temple, and was called to the bar in 1595. In his general onslaught on literature in 1599 the archbishop of Canterbury ordered to be burnt his volume, *All Ourselves*, 3 Books, by C. M. I. p. 159, by J. D. (Middleburgh, 1598), which contained numerous works by Marlowe. The epigrams were probably earlier in date of composition than the charming fragment entitled *Orchestra* (1596), written in praise of dancing, and dedicated to the author's "very friend, Master Richard Martin," but in the next year the friend quarrelled, and Davies was expelled from the society to which he stuck Martin with a cudgel in the hall of the Middle Temple. He spent the year after his expulsion at Oxford in the composition

of his philosophical poem on the nature of the soul and its immortality—*Nosce teipsum* (1599). Its force, eloquence and ingenuity, the orderly and lucid arrangement of its matter, place it among the finest of English philosophical poems. In 1599 Davies published a volume of 20 acrostics on the words *Elisabetha Regina*, entitled *Hymns to Astraea*. He produced no more poetry except two dialogues contributed to Francis Davison's *Poetical Rhapsody* (1608). In 1601 Davies was restored to his position at the bar, after making his apologies to Martin, and in the same year he sat for Corfe Castle in parliament. James I. received the author of *Nosce teipsum* with great favour, and sent him (1603) to Ireland as solicitor general, he was knighted in the same year. In 1606 he was promoted to be attorney-general for Ireland, and created sergeant-at-arms. One of his chief aims was to establish the Protestant religion firmly in Ireland, and he took an active part in the "plantation" of Ulster. In 1612 he published his prose *Discoverie of the true causes why Ireland was never entirely subdued until the beginning of his Majesty's happy reign* (ed. H. Morley in his *Ireland under Elizabeth and James I.* [1890]). In the same year he entered the Irish parliament as member for Fermanagh, and was elected speaker after a scene of disorder in which the Catholic nominee, Sir John Everard, who had been installed, was forcibly ejected. In the capacity of speaker he delivered an excellent address reviewing previous Irish parliaments. He resigned his Irish offices in 1610, and sat in the English parliament of 1621 for Newcastle-under-Lyme. With Sir Robert Cotton he was one of the founders of the Society of Antiquaries. He was appointed lord chief justice in 1626, but died suddenly before he could enter on the office. He had married (1609) Eleanor Touchet, daughter of George, Baron Audley. She developed eccentricity verging on madness, and wrote several fatal books on prophecy.

BIBLIOGRAPHY.—In 1615 Davies published at Dublin *Le Premier Discours des Cases et Matiers in Ley resolues et adjuages en les Courts du Roy en cest Realm* (reprinted 1628). He issued an edition of his poems in 1622. His prose publications were mainly posthumous. *The Question concerning Impositions, Tonnage, and Poundage* was printed in 1606, and four of the tracts relating to Ireland, with an account of Davies and his services to that country, were edited by G. Chalmers in 1786. His works were edited by Dr. A. B. Grosart (1860-76), with a full bibliography, for the Fuller Worthes Library, also by H. Morley for the "Carlsbrooke Library" (vol. x 1889). *Nosce teipsum* is printed in Arber's *English Garner* (vol. v 1882).

DAVIES, JOHN, of Hereford (1565?-1618), English poet, was born at Hereford, and settled in Oxford as a writing master. His principal work is the *Microcosmus* (1603), modelled largely on Joshua Sylvester's translation of the *Semaines* of Du Bartas.

Among other works are—*Mirum in modum* (1602), *The Holy Rood* (1609), *Whites Pilgrimage* (c. 1610), *The Scourge of Folly* (c. 1612), *The Muses Sacrifice* (1612), and *Whites Bedlam* (1607). His *Scourge of Folly* contains verses addressed to many of his contemporaries, to Shakespeare among others. He also wrote *A Select Second Husband* for Sir Thomas Overbury's wife (1616), and *The Writing Schoolmaster* (earliest known edition, 1631). His works were collected by Dr. A. B. Grosart (1873) for the Chertsey Worthes Library.

DAVIES (DAVISUS), JOHN (1679-1732), English classical scholar and critic, was born in London. He was president of Queen's college, Cambridge, and was considered one of the best commentators on Cicero. He edited the *Tusculanae disputationes* (1700), *De natura deorum* (1718), *De divinatione* and *De fato* (1725), *Academica* (1725), *De legibus* (1727), *De finibus* (1728) and other works. Davies's editions, which were intended to supplement those of Grævius, show a great knowledge of history and philosophy, but are too free in emendation.

DAVIES, JOHN LEWELLYN (1826-1916), English divine and educationalist, was born at Chichester on Feb. 26, 1826. He was educated at Repton and Trinity College, Cambridge, where he was made a fellow in 1851. He was ordained in the same year, and held successively several London livings. He was given the crown living of Christ church, Marylebone, in 1856, and in 1889 became vicar of Kurky Lonsdale, Westmorland, where he remained until 1908. Davies was closely associated with John Frederick Denison Maurice in the foundation of the Working Men's College (1854), where he taught for many years. He was elected to the first London school board in succession to Huxley,

and from 1873-74 and 1878-86 was principal of Queen's College, Harley street, founded by Maurice in 1848 for the advancement of women's education. Davies was an advocate of the higher education of women, a cause in which his sister, Sarah Emily Davies (q.v.), was also prominent, and favoured the granting to women of university degrees and the Parliamentary franchise. He died at Hampstead on May 17, 1916. With Vaughan he produced the well known translation of Plato's *Republic*.

DAVIES, SIR LOUIS HENRY (1845-1924), Canadian politician and jurist, was born in Prince Edward Island in 1845, of Huguenot descent. In 1882 he entered the Canadian parliament as a Liberal, and from 1896 to 1901 was minister of marine and fisheries. In the latter year he became one of the judges of the supreme court of Canada. In 1877 he was counsel for Great Britain before the Anglo-American fisheries arbitration at Halifax, in 1897 he was a joint delegate to Washington with Sir Wilfred Laurier on the Bering sea seal question, and in 1898-99 a member of the Anglo-American joint high commission at Quebec. In 1918 he became chief justice and a member of the privy council. He died at Ottawa on May 1, 1924.

DAVIES, RICHARD (c. 1501-1581), Welsh bishop and scholar, was born in north Wales and educated at New Inn Hall, Oxford, becoming vicar of Burnham, Bucks, in 1550. He took refuge at Geneva during the reign of Mary. In Jan. 1560 he was consecrated bishop of St. Asaph, whence he was translated, early in 1561, to the bishopric of St. Davids. Davies was a member of the council of Wales, was very friendly with Matthew Parker, archbishop of Canterbury, and was consulted both by him and by Burghley, on Welsh concerns. He took part in translating the New Testament into Welsh, and assisted with the Welsh translation of the Book of Common Prayer. He helped to revise the "Bishops' Bible" of 1568, being responsible for Deuteronomy and 2 Samuel. He died on Nov. 7, 1581.

DAVIES, SARAH EMILY (1830-1921), British educationalist, sister of John Llewellyn Davies (q.v.), was born at Southampton on April 22, 1830. She was educated at home, and later identified herself with the movement for the higher education of women, being also one of a group of women who, about 1858, were discussing the question of women's suffrage at the Kensington Society. In 1862 she became secretary to the committee which was formed to procure the admission of women to university examinations. In 1867, Miss Davies, with the help of Mme. Bodichon (Barbara Leigh Smith) and others, organized a women's college at Hitchin, which was subsequently transferred to Cambridge as Girton college in 1873. From 1870 to 1873 she was a member of the London School Board, and withdrew to become mistress of Girton college, Cambridge, a post which she held for two years. In 1873 she was elected a life governor of University college, London, and in 1882 became honorary secretary of Girton college, retiring in 1904. She died in London on July 13, 1921. She published *The Higher Education of Women* (1886), and *Thoughts on Some Questions Relating to Women* (1860-1908) (1910).

See B. Stephen, *Emily Davies and Girton College* (1927).

DAVIES, WILLIAM HENRY (1871-1940), British poet, born at Newport, Monmouth, April 20, 1871. After serving as apprentice to a picture-frame maker he tramped through America, crossed the Atlantic many times on cattle boats, became a pedlar and street singer in England, and after eight years of this life published his first volume of poems, *The Soul's Destroyer*, from the Marshalsea prison. Next year appeared in prose *The Auto biography of a Super Tramp* (1908) with a preface by G. Bernard Shaw, and also *Nature Poems and Others*. Collected editions of his poems appeared in 1916, 1924, 1928. His poetry includes *Forty New Poems* (1918), *The Hour of Magic, and Other Poems* (1922), *A Poet's Alphabet* (1925), *The Song of Love* (1926), *Poems* (1930-31, 1932), *The Loneliest Mountain* (1939). He published a novel, *A Weak Woman* (1911), and volumes of nature studies, including *A Poet's Pilgrimage* (1918), *Later Days* (1925), *The Adventures of Johnny Walker Tramp* (1926).

DAVILA, ENRICO CATERINO (1576-1631), Italian historian, was descended from a Spanish noble family. His im-

mediate ancestors had been constables of the kingdom of Cyprus for the Venetian republic since 1464. But in 1570 the island was taken by the Turks, and Antonio Davila, the father of the historian, had to leave it, despoiled of all he possessed. He travelled into Spain and France, and finally returned to Padua, and at Sacco on Oct. 30, 1576, his youngest son, Enrico Caterino was born. About 1581 Antonio took this son to France, where he became a page in the service of Catharine de' Medici, wife of King Henry II. In due time he entered the military service, and fought through the civil wars until the peace in 1598. He then returned to Padua, where, and subsequently at Parma, he led a studious life until, when war broke out, he entered the service of the republic of Venice. During the whole of this active life he never lost sight of his early design of writing the history of those civil wars in France in which he had borne a part. The success of the *Istoria delle guerre civili di Francia* was immediate and enormous. Over 200 editions followed, of which perhaps the best is the one published in Paris in 1644. Davila was murdered, while on his way to take over Cremona for Venice in July 1631.

The *Istoria* was translated into French by G. Boudoun (1642), into Spanish by Varen de Soto (Madrid, 1651, and Antwerp, 1686), into English by W. Aylesbury (1647), and by Charles Cottrell (1666), and into Latin by Pietro Francesco Cornazzano (1745). The best account of the life of Davila is that by Apostolo Zeno, prefixed to an edition of the history printed at Venice in 2 vols. in 1723.

DAVIS, CHARLES HAROLD (1857-1933), American landscape painter, was born at East Cambridge (Mass.), Feb. 2, 1857. A pupil of the schools of the Boston Museum of Fine Arts, he was sent to Paris in 1880. Having studied at the Academy Julian under Lefebvre and Boulenger, he went to Barbizon and painted much in the forest of Fontainebleau under the traditions of the "men of thirty." He became a full member of the National Academy of Design in 1906 and received many awards, including a silver medal at the Paris Exhibition of 1889. He is represented by important works in the Metropolitan Museum of Art, New York, the Corcoran Art Gallery, Washington, the Pennsylvania Academy, Philadelphia, and the Boston Museum of Fine Arts. The Union League club in New York had an exhibition of his works in Feb. 1927.

DAVIS, CUSHMAN KELLOGG (1838-1900), American political leader and lawyer, was born in Henderson, N.Y., on June 16, 1838. He was taken by his parents to Wisconsin Territory in the year of his birth, and was educated at Carroll college, Waukesha, Wis., and at the University of Michigan, where he graduated in 1857. After studying law he was admitted to the bar in 1860. During the Civil War he served as a first lieutenant in 1862-63 and in 1864 was an aide to Gen. Willis A. Gorman (1814-76). Resigning his commission in 1864, he settled in St. Paul, Minn., where he soon became prominent both at the bar and, as a Republican, in politics. He served in the State house of representatives in 1867, and was U.S. district attorney for Minnesota (1868-73). In 1874-76 he was governor of the State, and from 1887 until his death at St. Paul, Nov. 27, 1900, was a member of the U.S. Senate, where he was one of the acknowledged leaders of his party, an able and frequent speaker, and a committee worker of great industry. He was one of the peace commissioners who negotiated and signed the treaty of Paris by which the Spanish American War was terminated. In addition to various speeches and public addresses, he published an essay entitled *The Law of Shakespeare* (1899).

See sketch by W. B. Chamberlain in *Michigan Alumnus*, vol. vii, pp. 133-39 (1901).

DAVIS, HENRY WILLIAM CARLESS, C.B.E. (1874-1928), British historian, a son of H. F. A. Davis of Stroud, Gloucestershire, was born on Jan. 13, 1874, and educated at Weymouth college and Balliol college, Oxford. He was a fellow of All Souls (1895-1902), and of Balliol (1902-21). During the World War he served in the War Trade Intelligence Department, and after attending the Peace Conference, directed the Overseas Trade Department. In 1921 Davis was appointed professor of modern history at Manchester and in 1925 he returned to Oxford as regius professor of modern history. He became, in addition, curator of the Bodleian Library in 1926. He was made

director of the *Dictionary of National Biography*, when in 1902, the copyright of that work passed to the Clarendon Press. Davis's historical work was chiefly done in the medieval field and found expression in his *England under the Normans and Angevins* (1905), *Medieval Europe* (1911), a revised edition of the *Select Charters* of William Stubbs (1913) and *Medieval England* (1924). The calendar of Anglo-Norman Royal Charters 1066-1154, was not completed, owing to the difficulty of obtaining literary assistance during the World War. Davis was able to finish only the first volume (1913).

The considered judgment, exact scholarship and constructive imagination shown in his *England under the Normans and Angevins* brought him into prominence as an authority on medieval history. This work was remarkable for its appreciation of the true position held by England in the period dealt with, and marks a definite advance in historical scholarship. His *Medieval Europe*, though showing a masterly knowledge of the period, was written rather for the general public than for the serious student. After the outbreak of war, Davis's writings on subjects connected with modern political thought (*The Political Thought of Treitschke* [1914], and various articles) demonstrated his skill in the delineation of character and the exposition of policy, and he brought to this work in a very different field the same characteristic ability and thoroughness which had made his medieval studies famous. He was exceptionally gifted as a tutor, particularly for those who, themselves, intended to become teachers. Davis died of pneumonia on June 28, 1928, in Edinburgh, where he had gone to conduct an examination.

He contributed several articles to this *Encyclopædia*.
DAVIS, HENRY WINTER (1817-1865), American political leader, was born at Annapolis (Md.), U.S.A., on Aug. 16, 1817. He graduated from the law department of the University of Virginia in 1841, and began to practice law in Alexandria (Va.), but in 1850 removed to Baltimore (Md.). Early imbued with strong anti-slavery views, he began political life as a Whig, but when the Whig party disintegrated, became an "American" or "Know Nothing," and as such served in the national House of Representatives from 1833 to 1861. In 1860, not ready to ally himself wholly with the Republican party, he declined to be a candidate for the Republican nomination for the vice presidency. After Lincoln's election, he became a Republican, and was re-elected in 1862 to the National House of Representatives, in which his radical views commanded especial attention owing to his being one of the few representatives from a slave state. From Dec. 1862, to March 1865 he was chairman of the committee on foreign affairs. With other radical Republicans Davis was a bitter opponent of Lincoln's reconstruction plan of the Southern States. On Feb. 15, 1864, he reported a bill placing reconstruction under the control of Congress. The bill finally passed both houses but failed to receive the approval of the president, who on July 8 issued a proclamation defining his position. On Aug. 5, 1864, Davis joined Benjamin F. Wade of Ohio, in issuing the so-called "Wade Davis Manifesto," which violently denounced President Lincoln for encroaching on the domain of Congress. He was one of the radical leaders who preferred Fremont to Lincoln in 1864, but subsequently supported the President. In July 1865, he publicly advocated the extension of the suffrage to negroes. He died in Baltimore (Md.), on Dec. 30, 1865.

See *The Speeches of Henry Winter Davis* (1867), to which is prefixed an oration on his life and character delivered in the House of Representatives by Senator J. A. J. Creswell of Maryland.

DAVIS, JEFFERSON (1808-1889), American statesman, president of the Confederate States of America, was born on June 3, 1808 on a farm on the present site of Fairview Todd county, Ky. He was the tenth and youngest child of Samuel Davis (1755-1824), a descendant of a Welsh family that had settled originally in New Jersey, and he probably was a cousin of Samuel Davies (1724-1761), president of Princeton. Samuel Davis was born in Georgia, was a captain of infantry in the American revolution and subsequently was a planter. He married Jane Cook (1759-1844) of Scotch Irish stock. They moved to southwestern Kentucky in 1796, thence to Louisiana about 1810

and still again to Wilkinson county, Miss.

Schooled in Kentucky and in Mississippi, Davis attended Transylvania college, Ky., in 1821-24, entered the U.S. Military Academy in Sept. 1824 and graduated no. 23 in a class of 33, in July 1828. Albert Sidney Johnston was in a higher class during Davis's cadetship, and Robert C. Lee and Joseph E. Johnston belonged to the next junior class. Davis remained in the army seven years, and served chiefly in Wisconsin, where a severe attack of pneumonia left him with a facial neuralgia that often incapacitated and sometimes blinded him. After 1831 he was never a man of robust health or of a normal nervous system.

Finding in 1835 that army life had become a routine, Davis resigned his commission as lieutenant and after marrying Sarah Knox Taylor, daughter of Col. Zachary Taylor, started as a cotton planter in Mississippi. His young bride died within three months of their marriage, and he spent the next ten years of his life on his plantation with his leisure devoted to hard reading. He soon developed a system that was almost a model in the relations of master and slaves. He gave the servant community a large measure of self-government and left in its hands, through an interesting jury system, the trial of all petty offenders. His own experience shaped his views, knowing that his negroes were well fed, happy and advancing, he could not believe the evil alleged against slavery.

An unsuccessful candidate of the legislature in 1843 and a Democratic presidential elector in 1844, Davis was elected to the U.S. House of Representatives in 1845. He was married that same year to Virginia Howell (1828-1907), granddaughter of Gov. Richard Howell of New Jersey. His service in Washington had hardly begun when the war with Mexico broke out and he was named colonel of the First Mississippi Infantry. He resigned from Congress in June 1846, and speedily had his troops well drilled and ready to join in the advance of the army under Gen. Zachary Taylor. Davis and his regiment acquitted themselves well in the battle of Monterey, Sept. 21-23, 1846, and when Taylor's reduced force was attacked at Buena Vista on Feb. 22, 1847, a stand by the Mississippians saved the day for the American forces and made Davis something of a national figure. He was wounded in this battle and was forced to return to Mississippi, in the company of his troops, whose term of enlistment had expired. He declined President Polk's complimentary commission as brigadier-general of volunteers, on the ground that officers of volunteers should be named by the States, but in Aug. 1847 he accepted appointment to the United States Senate and soon was named chairman of its committee on military affairs. In 1851 the Democrats of Mississippi prevailed upon him, in the party's interest, to become a candidate for governor. He was defeated by a narrow vote, and was again in retirement for 18 months, but upon the inauguration of Franklin Pierce in 1853, he became secretary of war and served for four years. During this time he strengthened the coast defences, enlarged the army, directed valuable surveys for a railroad to the Pacific, introduced various betterments at West Point, and experimented with the use of camels as draft animals in the West. Expansionist plots in Cuba and in Nicaragua were supposed to have his support. President Pierce's endorsement of the repeal of the Missouri compromise was probably the result of Davis's influence with him.

Davis re-entered the United States Senate on March 4, 1857, but an affection of the eyes limited his activities for nearly two years. In 1859-60 he was one of the foremost leaders of Southern Democrats in opposition to Stephen A. Douglas. During his first term in the senate (1847-51) he had argued that all the territories should be opened to slavery, but he had been willing to accept an extension of the line of the Missouri compromise to the Pacific. After the verdict of the Supreme Court in the Dred Scott case he became more aggressive in his views of Southern rights and repudiated Stephen A. Douglas's doctrine of squatter sovereignty. He asserted that Congress had no right to deny admission to the Union to any territory because of the existence or non-existence of slavery, which he now frankly defended. His opinions were fully set forth in a series of resolutions offered on Feb. 2, 1860, and subsequently adopted. He did his utmost to

prevent the nomination of Douglas for the presidency, and after the split in the Democratic convention at Charleston, he supported Breckinridge and Lane, though he did not canvass for them.

Always a believer in the right of secession, Davis had favoured a convention of the Southern States in 1851, to consider what action they should take on the compromise of 1850, but until after the election of Lincoln in Nov. 1860 he never felt that circumstances justified a withdrawal from the Union. The victory of the party opposed to slavery, the uncompromising attitude of the Republican senators, and the unwillingness of President Buchanan to concede the right of a State peaceably to leave the Union, combined in the early winter of 1860-61 to convince Davis that the South in self protection should exercise its right of secession and should form a separate confederation. He united with six other senators from the cotton States in an historic declaration to this effect. At the instance of his colleagues he consented to serve on the "committee of thirteen" that sought a last minute settlement of slavery, but when he found that the Republic members would accept no compromise, he voted against the committee's report. Although he believed further efforts at accommodation were futile, he intervened in South Carolina's behalf in an attempt to have the Federal garrison withdrawn from Charleston harbour. Then, following the secession of his own State, he bade farewell to the senate on Jan. 21, 1861, in a moving address.

CIVIL WAR CAREER

Designated commander of his own State's troops, Davis hoped for a military career in case of war. Instead to his surprise and regret, he was unanimously chosen by Congress provisional president of the Confederate States Feb. 9, 1861. He was inaugurated at Montgomery, Ala., on Feb. 18, 1861, was formally elected by the people on Oct. 16, 1861, was again inaugurated, this time at Richmond, Va., under the "permanent constitution" on Feb. 22, 1862, and was holding the office of president when the Confederacy collapsed.

Selecting a cabinet of moderate views and of no more than moderate ability, Davis sought to negotiate for a withdrawal of the Union troops from military posts in the South, and he did not order military operations to be opened at Charleston, S.C., in April 1861, until he was convinced that the Lincoln administration had sent an armed expedition to retical and reinforce the garrison of Ft. Sumter.

The easy victory of the Confederates at Bull Run, on July 21, 1861, misled the South into believing that its independence would be won without great effort. Even Davis himself, who had warned the Confederacy of the magnitude of its task, seems to have been so deluded in the summer of 1861 by the hope of speedy foreign intervention that he did not capitalize the war ardour of the first months of the struggle. Events of the winter of 1861-62, however, spurred him to a vigorous policy. He procured the passage of a conscription law, and although the South had only one rolling-mill of any consequence, he contrived to manufacture cannon in sufficient numbers. Side arms, powder, uniforms and quartermasters stores were obtained in a country that had few facilities for making them. A navy was constructed in improvised yards and by secret, adroit purchase abroad. The war was financed on fiat money. The feeble, disjointed transport system of the South was welded together and was made to serve.

The results of hard effort, coupled with the fortunate choice of good commanders, showed during 1862 in a series of brilliant victories in Virginia. It was otherwise on the Mississippi. Friction among rival generals and a lack of co-ordination led from disappointment to disaster. A visit of Davis to the threatened front in Dec. 1862 failed to change the situation. The next year he decided on an offensive in the East in preference to reinforcement of the army on the Mississippi. It was his most momentous decision and perhaps his greatest blunder, because the Eastern offensive failed at Gettysburg and the very next day, by the fall of Vicksburg, the Confederacy was cut in half.

In 1864, Lee maintained a successful defensive in Virginia,

but in Tennessee and Georgia conditions went from bad to worse. Davis had delayed too long in removing the unsuccessful Braxton Bragg and after he at last relieved Bragg of command of the Army of Tennessee, he offended public opinion by making him his chief military adviser. On July 17, 1864, when Sherman was close to Atlanta, Davis supplanted Joseph E. Johnston by John B. Hood. This most ruinous change led to the speedy break-up of the only army that stood in the way of Sherman's march to join Grant, who by this time had pinned Lee to the Richmond defences. The reaction against Davis, who was blamed for all this, was immediate and severe. Congress no longer sustained him, the governors of North Carolina and of Georgia were openly antagonistic, the press denounced him, and Robert E. Lee would probably have been named dictator in Davis' place if Lee had been willing to countenance a revolution within the Confederacy. The failure of the Hampton Roads conference, on Feb. 3, 1865, to find any basis of peace, filled out the measure of Davis' unpopularity.

Davis was perhaps too harshly judged by his contemporaries. He never had a general military policy. He was too prone to take the course of immediate safety. After the removal of the Confederate capital to Richmond, in May 1861, he laid too much emphasis on the defence of Virginia to the neglect of other parts of the Confederacy. He acted on occasion as his own chief of staff, and then, with no apparent reason for change, he left his field commanders entirely to their own discretion. He became so absorbed in operations that he neglected the commissary and transport. Above all, he was not a good judge of men when his affection, his pride or his prejudice were involved, though it must be remembered to his credit that he kept his faith in Robert E. Lee at a time when the press and the country decreed Lee a failure because of his unsuccessful campaign in Western Virginia. Criticism sometimes aroused in Davis a dangerous obstinacy. He could not brook open opposition and he was singularly sensitive. This last named bad quality, his coldness and his personal dignity kept him from making an effective appeal to the emotions of his people. He was unhappy in his dealings with a short-sighted, contentious congress, and he was maladroit in his foreign relations, particularly with France. His loyalty to his friends was so extreme as to be a positive vice. But against all his failings it is to be set the fact that the agricultural South, with resources vastly inferior to those of the North, kept up the struggle for four years. Perhaps the strongest single force in that defence, when all is said, was Jefferson Davis.

On the evacuation of Richmond, April 2-3, 1865, Davis removed the executive offices to Danville, Va., and thence to Greensboro, N.C. Journeying southward in the hope of reaching the Trans-Mississippi department, he was captured near Irwinville, Ga., on May 10, 1865, and was transported to Ft. Monroe, Va. He was confined there, under threat of a trial for treason, until May 4, 1867, when he was admitted to bail and was allowed to go to Canada. During the early part of his imprisonment he was manacled and subjected to severities that impaired his health. This maltreatment, and the effort of the North to make him a scapegoat, won for him the sympathy of the South and restored him to his former place in its affection. Although he was twice indicted for treason, the proceedings were dropped after the general amnesty proclamation of Dec. 25, 1868. He subsequently visited Europe, served for a time as president of an insurance company and then retired to Beauvoir, the home of an admiring friend in Mississippi, where he wrote his *Rise and Fall of the Confederate Government* in two volumes (1881). This is an excellent review of the constitutional questions underlying secession but is in many respects a singularly reticent account of his administration. He later composed *A Short History of the Confederate States of America*, issued posthumously in 1890. He declined to take any part in politics on his return to the United States, and he was cheerfully engaged in his correspondence and in interviews with frequent visitors when a brief illness from a bronchial complaint terminated fatally on Dec. 6, 1889, in New Orleans, La. He was buried there, but in 1893 his body was taken to Richmond and on May 31 was reinterred in Hollywood cemetery.

of lyrics, "The Lament of Owen Roe O'Neill," "The Battle of Pontenoy," "The Geraldines," "Maure Bhan a Stoir," and many others. Differences arose between O'Connell and the young writers of *The Nation*, and Davis was one of the leaders of the extremist party, "Young Ireland," till his premature death.

See his *Poems and his Literary and Historical Essays* collected in 1846 (new ed. 1915). There is an edition of his prose writings (1889) in the *Camelot Classics*. See the monograph on *Thomas Davis* by Sir Charles Gavan Duffy (1890, abridged ed. 1896) and the same writer's *Young Ireland* (revised ed. 1896).

DAVIS, WILLIAM MORRIS (1850-1934), American geographer and geologist, was born in Philadelphia, Pa., on Feb. 12, 1850. After graduating from the Lawrence scientific school, Harvard university in 1870, he was assistant astronomer at the Argentine National observatory, Cordoba, Argentina, in 1870-71. In 1877 he made a tour of the world. He was instructor and professor of physical geography and geology at Harvard from 1877 until 1912 when he was made professor emeritus. In 1903 he went to Turkistan as a physiographer of Pumpelly's Carnegie institution expedition. He visited South Africa in 1905 and Australia in 1914 as guest of the British Association for the Advancement of Science. He was visiting professor at the University of Berlin in 1908-09, and at the University of Paris in 1911-12. In 1914 he crossed the Pacific on a Shaler memorial study of coral reefs. He was founder and for three terms president of the Association of American Geographers, founder and president (1902-11) of the Harvard Travellers' club, and president (1911) of the Geological Society of America. By his lectures and writings on the development of the physical features of the earth he won high rank among modern physiographers.

Among his published works are *Elementary Meteorology* (1894), *The Triassic Formation of Connecticut* (U.S. Geological Survey, 1895), *Physical Geography* (1898), *Practical Exercises in Physical Geography* (1908), *Geographical Essays* (1909), *Physiogeographie* (with G. Braun, 1911), *Erkl. Beschreibung der Landformen* (lectures in Berlin, 1912), *The Coral Reef Problem* (1928), and numerous scientific essays. In 1895 he was made a member of the editorial committee of *Science* and in 1909 he became associate editor of the *American Journal of Science*.

DAVISON, WILLIAM (c. 1541-1608), secretary to Queen Elizabeth, was of Scottish descent. In 1566 he acted as secretary to Henry Killigrew (d. 1603), when he was sent into Scotland by Elizabeth on a mission to Mary, queen of Scots. Remaining in that country for about 10 years, Davison then went twice to the Netherlands on diplomatic business, returning to England in 1586 to defend the hasty conduct of his friend, Robert Dudley, earl of Leicester, who had assumed the office of Governor of the Low Countries without Elizabeth's instructions. In the same year he became member of parliament for Knaresborough, a privy councillor, and assistant to Elizabeth's secretary, Thomas Walsingham, but he soon appears to have acted rather as the colleague than the subordinate of Walsingham. He was a member of the commission appointed to try Mary, queen of Scots, although he took no part in its proceedings, was never at Fotheringhay, and was not present at Westminster when the sentence of death was passed. The warrant for Mary's execution was entrusted to Davison. On this occasion, and also in subsequent interviews with her secretary, Elizabeth suggested that she would be glad to avoid the responsibility of the execution, but Mary's gaolers, Paulet and Drury, refused to take the hints thrown out to them. Meanwhile, the privy council having been summoned by Lord Burghley, it was decided to carry out the sentence at once, and Mary was beheaded on Feb. 8, 1587. When the news of the execution reached Elizabeth she was extremely indignant, and her wrath was chiefly directed against Davison, who, she asserted, had disobeyed her instructions not to part with the warrant. The secretary was arrested and thrown into prison, but, although he defended himself when interrogated in the Tower, he did not say anything about the queen's wish to get rid of Mary by assassination. Charged before the Star Chamber (March 28, 1587) with misprision and contempt, he was acquitted by many of the commissioners of evil intention, but was sentenced to pay a fine of 10,000 marks, and to imprisonment during the

queen's pleasure, but he was released in 1589. He retired to Stepney, where he died. He was buried on Dec. 4, 1608. Davison was undoubtedly made the scapegoat for the queen's pusillanimous conduct.

His eldest son FRANCIS DAVISON (c. 1575-c. 1619), and his fourth son WALTER (1581-1608?) both contributed poems to the *Poetical Rhapsody* (1602), notices of them are given in Sir N. H. Nicolas's edition (1826) of that miscellany. Francis Davison also wrote a metrical translation of the Psalms, which remained in ms. until they were edited by Sir E. Brydges and by Nicolas in the 19th century.

Many state papers written by him, and many of his letters, are extant in various collections of manuscripts. See Sir N. H. Nicolas, *Life of W. Davison* (1823), J. A. Froude, *History of England* (1881, fol.), *Calendar of State Papers 1580-1609*, and *Correspondence of Leicester during his Government of the Low Countries*, edited by J. Bruce (1814).

DAVIS STRAIT, the broad strait which separates Greenland from North America, and connects Baffin bay with the open Atlantic. At its narrowest point, which occurs just where the Arctic Circle crosses it, it is nearly 200 m. wide. This part is also the shallowest, a sounding of 112 fathoms being found in the centre, whereas the depth increases rapidly both to north and to south. Along the western shore (Baffin Land) a cold current passes southward, but along the east there is a warm northward stream. There are a few Danish settlements on the Greenland coast. The strait takes its name from the explorer John Davis.

DAVITT, MICHAEL (1846-1906), Irish Nationalist politician, son of a peasant farmer, was born at Straide, Co. Mayo, on March 25, 1846. His father was evicted for non payment of rent in 1852, and migrated to Lancashire, where at the age of ten the boy began work in a cotton mill at Haslingden. In 1857 he lost his right arm by a machinery accident, he was sent to school, and at 15 became a newsboy and printer's "devil." He drifted into the ranks of the Fenian brotherhood in 1865, and on May 14, 1870, he was arrested at Paddington for treason felony in arranging to send firearms into Ireland, and was sentenced to 15 years penal servitude. After seven years, spent chiefly at Dartmoor, he was released on ticket-of-leave. He at once rejoined the "Irish Republican Brotherhood," and went to the United States, where his mother, herself of American birth, had settled with the rest of the family, with the idea of grafting constitutional methods on the revolutionary movement on lines which he had thought out in prison. He proposed to link up the campaign for independence with the agrarian question. Returning to Ireland he seems to have persuaded Parnell of the importance of the agrarian element, and helped him to start the Land League in 1879, and his violent speeches resulted in his re arrest and consignment to Portland by Sir William Harcourt, then home secretary. He was released in 1882, but was again prosecuted for seditious speeches, and imprisoned for three months in 1883. Before this his support of Parnell had led to his expulsion from the supreme council of the I.R.B., though he remained a member of the organization until 1882. Between 1882 and 1885 he conducted a campaign on land nationalization, which Parnell repudiated. He had been elected to parliament for Meath as a Nationalist in 1882, but, being a convict, was disqualified to sit. He was included as one of the respondents before the Parnell Commission (1888-1889), and spoke for five days in his own defence. That he had brought the Irish Party into contact with the Fenians in America was undoubted. (See PARNELL.) He took the anti-Parnellite side in 1890, and in 1892 was elected to parliament for North Meath, but was unseated on petition. He was then returned for North East Cork, but had to vacate his seat through bankruptcy, caused by the costs in the North Meath petition. In 1895 he was elected for West Mayo. In 1898 he helped William O'Brien to found the United Irish League to reconcile the Parnellite and anti-Parnellite factions. He retired from the House of Commons to express his disapproval of the Boer War. He fiercely opposed the Wyndham Land Purchase Act and William O'Brien's conciliatory policy. He died on May 31, 1906, in Dublin. A sincere but embittered Nationalist, anti-English, anti clerical and sceptical as to the value of the purely parliamentary agitation

for Home Rule, Davitt was often in conflict with his fellow Home Rulers. In later years his socialist radicalism connected him closely with the Labour Party. His force of character earned him the respect of many, even of those who thought his doctrine pernicious. The chief original authority is to be found in his own works, notably in his speech before the Parnell Commission, separately published as *The Defence of the Land League* (1891).

See also F. Sheehy Skeffington, *Michael Davitt*, etc. (1908).

DAVOS, a mountain valley in the Swiss canton of the Grisons (Romansch *Tavau*), lying east of Coire (40 m distant by rail), and north-west of the Lower Engadine (18 m by road from Sus). It contains two main villages, 2 m from each other, Dorfl and Platz (the chief hamlet), which are 5,015 ft above sea level, and had a population in 1950 of 10,433, a figure exceeded in the Grisons only by Coire. Of the population in 1920 5,885 were Protestants, 3,309 Romanists and 163 Jews, while 7,776 were German-speaking and 430 Romansch speaking. Tavaus or Tavauns is mentioned in 1160 and 1213, as a mountain pasture or "alp." It was then in the hands of a Romansch speaking population, as is shown by many surviving field names. But between 1260 and 1282, German-speaking colonists from the Upper Valais were planted there, so that it has long been a Teutonic island in the midst of a Romansch-speaking population. Historically it is associated with the Prättigau or Landquart valley to the north, and in 1436 became the capital of the League of the Ten Jurisdictions (See GRISONS). It formerly contained many iron mines, and belonged from 1477 to 1649 to the Austrian Habsburgs.

In 1860 the population was only 1,705, the increase being due to the fact that the region is much frequented as a winter resort and has many sanatoria, etc. At the north end of the valley is lake Davos, while from Platz the *Landwasserstrasse* leads (20 m) down to the Alvanenbad station.

DAVOUT, LOUIS NICOLAS, duke of Auerstadt and prince of Eckmühl (1770-1833), marshal of France, was born at Annour (Yonne) on May 10, 1770. His name is also, less correctly, spelt Davout and Davoust. He entered the French army as a sub lieutenant in 1788, and was *chef de bataillon* in a volunteer corps in the campaign of 1792, and distinguished himself at Neerwinden in the following spring. He had just been promoted general of brigade when he was removed from the active list as being of noble birth. He served, however, in the campaigns of 1794-97 on the Rhine, and accompanied Desaix in the Egyptian expedition of Bonaparte. On his return he fought in the campaign of Marengo under Napoleon, who made him a general of division, and in 1801 gave him a command in the consular guard. Davout was created a marshal of France when Napoleon became emperor. As commander of the III corps of the *Grande Armée* Davout rendered the greatest services. At Austerlitz, after a forced march of 48 hours, the III corps bore the brunt of the allies' attack. In the Jena campaign Davout with a single corps fought and won the brilliant victory of Auerstadt against the main Prussian army (See NAPOLEONIC CAMPAIGNS). He took part in the campaign of Eylau and Friedland. Napoleon left him as governor general in the grand duchy of Warsaw when the treaty of Tilsit put an end to the war (1807), and in 1808 created him duke of Auerstadt. In the war of 1809 Davout took a brilliant part in the actions which culminated in the victory of Eckmühl, and had an important share in the battle of Wagram (1809). He was created prince of Eckmühl about this time. It was Davout who was entrusted by Napoleon with the task of organizing the corps of observation of the Elbe, which was in reality the army with which the emperor invaded Russia in 1812. In this Davout commanded the I corps over 70,000 strong and defeated the Russians at Molvny before he joined the main army with which he continued throughout the campaign and the retreat from Moscow. In 1813 he defended Hamburg, a city ill-fortified and provisioned and full of disaffection through a long siege, only surrendering the place on the direct order of Louis XVIII after the fall of Napoleon in 1814.

Davout was a stern disciplinarian, almost the only one of the marshals who exacted rigid and precise obedience from his troops. Thus, in the earlier days of the *Grande Armée*, it was always the

III corps which was entrusted with the most difficult part of the work in hand. His rapacity in the conduct of civil affairs was in reality Napoleon's, for he gave the same undeviating obedience to superior orders which he enforced on his own subordinates. He was admitted by his contemporaries and by later judgment to be one of the ablest, perhaps the ablest, of all Napoleon's marshals. On the first restoration he retired into private life, and at once joined Napoleon on his return from Elba. Appointed minister of war, he was so far indispensable to the war department that Napoleon kept him at Paris during the Waterloo campaign. Napoleon has been criticised for not availing himself in the field of the services of the best general he then possessed. Davout directed the defence of Paris after Waterloo, and was deprived of his marshals and his titles at the second restoration. When some of his subordinate generals were proscribed, he demanded to be held responsible for their acts, as executed under his orders, and he endeavoured to prevent the condemnation of Ney. After a time the hostility of the Bourbons towards Davout died away, and he was reconciled to the monarchy. In 1817 his rank and titles were restored, and in 1819 he became a member of the chamber of peers. He died in Paris June 1, 1833.

See Ch. de Mazade, *Corr. du mar Davout* (1885), the marquis de Blockville, *Le Maréchal Davout raconté par ses gens et lui-même* (Paris, 1870-80, 1887), Chemer, *Davout, duc d'Auerstadt* (Paris, 1866).

DAVY, SIR HUMPHRY, BART (1778-1829), English chemist, was born on Dec 17, 1778, at Penzance, Cornwall. His father was a wood carver. In his school days at the grammar schools of Penzance and Truro, the boy showed few signs of a taste for scientific pursuits. After the death of his father (1794) he was apprenticed to a surgeon-apothecary at Penzance where he studied metaphysics, ethics and mathematics. He turned to chemistry at the end of 1797, and, after reading Nicholson's and Lavoisier's treatises he began a series of chemical experiments with any apparatus and materials he could obtain. About this time he made the acquaintance of Davies Giddy, afterwards Gilbert (1767-1839), who was president of the Royal society (1827-31). Giddy recommended him to Dr Thomas Beddoes, who was in 1798 establishing his Medical Pneumatic institution at Bristol for investigating the medicinal properties of various gases. Here Davy, released from his indentures, was installed as superintendent toward the end of 1798. Early next year two papers by him were published by Beddoes, these contained the results of Davy's crude experiments and theories hastily formed on insufficient evidence.

One of his first discoveries at the Pneumatic institution on April 9, 1799, was that pure nitrous oxide is perfectly respirable, and he narrates that on the next day he became "absolutely intoxicated" through breathing 16 quarts of it for "near seven minutes." This discovery of the effect of laughing gas brought both him and the Pneumatic institution into prominence, and Count Rumford (*qv*) requiring a lecturer on chemistry for the recently established Royal institution in London, engaged him in 1801 as assistant lecturer in chemistry and director of the laboratory. He was almost at once appointed lecturer, and his promotion to be professor followed on May 31, 1802. One of his first tasks was the delivery of a course of lectures on the chemical principles of tanning. The main facts he discovered from his experiments in this connection were described before the Royal society in 1802-03. He showed that oak bark could be replaced by the much cheaper catechu. In 1802 the board of agriculture requested him to direct his attention to agricultural subjects, and in 1803, with the acquiescence of the Royal institution, he gave his first course of lectures on agricultural chemistry and continued them for ten successive years ultimately publishing their substance as *Elements of Agricultural Chemistry* in 1813. Although Davy had taken up the subject by order, this book remained for nearly 50 years the standard work on the subject.

But his chief interest at the Royal institution was with electro-chemistry. His early work on this subject is summed up in his first Bakerian lecture "On some Chemical Agencies of Electricity." One of the principal results was the proof that pure water does

not give acid and alkali when electrolyzed. He proposed an electrical theory of chemical compounds that gave an orderly presentation of a host of complex facts. It was based on the hypothesis that chemical and electrical attraction are produced by the same cause. This paper gained him from the French institute the medal offered by Napoleon for the best experiment made each year on "galvanism." Sodium and potassium hydroxide were considered to be elements. Their decomposition and the isolation of potassium and sodium by an electrolytic method was effected by Davy in Oct. 1807. This feat was of great importance and created a scientific furor. According to his cousin, Edmund Davy, then his laboratory assistant, he was so delighted with this achievement that he danced about the room in ecstasy.

Four days after reading his second Bakerian lecture (Nov. 1807) his health broke down, and he was unable to resume work until March 1808. He continued to research on the alkalis and earths and his results were communicated in successive Bakerian lectures (1808-10). Another important discovery due to Davy was that oxymuriatic acid was a simple substance, he proposed the name "chlorine" for it. He succeeded in preparing boron, for which at first he proposed the name boracium, under the impression that it was a metal. Davy also discovered hydrogen telluride, hydrogen phosphide and a number of other compounds. On April 9, 1812, he gave his farewell lecture as professor of chemistry at the Royal institution, though he continued his connection as an honorary professor. He was succeeded by William Thomas Brande, and then by Michael Faraday. In April 1812 he was knighted, and married to Mrs. Apreece, daughter and heiress of Charles Kerr of Kelso. A few months after his marriage he published the first and only volume of his *Elements of Chemical Philosophy*.

In Oct. 1813 he started with his wife for a continental tour, and with them, as "assistant in experiments and writing," went Michael Faraday, his assistant in the Royal institution laboratory. In spite of the fact that England and France were at war Davy was welcomed in Paris, where he was made a corresponding member of the first Class of the institute, i.e., the scientific section. While there he proved the newly discovered material iodine to be an element, similar to chlorine. From Paris he went to Genoa where he investigated the electricity of the torpedo fish, and at Florence, by the aid of the great burning glass in the Accademia del Cimento, he effected the combustion of the diamond in oxygen and decided that, beyond containing a little hydrogen, it consisted of pure carbon.

A few months after his return, through Germany, to London in 1815, at the request of the authorities, he considered the construction of a miner's safety lamp. His lamps were brought into use in the mines in 1816. A large collection of the different models made by Davy in the course of his inquiries is in the possession of the Royal institution. He took out no patent for his invention, and in recognition of his disinterestedness the Newcastle coal owners in Sept. 1817 presented him with a dinner service of silver plate. Davy's will directed that this service should pass to his brother, Dr. John Davy, on whose decease, if he had no heirs who could make use of it, it was to be melted and sold, the proceeds going to the Royal society "to found a medal to be given annually for the most important discovery in chemistry anywhere made in Europe or Anglo-America." The silver produced £736, and the interest on that sum is expended on the Davy medal, which was awarded for the first time, in 1877, to R. W. von Bunsen and Gustav Kirchhoff for their discovery of spectrum analysis.

In 1818 he received a baronetcy for this signal service to industry. In that year also he was commissioned by the British government to examine the papyn of Herculaneum in the Neapolitan museum. He had been secretary of the Royal society from 1807 to 1812, and on his return from Italy in 1820 became president, but his personal qualities did not make for success in that office, especially in comparison with the tact and firmness of his predecessor, Sir Joseph Banks. He resigned in 1826. He directed his attention to various subjects, chiefly electromagnetism, but his researches were less successful than his earlier experiments.

In 1823 the admiralty consulted the Royal society as to a means of preserving the copper sheathing of ships from corrosion and keeping it smooth, and he suggested that the copper would be preserved if it were rendered negatively electrical, as would be done by fixing "protectors" of zinc to the sheathing. This method was tried on several ships, but it was found that the bottoms became extremely foul from accumulations of seaweed and shellfish. For this reason the admiralty decided against the plan. In 1826 Davy's health, which showed signs of failure in 1823, made rest necessary. The following years were spent chiefly abroad, and he died where he lies buried, at Geneva on May 29, 1829. On this journey he wrote his *Consolations in Travel* (1830).

Of a sanguine, somewhat irritable temperament, Davy displayed characteristic enthusiasm and energy in all his pursuits. As is shown by his verses (all his life he found solace in writing verse) and sometimes by his prose, his mind was highly imaginative, the poet Coleridge declared that if he "had not been the first chemist, he would have been the first poet of his age," and Southey said that "he had all the elements of a poet, he only wanted the art." In spite of his ungainly exterior and peculiar manner, his happy gifts of exposition and illustration won him extraordinary popularity as a lecturer, his experiments were in genius and rapidly performed, and Coleridge went to hear him "to increase his stock of metaphors." Though his ambition sometimes betrayed him into petty jealousy, it did not leave him insensible to the claims on his knowledge of the "cause of humanity," to use a phrase often employed by him in connection with his invention of the miners' lamp.

See J. A. Paris, *The Life of Sir Humphry Davy* (1831); John Davy, *Memoirs of Sir Humphry Davy* (1836); *Collected Works* (with shorter memoir, 1839); *Pragmatical Remains, Literary and Scientific* (1858); T. E. Thorpe, *Humphry Davy, Poet and Philosopher* (1896); J. C. Gregory, *The Scientific Achievements of Sir Humphry Davy* (1930); W. Tilden, *Famous Chemists* (1921); W. Ostwald, in Bugge's *Das Buch der grossen Chemiker* (1930).

DAVY LAMP If a piece of metal gauze is interposed between a flame and an explosive gaseous mixture, the heat of the flame is absorbed and conducted away by the metal gauze so that the gaseous mixture does not explode. That is the principle of the Davy lamp, which was invented by Sir Humphry Davy in 1816. The Davy lamp consisted of a small cylindrical oil lamp, covered with a cylinder of wire gauze about 6 in. long and 1½ in. in diameter, with a flat gauze top. The upper part of the gauze was doubled to prevent it from being worn into holes by the products of combustion. The gauze was mounted in a frame of upright wires screwed into a brass ring at each end. The upper ring carried the handle, and the lower one was screwed to a collar on the oil vessel at the bottom of the lamp. Thus encircled with a case of metal gauze, the flame or gases could not pass out at a temperature high enough to fire an explosive mixture in the mine. For the subsequent developments of this invention, see **SAFETY LAMP**.

DAWARI or **DAURI**, a Pathan tribe on the Waziri border of the North-West Frontier Province of India. The Dawaris inhabit the Tochi Valley (q.v.), otherwise known as Dawar or Daur, and are a homogeneous tribe of considerable size.

DAWES, CHARLES GATES (1865-1951), U. S. statesman and financier, was born in Marietta, O., on Aug. 27, 1865, the son of Gen. Rufus R. Dawes. He was educated in his home town, graduating at Marietta college in 1884 at the early age of 19. He then attended the Cincinnati law school and in order to defray his expenses obtained employment during his vacation on the Marietta, Columbus, and Northern Ohio railway. Before finishing his two-years law course he was made chief engineer in charge of construction on this railway—a fact eloquent of the energy and versatility which were to distinguish his whole career. He graduated in 1886, before he was old enough to practise. Admitted to the bar several months later, he commenced practice at Lincoln, Neb., in 1887.

Dawes' reputation as a lawyer was established by his part in the Nebraska rate case, in which he appeared successfully as counsel for the Lincoln board of trade in an effort to obtain a reduction in railway rates in Nebraska. In 1894 he became ex-

tensively interested in the gas business at Evanston, Ill., and at other western points, and removed to Evanston in that year. In 1896 he organized the movement in Illinois to nominate William McKinley as Republican candidate for the presidency. He was active in securing McKinley's nomination and election and was chosen a member of the executive committee of the Republican national committee. He was appointed comptroller of the currency by President McKinley on Jan. 1, 1898. His tenure of office was conspicuous for efficiency of administration and disregard of "red-tape" methods, especially in the conduct of the many receiverships and trusts created by the financial disorders following 1893. Returning from this office in 1902, he organized the Central Trust Co. of Illinois, which, under his presidency, became one of the strongest financial institutions in Chicago.

On the declaration of war against Germany by the United States (April 6, 1917) Dawes volunteered for service and was given a commission as major and later as lieutenant colonel of the 17th Engineers (Railway), his well known ability and early experience in railway construction outweighing the fact that he was over age. He landed in France July 17, and was placed on the headquarters staff of the AEF by General Pershing as chairman of the general purchasing board and chief of supply procurement, charged with the duty of collecting supplies in Europe and of co-ordinating their purchase in such a way as to guard against inflated prices and duplication of orders. His conspicuous success in directing these transactions, which secured for the U.S. army 10,000,000 ship tons of supplies in Europe as against 7,000,000 shipped to it from the United States, led to his promotion to the rank of brigadier-general in 1918. On the unification of command of the Allied forces under Foch, General Dawes was appointed as U.S. member of the Military Board of Allied Supply, the organization of which had been largely due to his efforts. This board for the last four months of World War I co-ordinated the movement of supplies for the Allied armies in the zone of the advance.

After the conclusion of the Armistice, Dawes became a member of the liquidation committee of the AEF, charged with the task of disposing of the huge accumulations of U.S. property in France and of settling outstanding claims against the army. This engaged his efforts until Aug. 1919, when he resigned his commission and returned to the United States. Upon the creation of a budget bureau by congress, June 1921, the directorship of it was offered to General Dawes by President Harding and was accepted on condition that the bureau should be nonpolitical, that in gathering information the director should be assumed to be acting for the president and his calls for consultation or information should take precedence of all others. His work in organizing this bureau and creating under executive order the existing system of co-ordinating boards operating in government business was carried through with characteristic vigour and directness that resulted in savings estimated officially at \$250,000,000 in the first year. Having completed the task of placing the budget on a satisfactory and permanent basis, he resigned his position on June 30, 1922.

In the meantime the collapse of the German financial structure and international reactions resulting therefrom had precipitated a crisis in European affairs, the outcome of which appeared ominous. At this juncture, the Allied Reparations commission, in 1923, appointed General Dawes and Owen D. Young as U.S. members of the committee of experts to report upon means of balancing Germany's budget and stabilizing its currency. Dawes was selected as chairman, and the committee's report, known as the "Dawes Plan," was accepted by all the powers concerned. By making the actual transfer of reparation payments conditional on the stability of the German exchange, this plan provided a nonpolitical and automatic means for determining Germany's ability to pay and so withdrew this vexed question from international controversy and paved the way for the later agreement entered into at Locarno (See REPARATIONS).

At the Republican national convention held at Cleveland, O., June 10-12, 1924, following the nomination of President Coolidge for re-election, General Dawes was nominated for vice president on the third ballot by a vote of 6821 against 3141 for Herbert

Hoover and 75 for Judge Kenyon. Following the overwhelming triumph of the Republican ticket at the ensuing election General Dawes assumed office on March 4, 1925. In his inaugural speech he called for a revision of the rules of procedure in the senate so that a majority vote could apply the closure to debate. He later carried his proposals for senatorial reform before the people in a series of public meetings in various parts of the country.

Another aspect of General Dawes's character is revealed by two acts of philanthropy. In memory of his son, Rufus Fearing who was accidentally drowned (Sept. 5, 1912) he established the Rufus F. Dawes hotels in Chicago and Boston, at which impoverished men could obtain food and accommodation at nominal rates. As a memorial to his mother he established the Mary Gates Dawes memorial hotel, where women might live cheaply and retain the physical comforts and social opportunities compatible with self-respect. In the course of his varied and successful career as engineer, lawyer, politician, comptroller of the currency, public utility operator, banker, philanthropist, soldier, organizer of the government budget, leading spirit in the settlement of German reparations and vice president of the United States General Dawes also became an accomplished musician on the piano and flute. He was U.S. ambassador to Great Britain (1929-32) and was awarded the 1925 Nobel peace prize jointly with Sir Joseph Austen Chamberlain. He died in Evanston, Ill., on April 23, 1951.

Dawes wrote *The Banking System of the United States and Its Relation to the Money and Business of the Country* (1894), *Essays and Speeches* (1915), *A Journal of the Great War* (1921), *Notes as Vice President, 1928-1929* (1935), and *Journal of Reparations* (1939). (O. D. V. X.)

DAWES, RICHARD (1708-1766), English classical scholar, was born in or near Market Bosworth. He was elected fellow of Emmanuel college, Cambridge, in 1731. From 1738 to 1749 he was master of the Newcastle grammar school. The book on which his fame rests is his *Miscellanea critica* (1745), which gained the commendation of such distinguished Continental scholars as L. C. Valckenær and J. J. Reske. The *Miscellanea*, which was re-edited by T. Burgess (1781), G. C. Charles (1800) and T. Kidd (1817), will remain an enduring monument of English scholarship, although some of the "canons" have been proved untenable.

DAWES PLAN See REPARATIONS.

DAWISON, BOGUMIL (1818-1872), German actor, was born at Warsaw, of Jewish parents, and at the age of 19 went on the stage. In 1839 he received an appointment to the theatre at Lemberg in Galicia. In 1847 he played at Hamburg with marked success, was from 1849 to 1854 a member of the Burg theatre in Vienna, and then of the Dresden court theatre. He died in Dresden on Feb. 1, 1872. Dawison was considered in Germany an actor of a new type, a leading critic wrote that he and Marie Seebach "swept like fresh gales over dusty tradition." His chief parts were Mephistopheles, Franz Moor, Mark Anthony, Hamlet, Charles V., Richard III and King Lear.

DAWKINS, SIR WILLIAM BOYD (1837-1929), English geologist and archaeologist, was born at Buttington vicarage near Welshpool. Educated at Rossall school and Oxford, he joined the Geological survey in 1862, and in 1870 became curator of the Manchester museum, a post which he retained till 1890. He was appointed professor of geology and palaeontology in Owens college, Manchester, in 1872. He paid special attention to the question of the existence of coal in Kent, and in 1882 was selected by the Channel Tunnel committee to make a survey of the French and English coasts. He was also employed in the scheme of a tunnel beneath the Humber. His chief distinctions, however, were won by his researches into the lives of the prehistoric cave dwellers described in *Cave-hunting* (1874), *Early Man in Britain* (1880), *British Pleistocene Mammalia* (1866-87). He was knighted in 1919, and died on Jan. 15, 1929.

DAWLISH, urban district and seaside resort, Tiverton parliamentary division, Devon, England, on the English channel at the mouth of Dawlish brook, 12 m. S. from Exeter by G.W. railway. Population (1951) 7,512. Area, 9.5 sq. mi. It lies on a cove sheltered by two headlands, and both sides of the Dawlish brook are lined by pleasure grounds. The warm climate and excellent bathing attract many visitors in spring and early summer. It holds

an annual fair on Easter Monday and a regatta in August or September. Until its sale, in the 19th century, the site of Dawhsh belonged to Exeter cathedral from 1050.

DAWN, the time when light appears (*daws*) in the sky. The dawn colours appear in the reverse order from those of the sunset. When the sun is lowest in both cases the colour is deep red, this gradually changes through orange to gold and yellow as the sun nears the horizon. This is their order of refrangibility, in the spectrum, the blue rays usually are scattered in the sky. The colours of the dawn are purer and colder than the sunset colours as the reduced dust content of the atmosphere causes less sifting of the light rays.

DAWSON, GEORGE GEOFFREY (1874-1944), editor of the *Times*, 1912-19, and from 1923 until his retirement in 1941. He was educated at Eton and Magdalen college, Oxford, and was elected a fellow of All Souls college in 1900. Passing into the civil service, he went to South Africa in 1901 as private secretary to Lord Milner, then high commissioner. On Lord Milner's retirement from the high commissionership in 1905 he accepted the editorship of the *Johannesburg Star*, which he held for the next four years. Returning to London in 1910, he was appointed a director of the *Times*, which was then in the early days of Lord Northcliffe's direction, and in 1912 succeeded G. E. Buckle as editor. The conspicuous success which the *Times* attained during the difficult years of World War I was largely due to Dawson's sound judgment and knowledge of affairs, which formed an admirable and often very necessary complement to Lord Northcliffe's imagination and genius. In 1919, however, Dawson found himself unable to carry out Lord Northcliffe's policy for the *Times* and resigned. He was succeeded by Henry Wickham Stead (qv). When in consequence of Lord Northcliffe's death in 1923 the *Times* was reconstructed, Stead retired and Dawson was recalled to the editorship. He had been estates bursar of All Souls college (1919-23) and secretary to the Rhodes Trust (1921-22). In 1917 he changed his name by royal licence from Robinson to Dawson. He died Nov. 7, 1944.

DAWSON, SIR JOHN WILLIAM (1820-1899), Canadian geologist, was born at Pictou, Nova Scotia, on Oct. 30, 1820. He was educated at Edinburgh, Scotland, and on his return to Nova Scotia in 1842 he accompanied Sir Charles Lyell on his first visit to that territory. He was superintendent of education (1850-53), at the same time he studied the geology of the country, making a special investigation of the fossil forests of the coal measures. From these strata, in company with Lyell (during his second visit) in 1852, he obtained the first remains of an "air breathing reptile" named *Dendropteron*. He also described the fossil plants of the Silurian, Devonian and Carboniferous rocks of Canada for the geological survey of that country (1871-73). From 1855 to 1893 he was professor of geology and principal of McGill university, Montreal. He was elected F.R.S. in 1862 and knighted in 1884. Dawson published, besides other works, *Acadian Geology. The Geological Structure, Organic Remains and Mineral Resources of Nova Scotia, New Brunswick and Prince Edward Island* (1855, ed. 3, 1878), *Air Breathers of the Coal Period* (1863). He died on Nov. 20, 1899.

His son, **GEORGE MERCER DAWSON** (1849-1901), was born at Pictou on Aug. 1, 1849, and received his education at McGill university and the Royal School of Mines, London. In 1873 he was appointed geologist and naturalist to the North American boundary commission, and two years later he joined the staff of the geological survey of Canada, of which he became assistant director in 1883 and director in 1895. He was in charge of the Canadian government's Yukon expedition in 1887, and his name is commemorated in Dawson City, of gold-bearing fame. He was one of the Bering Sea commissioners in 1891. He was elected F.R.S. in 1891, and was president of the Royal Society of Canada in 1893. He died on March 2, 1901. He was the author of many scientific papers and reports on the surface geology and glacial phenomena of the northern and western parts of Canada.

DAWSON or **DAWSON CITY**, in the Yukon territory, Canada, on the bank of the Yukon river, and in the middle of the Klondike gold region, of which it is the distributing centre. It is in beauti-

ful mountainous country, 1,049 ft. above the sea and 1,500 mi. from the mouth of the Yukon river, and is reached by river steamer from Whitehorse (460 mi.) in summer, and by tractors and aeroplanes in winter. There are metalworks and sawmills.

Order is kept by the Royal Canadian mounted police. The city was founded in 1896, its population soon reached more than 30,000 at the height of the gold rush, in 1901 it was 9,142 in 1941, 1,043, and in 1951, 773. The record of temperature varies from 83° F. in summer to -60° in winter. (See *YUKON TERRITORY* and *NORTHWEST TERRITORIES*.)

Dawson was named for George M. Dawson, director of the Canadian geological survey. In 1898 the town became the administrative centre of Yukon territory, but in 1951 the seat of government was shifted to Whitehorse. Jack London, Robert Service and Rex Beach were among the inhabitants of the town in its boom days and later wrote of the robustness of the period of the gold rush. The town was severely damaged by fire in 1898 and 1899.

DAWSON-WATSON, DAWSON (1864-1939), U.S. artist, was born at London, England, July 21, 1864. He studied art under Mark Fisher and others in England and moved in 1893 to the United States to become art director of the Hartford (Conn.) Art society. Later he taught at the Byrdcliffe colony, Woodstock, N.Y., and from 1904 to 1915 at the St. Louis (Mo.) School of Fine Arts, he also was art director of the St. Louis Industrial exhibition in 1914 and the St. Louis centennial exhibition in 1918.

Aside from his paintings in oil and water colour, he designed textiles and costumes and was a wood carver and mezzotint engraver. He died at San Antonio, Tex., Sept. 3, 1939.

DAX, a town of southwestern France, capital of an *arrondissement* in the department of Landes, 92 mi. SSW of Bordeaux, on the southern railway between that city and Bayonne. Pop. (1946) 4,113. It lies on the left bank of the Adour, and its suburb, Le Sablat, on the right. Its ancient Gallo-Roman fortifications are now a promenade. Dax (*Aquæ Tarbellicæ*, *Aquæ Augustæ*, later *D'Acs*) was the capital of the Tarbelli in Roman times, when its waters were already famous. In the 11th century its viscosity passed to the viscounts of Béarn and in 1177 was annexed by Richard Coeur de Lion to Gascony. The bishopric, founded in the 3rd century, was in 1801 attached to that of Aire. The church of Notre Dame, once a cathedral, was rebuilt from 1656 to 1710, but still preserves a sacristy, a porch and a fine sculptured doorway of the 13th century. The church of St. Pauls Dax, mainly 15th century, has a Romanesque apse with curious bas-reliefs. Dax, well known as a winter resort, has thermal waters and mud baths (the deposit of the Adour). The principal of numerous bathing establishments are the Grands Thermes, the Bains Salés, adjoining a casino, and the Baignots, which fringe the Adour and are surrounded by gardens. Dax has a subprefecture and tribunals of first instance and of commerce. Commerce is chiefly in the pine wood, resin and cork of the Landes, and in mules, cattle and horses. Dax was occupied by Germany in June 1940.

DAY, JOHN (1574-1640?), English dramatist, was born at Cawston, Norfolk, in 1574, and educated at Ely. He became a sizar of Caius College, Cambridge, in 1592 but was expelled in the next year for stealing a book. As early as 1598 he became one of Henslowe's playwrights, collaborating with Henry Chettle, William Haughton, Thomas Dekker, Richard Hathway, and Wentworth Smith, but his almost incessant activity seems to have left him poor enough, to judge by the small loans, of five shillings and even two shillings, that he obtained from Henslowe. The first play in which Day appears as part author is *The Conquest of Brute, with the Finding of the Bath* (1598), which, with most of his journeyman's work, is lost. *The Isle of Gulls* (printed 1606), a prose comedy founded upon Sir Philip Sidney's *Arcadia*, contains in its light dialogue much satire to which the key is now lost. In 1607 Day produced, with William Rowley and George Wilkins, *The Travels of the Three English Brothers*, which detailed the adventures of Sir Thomas, Sir Anthony and Robert Shirley. The work on which Day's reputation chiefly

rests in the *Parliament of Bees*. This exquisite masque, or rather series of pastoral eclogues, is entirely occupied with "the doings, the births, the wars, the wooings" of bees. The bees hold a parliament under Prorex, the Master Bee, and various complaints are preferred against the humble bee, the wasp, the drone, and other offenders. This satirical allegory of affairs ends with a royal progress of Oberon, who distributes justice to all. There is no earlier edition of *The Parliament of Bees* than that in 1641, but a persistent tradition has assigned the piece to 1607. In 1608 Dry published two comedies, *Law Tricke*, or, *Who Would have Thought it?* and *Humour out of Breath*. The date of his death is unknown, but an elegy on him by John Tatham, the city poet, was published in 1640. The six dramas by John Day which we possess show a delicate fancy and daintiness of style all his own. The beauty and magnificence of *The Parliament of Bees* were noted and warmly extolled by Charles Lamb, and Day's work has since found many admirers.

His works, edited by A. H. Bullen, were printed at the Chiswick Press in 1881. The same editor included *The Mayday Metamorphosis* in vol. 1 of his *Collection of Old Plays: The Parliament of Bees and Humour out of Breath* were printed in *New and other Plays* (Maidenhead Series 1888), with an introduction by Arthur Symonds. An appreciation by Mr. A. C. Swinburne appeared in *The Nineteenth Century* (Oct. 1897).

DAY, THOMAS (1748-1789), British author, was born in London and is famous as the writer of *Sandford and Merton* (1783-89), a book for the young. Day was educated at the Charterhouse and at Corpus Christi college, Oxford, and became a great admirer of J. J. Rousseau and his doctrine of the ideal state of nature. Having independent means he devoted himself to a life of study and philanthropy. He brought up two foundlings, one of whom he hoped eventually to marry, on the severest principles, but neither spared the high quality of stoicism which he had looked for, and ultimately he married an heiress who agreed with his ascetic programme of life. He settled in 1781 at Otter shaw, in Surrey, and took to farming on philanthropic principles. His poem "The Dying Negro" (1773) struck the keynote of the anti-slavery movement.

DAY, in astronomy, the interval of time in which a revolution of the earth on its axis is performed. Days are distinguished as solar, sidereal or lunar, according as the revolution is taken relatively to the sun, the stars or the moon. The solar day is the fundamental unit of time in daily life and in astronomical practice. In the latter case, being determined by observations of the sun, it is taken to begin with the passage of the mean sun over the meridian of the place, or at mean noon, while the civil day begins at midnight.

The question of a possible variability in the length of the day is one of fundamental importance. One necessary effect of the tidal retardation of the earth's rotation is gradually to increase this length. It is remarkable that the discussion of ancient eclipses of the moon, and their comparison with modern observations, show only a small and rather doubtful change, amounting perhaps to less than one hundredth of a second per century. As this amount seems to be less than that which would be expected from the cause in question, it is probable that some other cause tends to accelerate the earth's rotation and so to shorten the day. (See *Moon and Times*.)

Legal Aspects—In law, a day may be either a *die naturalis* or natural day, or a *die artificialis* or civil day. A natural day includes all the 24 hours from midnight to midnight. Fractions of the day are disregarded to avoid dispute, though sometimes the law will consider fractions, as where it is necessary to show the first of two acts of events. In cases where action must be taken for preserving or asserting a right, a day means the whole natural day of 24 hours.

When a statute directs any act to be done within so many days, these words mean *clear days*, i.e., a number of perfect intervening days, not counting the terminal days. If the statute says nothing about Sunday, the days mentioned mean consecutive days and include Sundays. Under some statutes Sundays and holidays are excluded in reckoning days, and consequently all the Sundays, etc., of a prescribed sequence of days would be eliminated. By

custom, the word "day" may be understood in some special sense. **Lay Days**, which are days given to the charterer in a charter party, either to load or unload without paying for the use of the ship, are days of the week, not periods of 24 hours. As to lay days, running days, working days and weather working days, see **AFFREIGHTMENT**. For days of grace see **BILL OF EXCHANGE**.

Civil Days—An artificial or civil day is difficult to define, it is a convenient term to signify the various kinds of "day" known in legal proceedings other than the natural day. In England, the United States and most of the countries of Europe the Roman civil day still prevails, the day commencing at 12 P.M.

In England the period of the civil day may and does vary under different statutes. Daytime, within which distress for rent must be made, is from sunrise to sunset. An obligation to pay money on a certain day is discharged if the money is paid before midnight of the day on which it falls due, but the law requires reasonable hours to be observed. If, for instance, payment has to be made at a bank or place of business, it must be within business hours.

When an act of parliament is expressed to come into operation on a certain day, it is to be construed as coming into operation on the expiration of the previous day. (Interpretation Act 1889, § 36, Statutes [Definition of Time] Act 1886.)

Under the orders of the supreme court the word "day" has two meanings. For purposes of personal service of writs, it means any time of the day or night on week days, but excludes the time from 12 midnight on Saturday till 12 midnight on Sunday. For purposes of service not required to be personal, it means before six o'clock on any week day except Saturday, and before 2 P.M. on Saturday.

Closed Days, i.e., Sunday, Christmas day and Good Friday, are excluded from all fixtures of time less than six days; otherwise they are included, unless the last day of the time fixed falls on one of those days (R.S.C. O. lxxv). See **ENGLISH LAW**.

DAYAKS or **DYAKS** a name used by some people (especially Dutch ethnographers) for all the indigenous tribes of Borneo, but more usually applied to the Sea Dayaks or Iban and to the Land Dayaks. (See **BORNEO**). (B A L C.)

DAY BED, a small type of French couch bed, intended to serve as a bed at night and as a sofa during the day. The standard day bed is narrow, with foot and head pieces identical in size and appearance. Because of the convenience of its size the day bed came into wide use in small apartments where every effort must be made to conserve space. It was especially popular in the large cities of the United States. The low and symmetrical head and foot pieces give it the appearance of a divan, thus serving to conceal to some degree the fact that the living room in which it appears is converted at night into a bedroom.

DAYE, STEPHEN (c. 1594-1668), first printer in the Anglo-American colonies, was born in London. Although it has been stated that he served an apprenticeship as a printer there, the records extant indicate that he was a locksmith. In the summer of 1638, however, he went to America with the Rev. José Glover, a dissenting minister of some means, with whom he made a contract to set up the first printing press in the English colonies. This he did in the autumn of 1638 at Cambridge, Mass. The first issue from his press was the *Freeman's Oath* (Jan. 1639), the second, an *Almanack* by William Pierce, mariner (1639), the third, the *Psalms*, now known as the *Bay Psalm Book* (1640). According to the records of the general court of Cambridge, Dec. 10, 1641, he was granted 300 ac. of land for "being the first that sett upon printing." His name is not found in connection with the imprint of any of his publications, but that of his son, Matthew, who seems to have been next in charge of the press, appears on the title page of the *Almanack* (1647). The extant issues from his press are *The Whole Booke of Psalms, faithfully translated into English Metre* (1640), *A list of Theses at the Harvard Commencement in 1643* (1643), *A Declaration of Former Passages and Proceedings betwixt the English and the Narragansetts, with their confederates, Wherein the grounds and justice of the ensuing warre are opened and cleared* (1645). He died at Cambridge, Mass., on Dec. 22, 1668.

DAYFLOWER, rather weedy, quick wilting plants of the genus *Commelina* of the spiderwort family (Commelinaceae). There are about 115 species chiefly natives of tropical and sub-tropical regions, 8 of which are found in the southern United States. They are usually ascending or reclining somewhat fleshy, branching herbs, with short stalked leaves and irregular, usually blue ephemeral flowers in small clusters more or less enfolded in two spathe-like bracts. The Virginia dayflower (*C. virginica*), found in most places from southern New York to Illinois southward to Florida and Texas and thence to Paraguay, has diffusely branching stems, $1\frac{1}{2}$ ft to 3 ft high, lance shaped leaves and showy blue flowers an inch broad. The creeping dayflower (*C. nudiflora*), with reclining stems 1 ft to $2\frac{1}{2}$ ft long, rooting at the joints, and small blue flowers about $\frac{1}{2}$ in. broad, found from New Jersey to Missouri and southward is extensively distributed also in South America, Asia and Africa. The Asiatic dayflower (*C. communis*), with small, very deep blue flowers, has become widely naturalized in the eastern and southern states.

DAYLESFORD, a town 60 mi NW of Melbourne, Austr Pop (1947) 3,053. It lies on the main divide of the state, at an elevation of 2,030 ft. Much wheat is grown in the district, gold mining both quartz and alluvial, is carried on, and there is a mining school. Near the town are the Hepburn mineral springs.

DAYLIGHT, ARTIFICIAL The wide use of artificial light in civilization created a demand for lamps which show coloured objects truthfully, i.e., which do not change colours from their hues as seen by daylight. The problem is thus one of producing an artificial light whose spectrum (see LIGHT) closely resembles that of sunlight. Artificial light always contains too high a proportion of red, orange and yellow rays.

A gas filled electric lamp is employed, as its filament temperature is high and its form the most economical. The spectrum obtained from a black body, heated to $5,000^{\circ}\text{C}$, is found to be approximately that of average diffused daylight. According to the temperature at which the filament of an incandescent electric lamp burns, the amount of red and orange contained in the spectrum of its light varies, becoming greater as the temperature is lowered, a metal filament bulb burns at $2,200^{\circ}$ and has more red and orange in it than the gas filled bulb, which burns at approximately $3,000^{\circ}$. Therefore, the gas filled bulb is used in artificial daylight devices, but its light has to be subjected to special treatment to correct its undue yellowness and redness.

Various means are employed for this purpose, such as filtering the light through a coloured transparent medium (i.e., glass, talc or varnish) or by the use of a coloured reflector or by a series of coloured mirrors fixed in a reflector. Coloured reflectors with certain pigments have proved successful, and by this means it is possible to match practically any type of daylight, but this method absorbs a very large quantity of the initial illumination. By the use of tinted or coloured glasses, one or more different colours being placed one behind the other, the same effect can be obtained, the loss of light by this method, however, is not so high as in the former. Artificial daylight was at first mainly used for the purpose of matching colours. It came into use for general illumination, however, as the value of artificial daylight in resting the eyes became appreciated. Hospital staffs, dentists, physicians and surgeons find artificial daylight of great value. The method is also employed in dye and colour works. See LIGHTING AND ARTIFICIAL ILLUMINATION.

DAYLIGHT SAVING In the second year of World War I nearly every country in Europe adopted the device of putting the clock forward an hour during the spring, summer and autumn months. Action in the United States came somewhat later (see below). The motive was to save fuel for lighting and heating by getting people up and getting them to bed an hour earlier.¹

Great Britain—In Great Britain the idea originated about 1907 with William Willett, a Chelsea builder. Declaring that civilization got up an hour or two too late in the summer months and had only a short evening for outdoor recreation, he ran and financed a campaign for putting the clock ahead by 80 min. in

four moves of 20 min. each in the spring and summer months. In 1908 Robert (afterward Sir Robert) Peirce introduced a bill in the house of commons to put the clock ahead by law. In 1916 the expert committee set up by the British government to study the question of fuel economy advised that the measure should be adopted. The scheme was simplified. A select committee in 1909 had advocated in advance of the clock by one hour in the spring and the return to Greenwich mean time in the autumn. This was the method adopted by the act passed on May 17, 1916, and put into operation the following Sunday, May 21. There was a good deal of opposition. Farmers objected to it because milkers would have to get up in the dark during the greater part of the year and labourers in the hay and corn harvests would waste an hour waiting until the dew had dried off. When put to the test of practice these difficulties proved to have been exaggerated. Summer time was renewed after World War I by acts of parliament that of 1922 provided that summer time should begin on the day next following the third Saturday in April, or if that day is Easter day the day next following the second Saturday in April, and end on the day next following the third Saturday in September. The act of 1915 altered the closing date to the day following the first Saturday in October. The official time for altering the clock is always 2 A.M. Greenwich mean time. Nothing in the acts affects the use of Greenwich mean time for the purposes of astronomy, meteorology or navigation, and they apply to Northern Ireland, the Channel Islands and the Isle of Man as well as Great Britain.

Soon after World War II began it was found necessary to modify the date in order to assist war production, and emergency powers were granted under the Defence (Summer Time) regulations. Further powers given in 1941 allowed the introduction of double summer time, i.e., two hours in advance of Greenwich mean time. The periods were varied from year to year to meet national requirements, single summer time remained in force throughout the winters of 1940–44 inclusive. Double summer time ended in 1945, was reintroduced in 1947 but then discontinued. A further act passed in 1947 renewed the wartime powers of prescribing summer time dates by order in council, but these are exercised only when there are special reasons (e.g., fuel crises) which would justify the use of this exceptional procedure, and any permanent change would require further legislation. The statutory dates were resumed in 1953. (J. CL.)

United States—No public interest was developed in the project in the United States till after the outbreak of World War I, and it was not until 1916 that a nation wide campaign was initiated in its support. Opinion was divided but in 1917 congress passed an act, to take effect in 1918, whereby the standard time of the United States would be advanced one hour on the last Sunday in March and set back one hour on the last Sunday in October. The act was effective from March 31 till Oct. 27, 1918, and again on March 30, 1919. Strenuous opposition developed, however, from the farmers, and the law was repealed on Aug. 20, 1919, over the president's veto. Legislation on the subject was somewhat intermittent in the following decade, although daylight time was made obligatory by state law in Massachusetts and Rhode Island and by municipal ordinance in the New York metropolitan district, Chicago, Philadelphia and a number of other cities and towns. On Feb. 6, 1942, "war time," one hour in advance of standard time, was put into effect nationally and continued to the end of Sept. 1945.

At mid-20th century, daylight saving time was observed, at least in part, in the following states, usually from the last Sunday in April to the last Sunday in September: California (state wide by law), Connecticut (state law), Delaware, Illinois, Kentucky, Maine, Maryland (also District of Columbia), Massachusetts (state law), Missouri, Montana, Nevada (entire state), New Hampshire (state law), New Jersey, New York, Ohio, Oregon (entire state), Pennsylvania, Rhode Island (state law), Vermont, Virginia, Washington and West Virginia.

Other Countries—In the years following World War II a number of nations adopted summer time in whole or in part, including the following: Brazil, Canada, China, Germany, Hungary, Japan, Poland, Portugal, Union of South Africa and Turkey.

¹In 1784 Benjamin Franklin urged a similar proposal on the French people to conserve tallow and enjoy more daylight.

DAY NURSERIES These institutions, of a semi philanthropic nature, formerly known as "crèches" (from the Fr *crèche*—crib) but now as "day nurseries," form an integral part of the public health work of Great Britain, the United States, and other industrial countries.

Their original intention was to assist widows, and other women whose circumstances obliged them to go out to work, by caring for their young children, under school age, during the day. During the 19th century France and Belgium had many crèches, but they were on a very simple scale. A "motherly" woman was put in charge of two or three rooms and for very small fees the working mothers could leave their children to be fed and cared for during the day. This system proved unsatisfactory, want of technical knowledge and insufficient sanitary precautions led to the spread of infection and the crèche soon got a bad name. But with the increase in the knowledge and study of "mothercraft" and infant welfare, which coincided roughly with the early years of the 20th century, day nurseries were brought to England, and to the United States, and organized on modern and hygienic methods, very different from those of the old crèches. The value of fresh air and "moving" air was increasingly appreciated and open air nurseries were built in London, Manchester and elsewhere.

In Great Britain the movement is largely associated with the names of Mrs. Arthur Percival and Mabel, Viscountess Helmsley, who founded the National Society of Day Nurseries with the objects of starting nurseries, raising the standard of existing crèches, putting them in close touch with the government departments, and "standardizing" the training of staffs.

The movement, like many other branches of the infant welfare movement, originated in private enterprise and the day nursery was generally started by a voluntary committee. From the year 1915 a grant in aid was given by the board of education. When, in 1918, the local government board was merged in the ministry of health, day nurseries were placed under its maternity and child welfare department.

The ministry inspects the nurseries at regular intervals and gives a grant proportionate to the expenses incurred, in certain cases grants are also made toward capital expenditure, such as the purchase of premises, etc. The cost of upkeep is met by the parents' payments (1s a day is a common charge), the government grant, private subscriptions and, in some cases, a municipal grant. Local authorities have the power to provide day nurseries.

Children are received from the age of one month, until they attain school age. The mother brings the child in the early morning on her way to work and calls for it on her return in the evening. The child is inspected on arrival by the crèche trained matron and, if found to be free from any signs of infection, is bathed, dressed in the nursery clothes and cared for during the day in accordance with the requirements of its age. The infants have cots and the necessary food and sleep, the older children or "toddlers" have three good meals and plenty of opportunity for fresh air, rest and exercise. The mental development of the toddlers is assisted by "nursery school classes," under the supervision of a specially trained member of the staff. The furnishing of the nursery is of great importance, small tables and chairs are provided for meals, etc., and stretchers for rest. The staff generally consists of a matron and sister with "nursery" training and some hospital experience, a toddlers' nurse, young probationers and a cook.

The health of the children is under the daily care of the matron, who weighs the children weekly or fortnightly, accurate records are kept and are seen by the visiting doctor at the fortnightly medical inspection. The previous medical history of the child, if it has attended the infant welfare centre, is used for reference and the nursery record is available for the school doctor when the child leaves the nursery. In this way a complete record can, in some cases, be obtained of the child's medical history. A great point is made of the clothing and feeding of the children in the nursery, it is held that the nurseries are in this way of great educational value to the mothers.

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Since 1919 the headquarters of the National Society of Day Nurseries has been under the same roof as many other organizations for infant and child welfare at Carnegie House, 117 Piccadilly, London. The society publishes a monthly magazine (*Crèche News*) (N. L. H.)

United States—The day nursery movement in America has followed rather different lines, but there, even more than in England, its value is recognized as an essential part of child welfare. Inspection varies and may be under the control of state, county or city departments of health or welfare, but no government grant is given and the nurseries are supported by voluntary subscription, supplemented by parents' fees. Some states license the day nurseries, inspect periodically and require minimum standards. Progressive nurseries include programs of family case work, health and education. The first day nursery in America opened in New York in 1854, but the actual movement dates from conferences held 1892-1898. The National Federation of Day Nurseries, organized in 1898, was superseded in 1923 by the National Association of Day Nurseries, a consolidation of the federation and the New York Association of Day Nurseries. The national association serves as a co-ordinating body for day nurseries, raises standards, provides field service and information, and issues publications including a bulletin *The Day Nursery Headquarters*, 122 East 22nd street, New York.

As regards other countries the tendency of the present day is to establish day nurseries in connection with infant welfare work and nursery schools. In France the "Crèches d'Arrondissements" of 19th century Paris have been largely superseded by nurseries connected with large factories and shops, or department stores. These are frequently used for infants, and give special facilities to nursing mothers for the breast feeding of their own babies.

Belgium, Holland, Switzerland, Germany, India and Japan encourage the provision of day nurseries, and Poland, Serbia and Spain have followed their example.

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DAYTON, a city of Campbell county, Ky., U.S., on the Ohio river, opposite Cincinnati, served by the Chesapeake and Ohio railway.

The population was 8,943 in 1950 and 8,379 in 1940 by the federal census. There is some manufacturing, but the city is primarily a residential suburb of Cincinnati. It was settled and incorporated in 1849.

DAYTON, a city of southwestern Ohio, U.S., on the Great Miami river, 55 mi NNE of Cincinnati, a port of entry, the county seat of Montgomery county, and a leading centre of aviation research.

It is served by the Baltimore and Ohio, the Big Four, the Erie and the Pennsylvania railways, by a number of air lines and by numerous motorbus and motor truck lines operating over the hard surfaced roads which radiate in every direction.

There are three commercial and two government airports and numerous emergency landing fields. The population was 243,108 in 1950 and 210,718 in 1940 by the federal census. About 70% are natives of Ohio.

The city covers 24.24 sq mi of level ground 740 ft above sea level, in a wide river trough, where three rapid streams (Wolf creek, Stillwater river and Mad river) flow into the Miami. It is completely protected (since 1921) from all danger from floods. Boulevards and streets are wide and in the residential districts are lined with trees. The dwellings are for the most part small private houses, each with its own garden. Many of the factories are surrounded by attractive grounds.

The public parks and playgrounds comprise 1,100 ac (including 123 ac island in the Miami), and just south of the city there is a municipal country club (294 ac of natural forest) with golf courses and tennis courts. The elimination of grade crossings within the city and the construction of a boulevard on the bed of the abandoned Miami and Erie canal were begun in 1927. A comprehensive city plan was adopted in 1925.

Dayton adopted a commission manager form of government in 1914. The water supply comes from driven wells 50-100 ft deep. Natural gas is used. Electric current, steam generated is provided by a super power system, and the local power and light company furnishes steam heat to a considerable area in the central part of the city. The city has one of the few municipally successful municipal garbage reduction plants. Both the death rate and the cost of living are relatively low.

The manufacturers are many and varied. Dayton has long been known as the home of the National Cash Register company. It has become the leading producer, also, of electric motors. Water plants for home use, electric refrigeration equipment, fire registers, computing scales, water softeners, fan belts, automobile parts, aeroplane parts, golf clubs and ice cream cones, and it makes all the government stamped envelope. 'Precision in distress' predominates, in which labour is more important than material, and skilled labour more important than unskilled. The percentage of women in industry is relatively low, and there is little child labour. Except in the building trades the "open shop" prevails. The making of aeroplanes at Dayton began with the experiments of Orville and Wilbur Wright (qqv v) who in 1903 flew successfully the first heavier-than air machine.

During World War I the U.S. government located its aviation experiment laboratories at McCook field, on the northern boundary of the city. When this became too small, the people of Dayton raised \$400,000 in four days to buy a tract of 5,000 ac. northeast of the city (including the Wrights' original flying field), which they presented to the war department, to be a permanent home for the experimental and research division of the air corps. The city was again a centre of military aircraft research during World War II.

The annual volume of Dayton's wholesale business is estimated at \$352,000,000, its retail trade at \$338,000,000. In 1949 bank deposits amounted to \$2,658,875,201, post office receipts were \$6,474,733, and the assessed valuation of property was \$439,447,740.

The city has 82 public schools, including a normal college, and 20 parochial schools, 202 churches, and 3 daily newspapers, one of which is in German. It is the seat of the University of Dayton, a Roman Catholic institution founded in 1850 (formerly St. Mary college), Bonebrake Theological seminary (United Brethren), and Sinclair college, also the Dayton Art institute (established 1919).

The Engineers' club and the Foremen's club are distinctive organizations. The National Association of Foremen was founded in Dayton and its official organ is published there. The first house built in Dayton, a log cabin on the bank of the Miami, is preserved as a historic museum. There is a state hospital for the insane and a large Veterans' Administration facility which was the first soldiers home established in America (1867).

History—The site of Dayton was bought in 1795 from John Cleves Symmes by a party of Revolutionary soldiers. It was laid out as a town in 1796 by Israel Ludlow, one of the owners, and named after Jonathan Dayton (1760-1834), who had fought in the Revolution and was at the time a representative of New Jersey in congress. In 1803 it was made the county seat and in 1805 the town was incorporated. Growth was rapid after the opening

of the Miami and Erie canal in 1828, and in 1841 it was chartered as a city. By 1860 the population had reached 30,081, increasing to 38,678 in 1880, 85,533 in 1900 and 116,577 in 1910. In March 1913, the Miami valley was swept for five days by a steady down fall of rain, resulting in a great flood. Over 400 lives were lost in the valley, and damage to property was estimated at \$100,000,000. When the waters receded Dayton was left covered with mud and debris. A pestilence was averted only by prompt and energetic measures. Mortal law was declared, food was distributed and tents were put up for the homeless. A relief fund of \$750,000 was disbursed by the American Red Cross and the Citizens Relief committee. Steps were taken to prevent the recurrence of such a disaster. On June 29, 1915, the Miami conservancy district, a political subdivision of the state, was established under a new law for the purpose of building and maintaining flood control works in the Miami valley. The plan finally adopted combined channel improvement with the construction of five great retarding basins. Five dams (from 1200 to 6400 ft long, from 75 to 125 ft high, and from 180 to 785 ft thick at the base) were built across the upper valleys of the Miami and four of its tributaries. Construction work began in 1918 and was completed in 1921. The cost was \$32,000,000. Protection has been provided against a flood 10% greater than that of 1913, and 20% greater than the maximum estimated to be possible. Following the flood Dayton adopted a commission manager form of government which came into effect on Jan. 1, 1914. It was the first large city to install a manager and there has been no disposition to return to the mayorality system.

For an account of the flood of 1913 and the construction of the flood control works see *Technical Reports* (10 vols.) by various authors, published by the Miami conservancy district, Dayton, O.

DAYTON, a city of southeastern Tennessee, U.S.A., 38 mi NNE of Chattanooga, at the foot of the Cumberland escarpment, the county seat of Rhea county. It is served by the Southern railway. The population in 1950 was 3,701. In July 1925 the little county town was the scene of the famous "anti evolution" trial, in which John T. Scopes, a teacher of science in the high school, was found guilty of having violated a state law prohibiting the teaching, in the schools supported by the state, of any theories, to the effect "that man is descended from the lower animals". Counsel for the defense included Clarence Darrow and Dudley Field Malone. The prosecution had the support of William Jennings Bryan, who died in Dayton a few days after the close of the trial. Scopes was fined \$100, but the penalty was set aside by the state supreme court on a technicality, without any expression of opinion as to the constitutionality of the law. William Jennings Bryan, university, on a hill overlooking the town, was founded by Bryan's admirers as a memorial to him.

DAYTONA BEACH, a city of Volusia county, Fla., U.S.A. on the Halifax river, 50 mi below St. Augustine, on federal highways 1 and 92 and state highway 140, and served by the Florida East Coast railway, air lines and buses. It was formed in 1925 by the consolidation of the city of Daytona and the towns of Daytona Beach and Seville, its total population in 1950 was 29,254. Daytona Beach is a popular all year resort, with many hotels and private winter homes, and a summer season attracting 2,500,000 visitors. The Spanish style of architecture prevails, and the assessed valuation of property in 1950 was \$61,848,430. Along the broad, white beach which adjoins that of Ormond, is a fine automobile racing course, where many speed records have been made.

DEACON, a minister or officer of the Christian Church. The status and functions of the office have varied in different ages and churches, and the name is the Gr. *διάκονος*, minister, servant.

(a) **The Ancient Church**—The office of deacon is almost as old as Christianity itself. Tradition connects its origin with the appointment of "the Seven" recorded in Acts 6:1-6. This connection, however, is questioned on the ground that "the Seven" are not called deacons in the New Testament and do not seem to have been identified with them till the time of Irenaeus (c. 180). The officers of the church are described in Philippi 1:1 as "bishops and deacons", and in 1 Tim. 3:8-13 the office of

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There are three commercial and two government airports and numerous emergency landing fields. The population was 243,108 in 1930 and 210,718 in 1940 by the federal census. About 70% are natives of Ohio.

The city covers 24.24 sq mi. of level ground 740 ft above sea level in a wide river trough, where three rapid streams (Wolf creek, Stillwater river and Mid river) flow into the Miami. It is completely protected (since 1921) from all danger from floods. Boulevards and streets are wide and in the residential districts are lined with trees. The dwellings are for the most part small private houses, each with its own garden. Many of the factories are surrounded by attractive grounds.

The public parks and playgrounds comprise 1,100 ac. (including 123 ac. island in the Miami), and just south of the city there is a municipal country club (204 ac. of natural forest) with golf courses and tennis courts. The elimination of grade crossings within the city and the construction of a boulevard on the bed of the abandoned Miami and Erie canal were begun in 1917. A comprehensive city plan was adopted in 1925.

Dayton adopted a commission manager form of government in 1914. The water supply comes from driven wells 50–100 ft deep. Natural gas is used. Electric current, steam generated, is provided by a super power system, and the local power and light company furnishes steam heat to a considerable use in the central part of the city. The city is one of the few financially successful municipal garbage reduction plants. Both the death rate and the cost of living are relatively low.

The manufactures are many and varied. Dayton has long been known as the home of the National Cash Register company. It has become the leading producer also, of electric motors, water plants for home use, electric refrigeration equipment, fire engines, computing scales, water softeners, fire bells, automobile parts, aerophone parts, golf clubs and ice cream cones, and it makes also the government stamped envelope. Precision industries predominate, in which labour is more important than material, and skilled labour more important than unskilled. The percentage of women in industry is relatively low, and there is little child labour. Except in the building trades, the "open shop" prevails. The making of aeroplanes at Dayton began with the experiments of Orville and Wilbur Wright (qqv) who in 1903 flew successfully the first heavier than air machine.

During World War I the U.S. government located its aviation experiment laboratories at McCook field, on the northern boundary of the city. When this became too small, the people of Dayton raised \$400,000 in four days to buy a tract of 5,000 ac. northeast of the city (including the Wrights' original flying field), which they presented to the war department, to be a permanent home for the experimental and research division of the air corps. The city was again a centre of military aircraft research during World War II.

The annual volume of Dayton's wholesale business is estimated at \$552,000,000, its retail trade at \$538,000,000. In 1949 bank deposits amounted to \$26,887,301, post office receipts were \$6,474,733, and the assessed valuation of property was \$439,447,740.

The city has 83 public schools, including 1 normal college, and 20 parochial schools, 202 churches, and 3 daily newspapers, one of which is in German. It is the seat of the University of Dayton, a Roman Catholic institution founded in 1850 (formerly St. Mary college), Bonchiarke Theological seminary (United Brethren), and Sinclair college, also the Dayton Art institute (established 1919).

The Engineers' club and the Foremen's club are distinctive organizations. The National Association of Foremen was founded in Dayton and its official organ is published there. The first house built in Dayton, a log cabin on the bank of the Miami, is preserved as a historic museum. There is a state hospital for the insane and a large Veterans' Administration facility which was the first soldiers' home established in America (1867).

History—The site of Dayton was bought in 1795 from John Clevies Symmes by a party of Revolutionary soldiers. It was laid out as a town in 1796 by Israel Ludlow, one of the owners and named after Jonathan Dayton (1760–1824), who had fought in the Revolution and was at the time a representative of New Jersey in congress. In 1803 it was made the county seat and in 1805 the town was incorporated. Growth was rapid after the opening

of the Miami and Erie canal in 1828, and in 1841 it was chartered as a city. By 1860 the population had reached 20,081, increasing to 38,678 in 1880, 83,333 in 1900 and 116,577 in 1910. In March 1913, the Miami valley was swept for five days by a steady down fall of rain resulting in a great flood. Over 400 lives were lost in the valley and damage to property was estimated at \$100,000,000. When the waters receded, Dayton was left covered with mud and debris. A pestilence was averted only by prompt and energetic measures. Mortal law was defunct, food was distributed and tents were put up for the homeless. A relief fund of \$750,000 was disbursed by the American Red Cross and the Citizens' Relief committee. Steps were taken to prevent the recurrence of such a disaster. On June 25, 1915 the Miami Conservancy district, a political subdivision of the state, was established under a new law, for the purpose of building and maintaining flood control works in the Miami valley. The plan finally adopted combined channel improvement with the construction of five great retaining basins. Five dams (from 1,700 to 6,400 ft. long, from 75 to 125 ft. high, and from 50 to 785 ft. thick at the base) were built across the upper valleys of the Miami and four of its tributaries. Construction work began in 1918 and was completed in 1922. The cost was \$32,000,000. Protection has been provided against a flood 40% greater than that of 1913, and 20% greater than the maximum admitted to be possible. Following the flood Dayton adopted a commission manager form of government, which came into effect on Jan. 1, 1914. It was the first large city to install a manager and there has been no disposition to return to the mayorality system.

For an account of the flood of 1913 and the construction of the flood control works, see *Technical Reports* (10 vols.) by various authors, published by the Miami conservancy district, Dayton, O.

DAYTON, a city of south-west Tennessee, U.S.A., 48 mi. N.N.W. of Chattanooga, at the foot of the Cumberland escarpment, the county seat of Rhea county. It is served by the Southern railway. The population in 1950 was 3,191. In July 1925 the little country town was the scene of the famous "anti-evolution" trial, in which John T. Scopes, a teacher of science in the high school, was found guilty of having violated a state law prohibiting the teaching in the schools supported by the state of any theories, to the effect "that man is descended from the lower animals." Counsel for the defense included Clarence Darrow and Dudley Field Malone. The prosecution had the support of William Jennings Bryan, who died in Dayton a few days after the close of the trial. Scopes was fined \$100, but the penalty was set aside by the state supreme court on a technicality, without any expression of opinion as to the constitutionality of the law. William Jennings Bryan, in university, on a hill overlooking the town, was founded by Bryan's admirers as a memorial to him.

DAYTONA BEACH, a city of Volusia county, Fla., U.S.A. on the Halifax river, 50 mi. below St. Augustine, on federal highway 1 and 92 and state highway 140, and served by the Florida East Coast railway, air lines and buses. It was formed in 1925 by the consolidation of the city of Daytona and the towns of Daytona Beach and Seabreeze, its total population in 1950 was 29,254. Daytona Beach is a popular winter resort, with many hotels and private winter homes, and a summer season attracting 2,500,000 visitors. The Spanish style of architecture prevails, and the assessed valuation of property in 1950 was \$61,848,430. Along the broad, white beach which adjoins that of Ormond, is a fine automobile racing course, where many speed records have been made.

DEACON, a minister or officer of the Christian Church. The status and functions of the office have varied in different ages and churches, and the name is the Gr. *διακονος*, minister, servant.

(a) **The Ancient Church**—The office of deacon is almost as old as Christianity itself. Tradition connects its origin with the appointment of the Seven recorded in Acts 6:1–6. This connection, however, is questioned on the ground that "the Seven" are not called deacons in the New Testament and do not seem to have been identified with them till the time of Irenaeus (c. 180). The officers of the church are described in Philippi 1:1 as "bishops and deacons", and in 1 Tim. 3:8–13 the office of

deacon has evidently become a permanent institution of the Church. By the time of Ignatius (c. 110) the "three orders" of the ministry were definitely established, the deacon being the lowest and subordinate to the bishop and the presbyters. In the apostolic age the duties of deacons were naturally vague and undefined, with the growth of the episcopate, however, they became the immediate ministers of the bishop. Their duties included the management of Church property and finances, distribution of alms and care of the sick and of widows and orphans. They were also required to seek out and reprove offenders (*Apostolical Constitutions*, 4th cent.). With the growth of hospitals and other charitable institutions, however, the social work of the Church was transferred to others, and the diaconate came by degrees to be regarded (as in the Roman Catholic and Anglican Churches to-day) merely as a step towards the priesthood, and the deacon's duties were practically restricted to ritual acts, such as reading the Gospel, anointing the priest, etc., at High Mass.

(b) **The Church of England**—The diaconate is recognized as one of the "three orders," and is conferred by episcopal ordination. Candidates must be 23 years old and must satisfy the bishop as to their intellectual, moral and spiritual fitness. Deacons may perform any sacred office except that of consecrating the elements and pronouncing absolution.

(c) **Churches of the Congregational Order**—In these (which include Baptists) the deacons are laymen appointed by the members of the Church to superintend the financial affairs of the Church, co-operate with the minister in the various branches of his work, assist in the visitation of the sick, attend to the Church property and generally supervise its activities.

See Thomas, *Lines ad nova disciplina pars I*, lib. 1 c. 5 f. 1 and lib. 1 c. 29 f. 1 (Lundinum, 1706); J. N. Scott, *Die Diakonen in der katholischen Kirche* (Regensburg, 1884); R. Söhm, *Kirchenrecht*, 1. 1. 1-137 (Leipzig, 1892); F. J. A. Hort, *The Christian Ecclesia* (London, 1897).

DEACONESS, a woman set apart for special service in the Christian Church. The origin and early history of the office are obscure. The arguments for its existence in apostolic times, based on Rom. xvi. 1 (where Phoebe is called *diakonos*) and 1 Tim. ii. 11, and on Pliny's mention of two *ausiliae quae ministras dicebantur*, are hardly conclusive. But it is certain that before the middle of the 4th century there existed in the Eastern Church an order of deaconesses, of higher rank than the somewhat similar orders of "virgins" and "widows." The order is recognized in the canons of the councils of Nicea (325) and Chalcedon (451), and many of Chrysostom's letters are addressed to deaconesses at Constantinople. The ordination of deaconesses resembled that of deacons, but conveyed no sacerdotal powers or authority (for specimens of the ordination service see Cecilia Robinson, *The Ministry of Deaconesses*, 2nd ed., 1914, pp. 219-229). Their mission was to perform certain offices in connection with the care of women. The functions of the deaconess, according to the apostolical Constitutions, were as follows: (1) To assist at the baptism of women, (2) to visit and minister to the needs of sick and afflicted women, (3) to act as door keepers in the church, and conduct the women to their seats. In the Western church an attempt seems to have been made in the 4th century to introduce the order into Gaul. The movement, however, was strongly opposed, and was condemned by the councils of Orange (441) and Epone (577). Despite the prohibition the institution made some headway, and traces of it are found later in Italy, but it never became popular in the West. In the middle ages the order fell into abeyance in both East and West.

In modern times several attempts have been made to revive the order. In 1833 Pastor Fliedner founded "an order of deaconesses for the Rhenish provinces of Westphalia" at Kaiserswerth. The original aim of the institution was to train nurses for hospital work, but afterwards it trained its members for teaching and parish work as well. Kaiserswerth became the parent of many similar institutions. The revival of the order in the Church of England dates from 1862, when Miss Elizabeth Ferard was set apart by the Bishop of London. Other dioceses gradually adopted the innovation. It has been sanctioned by Convocation, and the Lambeth Conference in 1897 "recognized with thankfulness the revival of

the office of deaconess," but insisted that the name must be restricted to women set apart by the bishop and working under the control of the parochial clergy.

In addition to Miss Robinson's book cited above, see *Church Quarterly Review*, xlvii. 302 ff., art. "On the Early History and Modern Revival of Deaconesses" (London, 1899), and the works there referred to: D. Latas, *Χωρική Λαχολογία* 1. 163-171 (Athens, 1883); *Testamentum Domini*, ed. Rahmani (Maim, 1889); L. Zschirbach, *Der Dienst der Frauen im ersten Jahrhundert der Kirche* (1902).

DEAD, DISPOSAL OF THE Monuments and buildings set up by man for the use of the living were seldom preserved by him beyond their period of usefulness and seldom remain intact, but his arrangements for the dead were usually made with permanency in view and are frequently discovered undisturbed. From these records of the past knowledge is yielded of man's physical characteristics, circumstances, material achievements, customs and beliefs. Inscriptions are rarely present to give a date to graves, but the method of disposal, the type of grave, the objects deposited with the dead, their relative positions, the posture and orientation of the body, and, in the older periods, the geological stratification and contemporary fauna, provide knowledge of the period and race to which the remains may be assigned.

PALAEOLITHIC PERIOD

The earliest human remains as yet discovered—at Trimi (*pitheanthropus*), Heidelberg and Pildown—were river borne fragments, whether originally buried is unknown, but the earlier part of the last ice age supplies in several instances evidence of the disposal of its dead by the Neanderthal race in Europe. Thus the bodies of the La Ferrassie man and child were protected by stones, a pillow of flint chippings was gathered together for the Le Moustier youth, and graves were dug for the La Chapelle man and La Ferrassie infant. Belief that the dead lived on and had the same needs as the living is shown in the stone implements placed with the Le Moustier, Spy I, and La Chapelle burials, and in the ochre and food supplied for La Chapelle, and in each case the home of the dead is, as in life, the rock shelter or cave.

Finds from the Upper Palaeolithic period are more numerous, and here again almost all burials are in caves or by rock-shelters, including probably the remarkable oval grave fenced round with mammoth shoulder blades at Předmost (Moravia) this enclosed 20 burials in squatting position, and was dug in loess close to a limestone outcrop which once probably formed a rock shelter. The chief exception is the richly furnished single burial in level ground at Brunn. The same kind of provision continues to be made for the dead during this epoch, but its developed culture provides finer implements and a wealth of personal ornament: necklaces, armlets, anklets, aprons, caps, of threaded shells and animals' teeth, carved bone amulets, ivory figurines. Instead of the small lumps of red ochre at La Chapelle, many of these later graves are liberally bestrewn with the substance. The cave-hearth is now frequently chosen as burial site (Solutre, Grimaldi), and here occasional charred bones are more probably due to incompletely extinguished fires than to deliberate cremation.

Though no invariable position characterizes palaeolithic burials, an attitude of sleep—knees bent, arm under head—is the most frequent in Europe, while in Africa contracted posture obtained in the palaeolithic cave-burials discovered in 1927 near Lake Nakuru (Kenya), and with the skeleton of the same type and period from Oldoway (1913) further north. In Lower Palaeolithic burials at La Ferrassie and an Upper Palaeolithic at Grimaldi, however, were skeletons whose sharply-bent knees and arms were pressed close against the chest. So lie the dead of many primitive peoples bound tightly lest they walk, or use their hands for mischief on the living.

Already in Upper Palaeolithic Spain and France there are some indications of a cult of the skull in calvaria prepared as "bowls," and in occasional burial of the head alone. But with its closing phase (Azilian) comes the remarkable cave-burial at Olvet (Baranya) where the severed heads of the dead were deposited one by one into two scooped out "nests," six into one, 27 into the other. They wore rich ornaments of shells and stags' teeth, were ceremonially besprinkled with red ochre, and all faced west. Charcoal

and charred remains near by suggested that the bodies were cremated. From the same period date the human bones in *Mis d'Azil* (France), scraped clean of flesh and painted red before interment.

POST PALEOLITHIC

As mankind passes through stages marked by his discoveries of the crafts of stone polishing, copper, bronze and iron working, we find an immense variety of funerary custom, conditioned partly by natural and cultural resources, largely by belief as to the kind of life after death, and the relationship between dead and living.

Cremation and Inhumation.—In Europe total cremation is found associated with the Late Neolithic banded pottery and painted pottery cultures, from Belgium to southern Russia. Inhumation was general over Europe in the earlier part of the bronze age, but gradually in the later part it was largely replaced by cremation, and from then on the two methods competed and alternated in different countries until the spread of Christianity banished cremation from European civilisation down to its modern revival. This practice has a long and varied history in other continents also. A mid-4th millennium cemetery rich in gold and copper objects was discovered at Ur (Mesopotamia) in 1917, and contained partial cremations which argued total cremations at an earlier epoch, by the end of that millennium inhumation prevailed alone at Ur. Cremation has been the usual Hindu method, frequent also among Buddhists, rare in China. It was general among the Aztecs of Mexico, reserved only for people of rank in the Maya civilisations of Yucatan, and for occasional criminals among the Jews. In Egypt it is unknown.

Other Methods.—These include (1) the preservation of the body by smoke-drying, embalming, etc. (see MUMMIES), (2) exposure to birds of prey (as by the ancient Scythians, the Zoroastrians, the poorer Romans), river committal, or other methods little likely to help in identifying the remains, (3) disposal in two stages—first, of the corpse by burial, exposure, etc., until the soft tissues disappear, second, of the bones either individually as in eastern South America (in jars), or collectively, as in Neolithic British barrows, in the great Neolithic hypogeum at Hal Sufiani (Malta), or in vaults of mediaeval English churches such as Hythe.

Posture and Orientation.—In many cultures and religions a definite position is given to the dead. The posture usually ranges from tightly contracted to fully extended, the former tending to be associated with more primitive, the latter with higher civilisations, the body usually lies on side or back, or is seated, and it is frequently orientated in a given direction. Thus in Egypt the tightly contracted pre-dynastic posture gradually loosens as the dynasties pass until full extension is reached in the Middle Kingdom. From the Old Kingdom onwards the body usually lies with head north, face to the sunrise. In England bodies lay contracted till shortly before our era, but orientation varied until Christianity taught that the feet of the dead should be towards the east, whither they must hasten at the last trumpet. The custom mainly holds in England still, but Norway and Holland have long abandoned it, except in country districts. Buddhist tradition—where Buddhists bury—dictates head north, face upward, as Buddha died. The Mohammedan must lie on his right side, facing Mecca, but the Japanese in his tub-shaped coffin sits upright, like some among our ancestors in chambered barrows.

Tomb furniture.—Burials bare of all else but (originally) a garment or shroud are not infrequent, and betoken sometimes poverty, sometimes high beliefs. Strict Jews must bury thus. But further protection is usually afforded. The pre-dynastic Egyptian and early Sumerian were often wrapped in matting, though pan-shaped and bucket-shaped pottery coffins were already in use. Shipper-shaped pottery coffins were common among the Chorotegans (Nicaragua) and Parthians, large jars, in Greece at the end of the 2nd millennium, in prehistoric southern India, in the Americas. Wicker work, wood, stone, marble—all have played their part in confining the dead. As to possessions sometimes the latter have none, sometimes a sophisticated civilisation cheats them with useless imitations, but mostly the objects are real, valued in life and retained in death.

Type of Tomb.—The use of caves as sepulchres continued in the Neolithic period—usually as sepulchres alone, and in the Late Neolithic were excavated the first artificial burial-caves. In Mediterranean lands the single "cave" entered direct from cliff face then added an entrance passage, as the trench in level ground gained a side chamber, then both gradually developed extra chambers and niches. These elaborations culminated in catacombs such as those of Panticapaeum (Crimea), and—most elaborate of all—of Rome. Megalithic tomb architecture sprang up in Neolithic flowered and died in Bronze Age. CARNAC *Megalithic Monuments*. In Neolithic times the first barrows also were piled up as burial places and memorials. But as mankind elaborated—plays out—these various ideas conceived in his imaginative idleness, he reverts ever and again to the simple grave as standard, while, throughout, we find the simple grave persists for simple folk.

BURIAL PLACES.—HOLMES *L.R.I.* s.v. "Death and Disposal of the Dead" (1911), M. FERT, *Kulturbau der Vorgeschichte* (1924-), C. E. VILHJELM *Immortal Man* (1916) (M. L. T.)

In the early times of Neanderthal man the bodies of the dead were buried with some ceremony, and, with the apparent exception of one or two primitive tribes, there is no known people to-day which does not dispose of its dead in some well defined, traditional manner. The treatment of the corpse, however, is not as a rule complex in itself, it is but an incident in a series of rites. When a community loses one of its members, especially anyone of importance, it suffers a shock, and the rites connected with the dead are to be regarded as a period of strain and emotional disintegration. For this reason their correct performance is important to society. The more serious the loss that is, the greater the value of the deceased to the community, the more elaborate will these rites be and the greater the number of people which they concern. The very aged, on the other hand, and those who have long been ill and who, therefore, have for some time taken little part in the life of the community, often receive scant attention at death and may even be buried alive, since, socially, they are in a sense already dead.

There are many variations in the ceremonies connected with death, and in the treatment of the corpse, but each has its recognized procedure from which deviations are rare, and in all there seem to be three distinct phases. The first lasts from the time of death, or when all hope of the sick person's recovery is abandoned, until the beginning of the rites directly connected with the disposal of the body, the second is during the performance of these rites, the third is covered by the period from the disposal of the body till the cessation of mourning.

When the individual is dead, or regarded as dead, the corpse is usually washed and decorated and a ceremony of leave-taking may be gone through, often accompanied by the presentation of gifts. The duration of this period varies considerably according to the importance of the deceased or to the affection felt for him. For a commoner a day or two may suffice but for a chief it may occupy many weeks and the body is sometimes partially embalmed to prevent decomposition from setting in during this time. If it is suspected that death was due to foul play, especially sorcery, omens are now carefully observed or the body is asked to indicate in some recognized manner the guilty person or village. Friends and relatives having now said farewell, the body is laid to rest.

The number of ways in which a body can be disposed of, are six: inhumation or burial, cremation, preservation, exposure, water-burial and hastening decomposition by artificial means. Occasionally the bodies are exposed for destruction by wild animals. Many or all of these methods are sometimes found in use among a single people. Where this is so, the mode of disposal of the body is usually determined by his social status, by membership of some social group, his achievements in life or the cause of his death. In general, such methods as preservation and the artificial hastening of decomposition are reserved mainly for those who have been important in life. Those who are unimportant to society are usually given a form of disposal which entails little trouble or expense. The cause of a person's death often affects profoundly the fate both of the body and soul. A person who has died by

falling from a tree, or by violence in peace or war, is usually treated differently from his fellows, and special treatment is at most always allotted to suicides and women who have died in childbirth. The reasons for such distinctions are not always clear but, in general, these unfortunates are considered to be undesirable. Those who are earth-bound are usually feared and measures are taken to prevent their souls from troubling the living, such as putting thorns into the feet of the corpse so that the spirit may not walk, placing stones or briars over the grave that it may not escape thence, or burning the body and so destroying the soul.

Inhumation—Where inhumation is practised there is often a cemetery, usually situated at a little distance from the village, where all of that community are buried, or there may be separate ones for the different kinds which compose it, occasionally one is reserved for men, and another for women. These are often carefully tended and are sometimes used for the meetings of the village council. Frequently, however, cemeteries are absent and the site of a man's grave is either fixed by tradition, as, for instance, in his garden or before the threshold of his house, or selected by himself or his heirs. The most usual form of grave is a trench, sometimes shallow, occasionally of considerable depth, but some are more elaborate. A common form is a pit at the bottom of which a horizontal recess is excavated and in this the corpse is laid the pit being usually but not always filled in afterwards. In some areas the grave is an underground chamber approached by a subterranean passage. To prevent the soil touching the corpse the sides of the grave are sometimes lined with wood, stone, leaves or mats, or the body itself is carefully wrapped up. Wooden coffins are used by some tribes, or, among sea-faring peoples, the deceased is buried in his canoe. The superstructure of the grave may be only a low hummock of earth, but, over the remains of important people, large mounds are often erected. A small hut is often set up over or beside the grave, to protect the soul (which usually lingers near the body until decomposition is complete) from the inclemencies of the weather. Grave-stones are also erected as memorials and as temporary abodes for the spirits when they desire to visit the living.

Cremation—The destruction of the corpse by fire has a world-wide distribution. Often it is restricted to a certain class of people, notably chiefs, but sometimes, where other methods are normal, it is used for lunatics, workers of black magic and other dangerous members of society. When such people are burnt the remains are generally thrown away. In other cases they are buried, cast ceremonially into water or placed in ossuaries belonging to a kindred or village group. Sometimes some member of the deceased's family keeps them, or certain of them, and treasures them as a link with the soul of the departed. The construction of the pyre and the kind of timber used are generally decreed by custom, since any deviation brings misfortune on the soul of the deceased.

Preservation—The practice of preserving the bodies of the dead is not restricted to ancient Egypt. It is found to day among tribes scattered throughout the world and even among such primitive ones as those of Torres Straits. Generally it is reserved for chiefs or priests. The methods used vary considerably. Preservatives, such as alcohol, honey, salt, butter or the shavings of certain woods are common, sometimes the body is dried by smoking, usually preceded by evisceration or massage to extract the juices, and sometimes it is placed in a sealed wooden effigy or coffin. In one tribe in East Africa, a fire is lit on the top of the grave with the intention of baking the body.

Exposure—More common than preservation is the custom of exposing the dead on trees, rocks or on platforms erected in the gardens or the bush. Where the atmosphere is hot and dry this may result in desiccation which possibly is intended. Elsewhere the corpse is left to decompose and the bones are collected and kept as relics or placed in an ossuary. During the period of decomposition the living often visit the body and sometimes rub themselves with its juices probably in order to link themselves more closely to the deceased or to absorb his virtues. Exposure may, in some places, be closely allied to burial, for where there is

not sufficient depth of soil to dig a grave (as in islands of coralline and volcanic formation), the obvious alternative is to lay the body on the ground.

Artificial Decomposition—Artificial means to hasten decomposition are often reserved for important men. It is sometimes effected by warming the body over a slow fire or by washing it regularly and scraping away the putrifying flesh. If only a portion of the body is to be cleaned, such as the head, which is treasured by many who have an ancestor cult, this may be wrrenched off and placed in a terracotta vessel to be eaten clean, while the rest of the body is disposed elsewhere.

Water Burial—To fling a corpse into the water is an easy mode of disposal and is, therefore, often the fate of slaves, foreigners or people of no account. But there are tribes among whom it is not considered an undistinguished end, and some individuals may even request to be buried at sea, because they "like wash all time long salt water." Certain parts of the coast are in some islands set aside as water cemeteries where, after being wrapped up to protect them from the fish, and weighted to prevent them from being washed on shore, the bodies are sunk. In the Solomon Islands, however, where sharks are regarded with veneration, the dead are laid on the reef for these creatures to complete the burial. A method (not strictly "water burial") is that of placing the deceased in a canoe and pushing it out to sea. This was formerly practised in many parts of Polynesia, and is recorded from the Cameroons, where the coastal inhabitants set the figure of a bird on the prow of a funeral canoe to guide it on its way because those for whom it is done are descendants of an immigrant people who, at death, must return across the sea to the land of their origin. This may also explain the other forms of sea burial and likewise the use of a canoe as a coffin, certainly the latter is sometimes definitely connected with an after world which must be reached by boat.

Orientation—Wherever inhumation, cremation or exposure are the custom, the position in which the body is placed and the orientation in the grave or on pyre or platform, are important. Even so insignificant a point as whether the body is laid on its right or left side may affect the fate of the soul in the land of the dead. The corpse may lie extended on its back or front, or be seated upright or recline with flexed knees. Sometimes if buried on land or in the sea it may be fixed as though standing, the erect position in the water being obtained by weighting the feet. A very common position for burial is lying on one side with knees drawn up and the hands raised to the face as in sleep, though it has also been suggested that this is in imitation of an infant before birth.

Often there is no definite orientation. Even in one cemetery the bodies may be facing in many different directions. But it is frequently the custom for the head to point or the face to look towards that point of the compass where lies the other world or the land whence the people have migrated.

Secondary Disposal—The disposal of the remains after cremation and exposure is a necessary part of the funeral rites. But even where inhumation is practised the bones are sometimes exhumed and laid in a special spot, often as a regular part of the ritual which may take place at a definite time after the burial or on a great annual ceremony when the bones of all who have died within the year are finally laid to rest. Among people who have a cult of the dead the skull is often kept by the living to be an abode for the soul if it wishes to visit this world. Other bones are also sometimes kept, not as shrines, but for use in magical ceremonies or for the making of weapons. This secondary disposal often marks the close of the period of mourning and may be for the deceased the last act in the *passage rite* (see *PASSAGE RITES*), as a ceremony whereby the soul is finally despatched to the other world of which community it is henceforth a full member. Some times, however, exhumation and secondary disposal are only performed under exceptional circumstances. If a soul troubles the living, the body may be dug up and either removed elsewhere or destroyed by fire or water. Often the soul itself indicates that it desires such a removal, and it may demand several changes of abode before it finds one to its liking. It expresses its wishes

either to a relative in dreams, or by curing sickness and misfortune.

Grave goods.—To the savage the dead closely resemble the living in both psychological and physical make up. It often seems that at death the soul is conceived as being weak, just as its body was. To give it increased vitality the mourners cut themselves and allow the blood to drip on to the corpse for blood is the spirit of life. The laying of food on the grave and the lighting of fires are plainly the result of this material conception of the soul, but the reasons given for the practice vary. Sometimes the journey to the other world is long and the food is for the support of the traveller on his way. In other places it is intended for the comfort of the disembodied creature during the time that it hangs about its home before departing to join its ancestors. The grave goods destroyed or buried with the body are definitely for use in the land of the dead which in physical and social formation is very like that of the living. In it a man will need those things which were valuable in life—weapons, tools, wealth. They are therefore buried or burnt with him, if buried they are often broken in order that their non-material essence may be released. Pots have been found specially made as grave goods, with holes in the bottom or with uncompleted designs, though which this spiritual part can escape. The killing of a man's favourite wife or slaves is a further logical result of this conception of life after death, for he will continue to need them to minister to his wants. To avoid the actual destruction of the property cheap imitations may be buried or burnt as in China to day, or the objects may be laid on the corpse while it lies in state and removed before disposal. In this way the dead man retains the use of them in the other world and his heirs have the use of them in this.

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DEAD RECKONING, the computation of a ship's position derived from the latitude and longitude last determined, from the direction of the compass and rate and time of sailing according to the log reference also being made to astronomical observation for correction and comparison of this method. See NAVIGATION, and AERIAL NAVIGATION.

DEAD RENT The fixed rent payable under the leases of mines or quarries and paid in addition to the stipulated royalties. This payment secures to the owner of the mineral a certain income, and ensures that the mine or quarry is worked in his interest, since if the property lies idle the dead rent must be paid. (See RENT.)

DEAD SEA, the lake in southern Palestine in which the river Jordan terminates. It is bounded on the north by the Jordan valley—at that point broad and forbidding, on the east by the escarpment of the Moabite plateau, on the south by the desert of the Arabah, and on the west by the mountains of Judaea. It has a length of 47 m. and a breadth of 10 m., a superficial area of 360 sq. m. and a mean depth of 1,080 feet. Its surface level, which has a seasonal variation of 10 to 15 ft., lies about 1,300 ft. below that of the Mediterranean, and is the lowest sheet of water on the earth's crust. The Jordan alone pours into the Dead sea on a daily average a volume of water estimated at 6 million tons, and in the winter season torrents—very few of which are perennial—from the hills to the east and west add their contribution. The rainfall in the Dead sea valley seldom exceeds 5 in. in the year. There is, of course, no effluent. The heavy inflow is carried off by evaporation (estimated at 13½ mm. per day), visible in stange looking blue-white clouds which float half formed and ethereal above the waters. An interesting feature is the peninsula, called from its shape the *Lisan* (tongue), which projects from the east shore. The sea to the south of this peninsula is shallow, showing a depth of from 3 to 30 ft., whilst north of it, towards the eastern shore, is the point of greatest depth

(1,310 feet).

Geology.—The Dead sea occupies the lowest point of the Jordan rift valley or trough fault, caused by the slipping down of the stamp of earth's crust confined by the two parallel fractures visible in the rock walls on either side of the valley. In the Jurassic and Cretaceous periods an extended Mediterranean covered Syria and Palestine, but during the Tertiary period an extensive upheaval of the sea bed produced land. The earth movement was uneven, creating wrinkles (the Lebanon and the hills of western Palestine) and causing the fractures which resulted in the Jordan Dead sea depression. There seems reason to suppose that prior to the Pluvial period, which later followed the climate of this region was similar to that now prevailing, and that the Dead sea was approximately the same size as at present. During the Pluvial period the surface of the Dead sea gradually rose until it reached a height of 1,400 ft. above present level, and consequently higher than the Mediterranean. At this stage it was a vast inland sea stretching 200 m. from Huleh in the north to a point 40 m. beyond its present southern limit. Its waters were capable of supporting life, and remains of its fauna have been found in its marginal deposits.

A dry period supervened during which evaporation prevailed over precipitation causing a gradual shrinkage, until after a long interval only a remnant of the great sea remained, leaving in its wake deposits of marl, gypsum and salt and clearly defined beaches to bear silent witness to the uneven course of desiccation. The formation of the *Lisan* and of Jebel Usdum, a hill on the south west shore, must have occurred subsequent to this period of contraction, since both are composed entirely of these lacustrine deposits. The strata of the *Lisan* dip to the east showing that there has been an upheaval of the floor of the Ghor. It is permissible to conjecture that the crustal movements, due probably to continued faulting, which forced up the *Lisan* and Jebel Usdum, forming a southern escarpment of varying elevation and irregular base line, depressed at the same time the sea-bed to the north of the *Lisan*, where its deepest part is known to be. With the sea confined to the north of this barrier, what is now the shallow end of the Dead sea would be dry land. At no very distant date the sea broke this barrier at its western side, aided, it may be, by another tremor, or by merely overflowing, as its level rose, at a point where the barrier was low. That the level of the Dead sea is now rising, and has seemingly been rising for centuries, is well established. Since Kitchener's survey in 1883–84 it has risen nearly 20 feet. Since 1900 it has not risen more than 6 to 8 ft., however. The chief contributing factors to this rise of level are the encroachment on the sea of the Jordan delta, the gradual raising of the sea bed through fresh layers of precipitate and climate that seems to be becoming more moist.

Salinity.—The water of the Dead sea is intensely saline. Whilst ocean water has a salinity of 4–6%, Dead sea water contains 23–25% of salts. Exhaustive analyses of water taken from different parts and at different depths have been made. The following selection from the analyses made by Terrell will suffice. A is surface water at the north end, B 120 metres deep 5 m. E of Käs el-Feshkha, C 300 metres deep at the same point. T = Trace.

| | A | B | C |
|---|--------|--------|--------|
| Chlorine | 65.81 | 67.66 | 67.30 |
| Bromine | 2.37 | 1.98 | 2.12 |
| Sulphate | 0.31 | 0.22 | 0.24 |
| Carbonate | T | T | T |
| Sodium | 11.65 | 10.20 | 5.50 |
| Potassium | 1.85 | 1.60 | 1.58 |
| Calcium | 4.73 | 1.51 | 6.64 |
| Magnesium | 13.20 | 16.80 | 15.90 |
| Silica | T | T | T |
| Total solids in grams for 100 grams of liquid | 100.00 | 100.00 | 100.00 |
| | 19.2 | 24.5 | 25.9 |

Magnesium, sodium, calcium and potassium are present as chlorides. The chloride of magnesium, largely held in solution,

gives the water its nauseous taste, and chloride of calcium its smooth, oily feeling. The brine, as can be seen, is a commodity of great economic and commercial value, and applications have recently (1926) been invited by the Government of Palestine for the monopoly right for developing the mineral resources of the Dead Sea. The density of the water is roughly 1.160, increasing from north to south and with the depth. At the southern end the density is 1.253. In consequence the water in the Dead Sea finds that when the water reaches his armpits he is swept off his feet, and in swimming the shoulders are all the time out of the water. When the water is permitted to dry on hands or clothing the resulting stickiness is distinctly disagreeable. No animal life can exist in its waters. Fish brought down by the Jordan die and furnish food for the sea birds. From the salt pools on the north shore and from the Jebel Usdum the Badouin have been in the habit of retrieving salt to smuggle. Salt was a Government monopoly under the Turks and continues to be so under the new Palestine regime.

Recent investigation has shown that the river Jordan carries an unusually high percentage of salts, especially sodium chloride and magnesium chloride. In the Dead Sea the sodium chloride crystallizes out, but the magnesium chloride remains in solution. With magnesium as a permanent and increasing element in Dead Sea water, its rate of entry and the cubical content of the sea calculable, the age of the Dead Sea becomes a matter of simple arithmetic. From the data available to him Irwin puts the figure at 50,000 years—obviously much too low.

Bitumen, or more exactly, asphalt, floats ashore on occasion. It is collected and used as a protection against worms and grubs in vineyards. According to Arab writers, it had many medicinal virtues. Search is now being made for petroleum in the Dead Sea area.

History.—No other sea has had such a variety of names. The term "dead sea" was first introduced by late Greek writers, and is used by Pausanias, Galen, Justin and Eusebius. To the Hebrews it was "the sea," "the salt sea," "the sea of the Arabah," "the eastern sea." To Josephus it was "the asphalt sea," "the Sodomitic sea," whilst to Arab writers it was "the sea of Zarah (Zoar)," "the stinking sea," "the sea of overwhelming," "the dead sea" and "the sea of Lot." This last is its modern designation. Historically, interest in the Dead Sea centres in the biblical narratives of Abraham and Lot, and the destruction of Sodom and Gomorrah. At En Gedi, on its western shore, David took refuge. To the south of En Gedi lies the fortress of Masada (Sebbak), built by Jonathan Maccabeus, the refuge of Herod and Mariamne when the Parthians took Jerusalem (42 B.C.), and the scene of the last stand and self-destruction of Eleazar and his devoted band of zealots after the fall of Jerusalem (A.D. 70)—this last a grim tale of Roman determination and Jewish heroism.

In early times the sea was navigated, as Tacitus and Josephus bear witness, and under the crusaders the new navigation dues formed part of the revenues of the lords of Kerak. The Turkish sultans of more recent times regarded the sea as their private possession, and sold to individuals the exclusive right of putting boats on it. The Turks, with German assistance, put a flotilla of motor boats on the sea during the World War, and in 1922 one steamer, three motor boats and 14 sailing vessels were plying on its waters.

The tradition that the Dead Sea covers Sodom and Gomorrah dates from Josephus. The site of the overwhelmed cities, whether under the waters of the sea at its north end, or its south end, or on its eastern or western shores, continues to occupy the minds and excite the ingenuity of investigators. Although the question is not fully resolved—if, indeed, it ever can be—the evidence seems to favour the south end, where, as we have seen, there was almost certainly dry land within historic times. That in this bituminous region a violent earth tremor—to which, indeed, the Ghor and its borders are peculiarly liable—should have brought into play eruptive forces whose catastrophic effects are indicated in the Bible narrative, is more than probable. The recent (1924) joint expedition of the Xena seminary and the American School of Oriental Research sent out to locate the Cities of the Plain

were convinced that three of them, Sodom, Gomorrah and Zoar, stood in the south east corner of the Dead Sea, on the lower courses of the only perennial streams in that region, the Numeirah, the Eslal and the Kurahl respectively, but now of course beneath the sea. Kyle and Albright would assign but one town to each watercourse, and think that Admah and Zebonim must be sought elsewhere. Yet if they would but think of these perennial streams meandering over the plain to meet the sea west of the Lisan, the vision pictured is of an oasis like Damascus, a veritable "garden of the Lord," where there would be room for Admah and Zebonim and, indeed, many others.

The dismal associations of its name are not borne out by the sea itself. The wild tales of mediaeval travellers that in its poisonous air no plant could live, that over its dread waters no bird could fly and that no waves ever disturbed its gloomy surface, are figments of the imagination. The doom of Sodom and Gomorrah must needs be writ large on the waters that hid them. "To think of this lake as sombre is quite an illusion, its intense colouring, its varied effects of light, its scarped overhanging slopes, broken by deep gorges, produce a picture of wild and sublime beauty." Its winter climate, with a temperature of 75° F by day and 60 to 65° by night, is probably the finest in the world. The possibility of the development of some oases on its south-east shore as winter resorts has been suggested. Here is the testimony of the Xena seminary expedition, which spent part of the winter there in 1924: "With proper irrigation three large oases, totaling perhaps 10,000 ac., could be made into a veritable tropical garden. The atmosphere was pure and refreshing and there was as little swamp smell as may be found anywhere along the shores of salt water. The scenery is beautiful, sublime and romantic far beyond that of many of the winter resorts of the world. Under proper irrigation, with the establishment of a motor boat and automobile line to Jericho and Jerusalem, this plain may soon vie with Luxor as a winter health resort."

The future of this, the most interesting of all seas, will be watched with interest whilst modern enterprise takes a hesitating step towards the fulfilment of Ezekiel's prophetic vision.

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DEADWOOD, a city in the Black hills of western South Dakota, U.S., 2 mi. N.E. of Lead, the county seat of Lawrence county. It lies in a narrow canyon 4,530 ft. above the sea, on federal highways 14 and 85, and is served by the Burlington and the Chicago and North Western railways, air and bus lines. Pop. (1950) 3,270, (1940) 4,100. Deadwood is a headquarters for tourists, and the commercial centre of a cattle raising and gold-mining region. It has stamp mills, smelters and cyanide mills. In 1875 the discovery of gold in this region was made public. The United States bought the land from the Sioux and in 1877 opened it to settlement. Deadwood gulch was the centre of the rush that followed, and its colourful history is commemorated by pageants held in a natural amphitheatre rimmed by steep hills. Mount Moriah cemetery, on a high mountain overlooking Deadwood, contains the graves of "Wild Bill" Hickok, "Calamity Jane," "Preacher" Smith and "Potato Creek" Johnny. The Adams Memorial museum, free to the public, has one of the finest historical collections in the country. Ft. Meade is 10 mi. N.E. of Deadwood.

DEAF AND HARD OF HEARING, EDUCATION OF The term "deaf" is frequently applied to those who are deficient in hearing in any degree, however slight as well as to people who are unable to detect the loudest sounds. In this article the term "deaf" is applied to those who are so handicapped they are unable to receive instruction through the sense of hearing. These are divided into two groups, the congenitally deaf—those who are born deaf—and the adventitiously deaf—those who were born with normal hearing, but in whom the sense of hearing is non-functional later through illness or accident. The hard of hearing are those in whom the sense of hearing, although defective, is functional with or without a hearing aid (D M L)

DEAFNESS IN CHILDREN

Children may be born deaf or may acquire deafness in early infancy. There is a serious interference with the normal course of mental and educational development when the deafness is so great as to prevent the hearing of the spoken word. It is through hearing that the normal child learns to appreciate the meaning of words and to gain a knowledge of his mother tongue. It is through hearing that the normal child obtains those sound patterns which guide his infant attempts at speech. The severely deaf infant who is unable to hear spoken language consequently fails to acquire a knowledge of words or language and does not develop the power of speech. Devoid of the common means of communication (i.e., the knowledge of language and the ability to speak) such children are isolated from the rest of society and suffer a major handicap in education. Such children who are dumb through deafness produce that section of the community commonly, but often erroneously, known as the "deaf and dumb." They constitute a special class of handicapped children for whom special educational provisions are necessary. Dumbness divorced from deafness is a rare condition which is outside the scope of this article.

Classification—Where deafness is so severe that the child is unable to acquire a knowledge of language and the power to speak in the natural way, very special educational treatment is necessary, and such children are educated in special schools for the deaf. In other cases the degree of hearing loss may not prevent the acquisition of normal speech and language but yet constitute a serious handicap to normal educational progress. These children, known as "partially deaf," need also special educational treatment which is provided in special schools for the partially deaf or in special classes in schools for the deaf. The policy in the United Kingdom is to segregate the two classes since the basic educational problems are different. In the schools for the deaf the essential task is to teach by special methods a knowledge of language and speech.

In schools (or classes) for the partially deaf the main work is to carry on the normal process of education with the use of hearing aids and lip reading.

Where the degree of hearing loss is small, children may be trained in the use of individual hearing aids and taught to lip read, and their education successfully carried on in the normal schools. Such children are generally known as "hard of hearing." There are three recognized categories of deaf children as follows. Grade I, where the hearing loss constitutes no threat to normal education, Grade II, divided into two categories IIa (hard of hearing) and IIb (partially deaf), where the hearing loss has not prevented the natural acquisition of language and speech but where special assistance is necessary according to category as follows: in Grade IIa, by provision of hearing aids or lip reading instruction, or both, and education in the normal schools, in Grade IIb, by provision of hearing aids and education in special schools or classes for the partially deaf, Grade III, where the hearing loss is severe and prevents the natural acquisition of language and speech. For children in Groups IIb and III education is provided in special schools, and attendance is compulsory.

Causes of Deafness—There are two main types of deafness, conduction deafness and nerve deafness, and they may occur singly or in combination. The former is due to some obstruction to the passage of sound to the inner ear while the latter is due to

a defect of the inner ear or to the nerve fibres from this sensory organ. Infections of the middle ear give rise to many cases of conduction deafness often found in children in Group IIb but considerable mystery surrounds the predominant cause of deafness (i.e., in those born deaf). Surveys show that among children in schools for the deaf and partially deaf about 60% are congenitally deaf. A further cause of severe deafness of the acquired type is meningitis—a cause of increasing significance in England in the 1950s. Maternal rubella during the first three months of pregnancy had been a new and serious cause of deafness in Australia but instances in the United Kingdom had been much rarer.

Nerve deafness may be inherited, but the proportion of such cases is small. The incidence of deafness sufficiently severe to demand special education varies from place to place and country to country and is approximately 1 to 1,000 of the child population in the United Kingdom.

History of the Education of the Deaf—The history of the education of the deaf begins properly in the 16th century. Before this time those born deaf were the subject of philosophic speculation but it was generally assumed that they were incapable of education. Pedro de Ponce (1520?–84) successfully taught some deaf pupils in Spain to speak, read and write and it is assumed that his methods were followed by Juan Pablo de Bonet who in 1620 published the first book on this subject. This gave rise to a wider interest in this subject in western Europe.

In England, John Bulwer (fl. 1654) wrote on the subject of teaching the deaf to speak and read the lips, and he was followed by William Holder, D.D., F.R.S. (1616–98), John Wallis, D.D., F.R.S. (1616–1703) and George Dalgarno (1626?–87).

In France similar work had been carried on by the Abbé de l'Épée (1712–89) who made a most profound contribution in developing the natural sign language of the deaf into a systematic and conventional language to be used as a medium of instruction. His work was developed by the Abbé Sicard (1742–1822) and gave rise to the "silent method" of teaching the deaf.

In Germany, Samuel Heinicke (1707–90) educated deaf children orally and later Moritz Hill (1805–74), perhaps the greatest educator of the deaf of all time, developed this method. Thus arose the "oral method" of instruction which continued to influence the teaching of the deaf and in time became the accepted practice throughout the world. Thomas Brudwood (1715–1806) established the first school for the deaf in Great Britain, first in Edinburgh and later in London. This school was of a private nature but at this time the attention of the philanthropic public became focused on the needs of the deaf and funds were raised to establish schools for the deaf generally. The first school for the poor deaf was opened in the Old Kent road, London, in 1792 and later removed to Margate. In quick succession Edinburgh followed suit in 1810, Birmingham (1814), Liverpool (1825), Manchester (1825), Exeter (1827) and Doncaster (1829) until by 1870 ten residential institutions for the deaf had been established in England, four each in Scotland and Ireland and one in Wales. In these early institutions the method of instruction was generally a mixed one, and in certain cases an entirely silent mode of instruction was employed. The German or oral system, however, was gaining ground rapidly, and the Yorkshire institution adopted it in 1876. From this time onward the oral method, in which lip reading replaces hearing and the children are taught to use speech as a normal means of communication, advanced in favour, and for many years it has been the accepted method for the instruction of the deaf in the United Kingdom. In other parts of the world the oral method has proved acceptable although in some schools a combined method, in which oral methods are used in conjunction with manual communication, is used with success.

Education of the Deaf in the United Kingdom—During the greater part of the 19th century the education of deaf children depended entirely on the work of the charitable institutions, but following the Elementary Education act of 1870 further efforts to widen the field of state education gave rise to the Elementary Education (Blind and Deaf) act of 1893–94. This act (which had been anticipated in Scotland in 1890) made compulsory the

education of deaf children from the age of 7 to 16 years. In consequence further residential institutions and day schools were opened. From this time onward the schools for the deaf, whether in establishments maintained by independent governing bodies or in schools maintained by local authorities, became an integral part of the state system of education. The Education Act, 1944 further improved the position of deaf children and provided for the establishment of nursery schools for the deaf with optional attendance from the age of two years with the compulsory period continuous from 5 to 16 years. The act also allowed for the establishment of schools for the partially deaf and for schools for education of a more advanced type.

Schools for the Deaf and Partially Deaf—In England schools for deaf children may be either residential establishments or day schools or a combination of both. They may accept severely deaf or partially deaf pupils or in special cases both types. In general the older institutions appear as the residential schools and these are managed by independent bodies of governors. Day schools and other schools established since the beginning of state education are almost entirely managed by local education authorities. In addition to the types of schools for the deaf already mentioned there exist in England two schools for deaf children with additional defects and established in 1946, a grammar school for the deaf where education for bright deaf and partially deaf children is taken to the standard of university entrance. Training in certain trades is given to deaf boys and girls between the ages of 16 and 19 years at a special department of the Royal Schools for the Deaf, Manchester.

Education whether at day or residential schools in the United Kingdom is free.

The Training of Teachers of the Deaf—Teachers in schools for the deaf must be qualified teachers and in addition must obtain a second qualification to teach deaf children. This second qualification may be obtained by practising teachers by passing the examination arranged by the National College of Teachers of the Deaf or by successfully undertaking a course of one year, for graduates or qualified teachers, which is arranged by the department of education of the deaf at Manchester university. Teachers of the deaf are paid according to the standard scales in operation and in addition receive special allowances for the extra qualification.

Research—Educational research into the many problems of deafness is carried on in the department of deaf education at Manchester university where there is also facility for postgraduate work. The Medical Research Council also fosters research on a wider basis into all aspects of deafness as does the National Institute for the Deaf. Special children's clinics also exist in the larger centres of population and these, modelled largely on the original clinic in the deaf department of Manchester university, deal in particular with the problems of deafness in children of preschool age.

British Commonwealth and Europe—In the British Commonwealth the pattern of education of deaf children is copied largely from that in England, and many of the teachers in such schools are recruited from this country or trained in the University of Manchester.

In Europe also the methods of education bear close resemblance to those in England and Scotland although in France and Spain schools will be found where the silent methods are followed to a much greater degree.

WELFARE OF THE ADULT DEAF

The welfare of the adult deaf (often known as the "deaf and dumb") is in the management of charitable organizations which were established in a manner somewhat similar to the older educational institutions (now residential schools) for the deaf. Since the passing of the National Assistance act, 1948, in England these independent bodies have received an increasing amount of public assistance but remain essentially as charitable organizations, each peculiar to its locality. Such a mission, or institute, for the adult deaf is controlled by a local committee who appoint a missioner or superintendent, who may or may not be an ordained

minister of religion, to organize its activities which are essentially of a social nature. Unlike schools for the deaf where the teaching method of communication is entirely oral (i.e., by speech and lip reading), the means of communication of the deaf members is generally a combined or mixed one, speech, signs and finger spelling being used in varying degrees.

The National Institute for the Deaf in London is concerned with all aspects of the welfare of the deaf and works through its central headquarters and through its regional associations. It is the recognized source of information on matters relating to the deaf. Other national bodies are the Royal Association for the Deaf and Dumb and the British Deaf and Dumb Association in organization managed by the deaf to further their own cultural interests. The Central Advisory Council for the Spiritual Care of the Deaf and Dumb furthers the spiritual welfare of the deaf throughout England and Wales.

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UNITED STATES

The increasing emphasis on oralism in the United States by the 1950s was breaking down the barriers that separated the totally or partially deaf from normal people. The teaching of speech and lip reading became generally prevalent so that the use of communication is available to almost everyone. According to a survey in 1952, there was an estimated incidence of hearing impairment of about 10% of the total population, and about 2.4% of children had a handicapping amount of hearing impairment.

Education—The first attempt to teach a deaf mute recorded in the United States was by Philip Nelson in Rowley, Mass., 1679, but not until the early 19th century was concerted action taken to educate deaf children. Francis Green of Boston, Mass., whose deaf son was sent to Edinburgh, Scot., to be educated at Thomas Braidwood's institution, became much interested in the problem. With some ministers he attempted a census of Massachusetts in 1803, when 75 deaf were found. They then estimated that there were 500 deaf persons in the United States and urged the creation of a special school. In 1810 in New York city, the Rev. Dr. John Stanford found several deaf children in the city almshouses and tried to instruct them; efforts which later resulted in the founding of the New York institution. A grandson of Thomas Braidwood, John Braidwood, began to teach a family of deaf children in Virginia in 1812, later establishing a school. In 1812 an investigation disclosed 84 deaf in the Hartford (Conn.) area and an estimated 400 in New England and 2,000 in America. In 1815 a group of Hartford men organized a society to instruct the deaf; raised \$2,278 and sent a young minister, the Rev. Thomas Hopkins Gallaudet, to Europe to learn methods of teaching the deaf. Gallaudet studied the sign language method at the Abbe Sicard's school in Paris, which influenced the whole course of the education of the deaf in America. When Gallaudet returned in 1816, he was accompanied by the celebrated Laurent Clerc, himself deaf, one of the Paris institution's teachers. On April 15, 1817, the Hartford school was opened with subscriptions from other cities amounting to \$12,000 and an appropriation of \$5,000 from Connecticut, probably the first made in the United States for other than regular schools. It used the sign language, the manual alphabet and writing as the basis of instruction. In 1819 the federal government granted 23,000 ac. of public land, the proceeds from which formed a fund of \$339,000.

In May 1818 the New York Institution for the Deaf was opened with 62 pupils. After an exhibition by the students in 1819 the state legislature appropriated \$10,000 and granted "a moiety of the tax on lotteries in the city of New York" which for 14 years formed a good income.

In Philadelphia, Pa., David Saxton began teaching deaf children in his home in 1820. After an exhibition of results accom-

plished in 1831 he secured a charter and a per capita appropriation from the state of \$160. The Hartford school lent him Laurent Clerc. New Jersey began at once to send pupils to the Pennsylvania institution, Maryland followed in 1837 and Delaware in 1835. Kentucky in 1832 was the fourth state to establish a school for the deaf, the Kentucky asylum at Danville, which was the first school established distinctly as a state enterprise. In 1863, there were 22 schools for the deaf with 2,012 pupils. Within 60 years of the first foundation, they were established in 37 states, great areas of public land being granted in several instances, for such purpose. In all the institutions up to 1867, the manual system of instruction held sway, though the oral method had been tried at the New York institution.

In 1867 the Clarke school was established at Northampton, Mass., the first permanent oral school in the United States. The Institution for the Improved Instruction of the Deaf, New York city, also came into being in 1867 instituting oral instruction. Both schools exerted an influence on the early education of the deaf.

Educators of the deaf divided themselves into those who favoured the manual system supplemented by articulation and those who taught speech and lip reading, vetoing the manual method. Manual teachers maintained that certain deaf mutes would never learn to speak and to read lips, oral teachers considered it unjust to separate the deaf from the hearing because of lack of instruction in the use of vocal organs. Edward Miner Gallaudet's stand for the teaching of speech to deaf children after his extended European tour of 1867 influenced many instructors. In 1886 tension had modified sufficiently to permit the convention of Instructors of the Deaf to pass noteworthy resolutions urging endeavours in the schools to teach every pupil to speak and read from the lips. The resulting "combined system" was defined in the *American Annals of the Deaf*, the instructor's official organ as follows:

Speech and speech-reading are regarded as very important, but mental development and the acquisition of language are regarded as still more important. It is believed that in some cases mental development and the acquisition of language can be best promoted by the Manual method, and such method is chosen for each pupil as seems best adapted for his individual case. Speech and speech-reading are taught where the measure of success seems likely to justify the labor expended, and in some of the classrooms of most of the Combined System schools the Oral method is strictly followed.

The combined and the oral systems came into increasing use. Yet even in 1904 the World's Congress of the Deaf at St. Louis, Mo. ruled that champions of the oral method were not friends of the deaf and that every teacher of the deaf ought to have a working command of the sign language. Oralism was helped forward by the establishment of day schools. The Horace Mann school at Boston was the first, starting Nov. 10, 1869 under Sarah Fuller, principal for 41 years, who gave Helen Keller her first lessons in speech. The number of day schools increased slowly up to 1894 when there were 15, and more rapidly thereafter

compulsory attendance laws for deaf children who are mentally competent. Admittance ages range from 3 to 8 and duration of attendance varies from age 16 to 25. More than half the states have day schools for the deaf in larger cities or a department for training deaf students within the existing school system. It has been estimated that 88.6% of the deaf in the United States have had some schooling. Every state requires periodic surveys for screening out children with hearing defects. Legal requirements vary from annual checks in some states to one survey every three years in others. In this way, most children with hearing problems are recognized at least by school age. Students in residential schools for the deaf are given vocational training according to their aptitudes. If this is not sufficient or if facilities are limited, the vocational rehabilitation division of the U.S. office of education will assume the responsibility for further education providing the students' potential ability warrants the expenditure. The vocational rehabilitation division is a national agency with one or more regional offices in each state. This agency will also assist individuals who have sustained hearing impairment after the age of 18.

Most states have mobile clinics which visit each section or community once a year. Parents may bring their children to be examined, and the specialists there refer them to their local physicians for further medical care. Many of the larger cities have established audiology centres for the recognition of problems, hearing aid fittings and some rehabilitative measures. Hospital centres of note include an audiological service in the otolaryngology department or correlated with this medical service. In these areas the patient with impaired hearing receives not only complete medical care and audiological examination but a plan of therapy or recommended procedures. Each audiology and hospital centre maintains a staff of trained experts including an otologist, psychologist, physicist, speech and hearing specialist and social worker and usually has access to a psychiatrist. Although the United States pioneered in this field, other countries came to recognize its value and show great interest in following the U.S. example. These centres are to be found throughout the U.S. similar to those at Johns Hopkins (Baltimore, Md.), the State University of Iowa hospitals (Iowa City) and the Children's hospital (Los Angeles, Calif.). Some schools of higher education have concentrated courses for rehabilitating hearing defective individuals. This therapy includes speech correction, auditory training and lip reading. There are also summer camps which include therapists in these areas.

with departments for educating deaf blind children. Perkins in situation, Watertown, Mass., New York Institute, New York City, Michigan School for the Blind, Lansing, Washington State School for the Deaf, Vancouver, Iowa State School for the Deaf, Council Bluffs, and California School for the Blind, Berkeley. Children from other states are sent to these schools on a tuition basis. The American Foundation for the Blind acts as a disbursing centre and clearing house for acceptance of fee basis students. This organization is an excellent source of material for parents seeking aid for deaf blind children.

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DEAF-MUTISM, MEDICAL ASPECTS OF

Mutism or dumbness is almost always due to malformation or disease of the ear. Children learn to speak by imitating those about them who speak. Cases have occurred in which a child with normal hearing, brought up by deaf and dumb guardians in an isolated cottage in the mountains did not learn to speak until it came into contact with speaking people in a town.

The air vibrations constituting sound are conducted through the outer ear passage to the tympanic membrane, and from this through a chain of three small bones in the middle ear to the inner ear or labyrinth—the essential part of the organ of hearing. The inner ear itself consists of (1) the cochlea, which is concerned in hearing, and (2) the vestibule and three semicircular canals, which together are concerned with body equilibrium (See EAR, ANATOMY OF, HEARING). From the inner ear the cochlear and vestibular nerves pass to the corresponding centres in the brain. Lesions of the ear producing deafness serious enough to cause a child to become mute are almost always situated in the inner ear. Deaf mutisms are usually classified as congenital cases, (abnormal development of the ears) or acquired cases, in which the ears, normal at birth, become diseased in childhood. About half the cases of deaf mutism are congenital.

Congenital Deaf Mutism may be endemic or sporadic. Endemic deaf mutism is peculiar to certain districts, notably Switzerland, and is associated with cretinism (*g.v.*) Cretinism is due to deficient activity of the thyroid gland. With increasing provision of iodine in the diet both cretinism and the associated endemic deafness are becoming less common, but cases still occurred at mid 20th century. In this type of case the middle ear is filled with connective tissue or bone instead of with air. The loss of hearing is not very profound, and the mutism is due largely to poor mental development.

Sporadic congenital deafness is usually due to failure of normal development or to degeneration in the inner ear. It is subdivided into the hereditary and the nonhereditary forms. Hereditary deafness may be total, but often the patient has considerable residual hearing, particularly for tones of low pitch. The hearing losses are usually very similar in the two ears. The vestibular portion of the inner ear, concerned with the sense of equilibrium, and the general structure of the temporal bone are usually normal. Most hereditary deafness is monogenic, due to a single recessive gene (see MENDELISM AND HEREDITY). When this gene is inherited from both parents the inner ear fails to develop normally. The implications of the single recessive gene are as follows.

Marriage between two persons with this type of deafness will result in similar deafness in all of their offspring. Marriage between a person with this deafness and one who, although hearing normally, is a carrier of the gene gives an even chance of deafness for each child and the hearing children will all be carriers. Between two carriers there is a one-in-four chance of deafness for each child and a two-out-of-three chance that the hearing children will be carriers. Marriage between a carrier and a person who is not a carrier will result in no deaf children, but an even chance that each child will be a carrier.

There is also a rarer form of hereditary deafness, apparently

due to a single dominant gene which causes deafness if inherited from either parent. Still other rare hereditary forms are associated with abnormal development of the external ear canal or of other sense organs or parts of the nervous system. In some cases the child may have normal hearing for several years and then suffer a gradual and more or less complete loss of hearing from degeneration of some or all of the sensory cells in the cochlea. (This form of deafness is quite distinct from otosclerosis. The latter is also a hereditary disease and causes partial hearing loss in early adult life, but the abnormality in otosclerosis is in the sound-conducting mechanism, not in the sensory cells, and the hearing loss is rarely severe enough, nor does it occur early enough, to be a significant cause of deaf mutism.)

Nonhereditary congenital deafness is usually due to a disease of the mother which is either transmitted to the child, or which by its toxins causes abnormal development of the inner ear in the foetus. Congenital syphilis is the commonest example of the first situation, here the deafness usually develops in the preadolescent period. German measles (rubella), and probably also mumps, influenza and some other infectious diseases in the mother during the first three months of pregnancy are important examples of the second situation. Here the affected children are born deaf or hard of hearing.

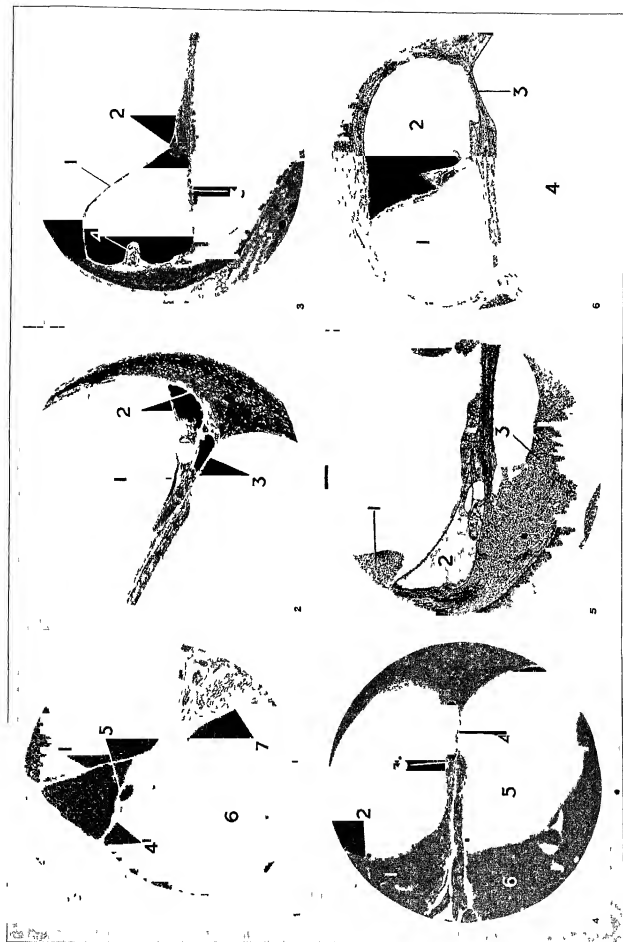
Acquired Deafness occurring early enough to cause deaf mutism is also usually due to disease of the inner ear. Mechanical injury, such as fracture of the skull, is a rare cause. Sometimes an untreated infection of the middle ear in a severe case of scarlet fever, measles or influenza, or even a common cold may break through into the inner ear. Infection reaches the middle ear from the pharynx by way of the Eustachian tube. Pus forms in the middle ear (otitis media), and if the infection also invades the inner ear, it destroys the organ of hearing and the vestibular mechanism as well. Towns also sometimes cause degeneration of the delicate sensory cells without the formation of pus and without any localized infection in the middle ear. Probably about half of the cases of severe acquired deafness in childhood are due to scarlet fever, measles, influenza, pneumonia, whooping cough, diphtheria and mumps.

Meningitis is the commonest single cause of acquired deafness. This infection spreads from the coverings of the brain, the meninges, along the sheath of the auditory nerve to the inner ear. The destruction of the sense organs of hearing and of equilibrium is usually complete. In one survey (1927) of children in public schools for the deaf in several midwestern states of the U.S. meningitis alone was found to have caused about one-fifth of the cases of acquired deafness. In the U.S. army in World War II meningitis was so well controlled by chemotherapy that it was a negligible cause of deafness, in contrast to its position as the leading cause of total deafness in World War I. Its importance as a cause of deaf-mutism in children may likewise be expected to decrease.

The incidence of deaf-mutism has varied from about 43 per 100,000 in Denmark and 47 in the United States, to 80 in England and Wales, 87 in Sweden and 129 in Switzerland. The high figure for Switzerland is due to the presence of endemic deafness. The differences in incidence among the other countries are due in part to differences in the definition of deaf mutism.

Diagnosis—It is particularly important in diagnosis to determine whether or not a mute child is totally deaf, whether he has a significant amount of residual hearing, or whether his muteness is due to a disorder of the residual function. Congenital aphasia (see APHASIA) may closely resemble true deaf-mutism and its nature may be demonstrated only when, after patient education has built up his understanding of auditory language, the child's hearing is found to be practically normal. And even if a child has a real and severe hearing loss, the loss may be less than appears on casual examination because such a child forms the habit of disregarding his few weak auditory sensations. A powerful hearing aid, particularly the group instruments used for instruction in most schools for deaf children, may be used to good advantage if there is a small amount of residual hearing.

Any conclusion as to the presence or absence of residual hearing must be made by an experienced examiner who knows how to distinguish



PATHOLOGICAL ASPECTS OF DEAF-MUTISM

1. Normal cochlea of dog. (1) Reissner's membrane. (2) Normal stria vascularis. (3) Normal basilar membrane. (4) Normal cochlear duct. (5) Normal cochlear canal. (6) Normal cochlear duct. (7) Normal cochlear canal.
2. Normal cochlea of dog. (1) Reissner's membrane. (2) Depressed Reissner's membrane. (3) Atrophied stria vascularis. (4) Depressed basilar membrane. (5) Depressed cochlear duct. (6) Depressed cochlear canal. (7) Depressed cochlear canal.
3. Basilar membrane cochlear canal largely filled with a mass of cells and coiled material. (1) Reissner's membrane. (2) Depressed basilar membrane. (3) Depressed cochlear duct. (4) Depressed cochlear canal. (5) Depressed cochlear canal. (6) Depressed cochlear canal. (7) Depressed cochlear canal.
4. Basilar membrane detached from the cochlear duct. (1) Reissner's membrane. (2) Depressed basilar membrane. (3) Depressed cochlear duct. (4) Depressed cochlear canal. (5) Depressed cochlear canal. (6) Depressed cochlear canal. (7) Depressed cochlear canal.
5. Inflammation of lamina propria. (1) Reissner's membrane. (2) Depressed basilar membrane. (3) Depressed cochlear duct. (4) Depressed cochlear canal. (5) Depressed cochlear canal. (6) Depressed cochlear canal. (7) Depressed cochlear canal.
6. Congenital aplasia of the cochlear duct. (1) Reissner's membrane. (2) Depressed basilar membrane. (3) Depressed cochlear duct. (4) Depressed cochlear canal. (5) Depressed cochlear canal. (6) Depressed cochlear canal. (7) Depressed cochlear canal.
7. Congenital aplasia of the cochlear duct. (1) Reissner's membrane. (2) Depressed basilar membrane. (3) Depressed cochlear duct. (4) Depressed cochlear canal. (5) Depressed cochlear canal. (6) Depressed cochlear canal. (7) Depressed cochlear canal.

between a child's reaction to actual sound and his ability to see and to feel vibrations. Parents' opinions as to whether a child hears or not are notoriously biased by wishful thinking. A child may even learn to hear by watching the lips of a speaker.

established. It is important, however, to begin special education by the fourth or fifth year at the latest, preferably in one of the many institutions, public or private, that specialize in this type of instruction. (See DEAF AND HARD OF HEARING, EDUCATION 01.)

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DEÁK, FRANCIS (FERENCZ) (1803–1876), Hungarian statesman, was born at Sojtor in the county of Zala on October 17, 1803. Of an ancient and distinguished family, he was educated for the law and practised first as an advocate and ultimately as a notary. His reputation in his own county was quickly established and when in 1833 his elder brother, Antal, was obliged by ill-health to relinquish his seat in the Hungarian parliament, the electors chose Ferencz in his stead. No man owed less to external advantages. He was to all intents and purposes a simple country squire. His true greatness was never exhibited in debate. It was in friendly talk, generally with a pipe in his mouth and an anecdote on the tip of his tongue, that he exercised his extraordinary influence over his fellows. He convinced them from the first of his disinterestedness and sincerity, and impressed them by his instinctive faculty of always seizing the main point and sticking to it. Perhaps he is unique in history, for though neither soldier, nor diplomatist, nor writer he became the leader of a great party by sheer force of intellect and moral superiority. This is all the more remarkable because he appealed to no passion but patriotism, and avoided power instead of seeking it.

During the struggle between Austria and Hungary for the preservation of the Hungarian constitution, Deák and Count Stephen Széchenyi were the leaders of that party who wished all proceedings to be conducted in a strictly legal manner, and who therefore were opposed to the extreme revolutionary methods of Kossuth and his followers. In the diet of 1839–40 it was Deák who brought about an understanding between a reactionary government in need of money and recruits for the army and a Liberal opposition determined to vindicate Hungary's political rights. He did not sit in the diet of 1843–44 because his election was the occasion of bloodshed in the struggle between the Clericals who would have ousted him and the Liberals who brought him in. After the constitutional victory of 1848 he became minister of justice in the Batthyány ministry. All through the stormy days that followed, culminating in the War of Hungarian Independence, he never ceased to urge moderation and the adoption of a strictly legal position, but Kossuth and the extremists got the upper hand. "You cannot argue with a drunken man," he is reported to have said, "and at the moment the diet is drunk." When it became obvious that the Viennese Government did not intend to keep its promises to Hungary, Deák resigned with Batthyány, but without ceasing to be a member of the diet. He was one of the parliamentary deputation which waited in vain upon Prince Windischgratz in his camp. He then retired to his estate at Kehida. After the War of Independence he was tried by court martial but acquitted.

After 1854 he spent the greater part of his time in Pest, where his room at the "Queen of England" inn became the centre for those patriots who in the dark days of the Bach administration looked to his wisdom for guidance. He did all in his power to stimulate the moral strength of the nation and to keep its hopes alive. He considered armed resistance dangerous, but he was the immutable defender of the continuity of the Hungarian constitution on the basis of the reforms of 1848. The Kossuth faction looked for salvation to a second war with Austria engineered from abroad, while the followers of Széchenyi adopted an attitude of resignation, equally repugnant to Deák.

The Italian war of 1859 convinced the Austrian Government of the necessity of a reconciliation with Hungary. Bach was replaced by Schmerling and an imperial patent of April 19, 1860 removed some of the chief grievances of the Magyars. The October diploma of the same year was intended to provide the empire with a federal system of government on constitutional lines. Deák rejected it, but at the request of the government he went to Vienna to set forth the national demands. He insisted on the re-establishment of the constitution in its integrity as a *sine qua non*. On February 16, 1861 the government withdrew the diploma and issued a patent which was a return to the former centralist and bureaucratic system. On April 6 the diet met at Pest. Deák rose to defend the national right and traditions, and on June 5 moved an address to the crown refusing to recognize the February patent, insisting on the laws of 1848 as the sole basis of accord, and reminding the Emperor that an uncrowned king was no true sovereign of Hungary. The speech of Deák on this occasion was his finest effort and he was acknowledged the leader of the nation by all parties. He next proposed to the emperor that he should break away from counsellors who had sought to oppress Hungary, and restore the constitution as a personal act. The emperor thereupon dismissed Schmerling, suspended the February constitution and summoned the coronation diet. Of that diet Deák was the indispensable leader, and all parties left him to conduct the delicate negotiations with the emperor. The committee of which he was president had completed its work when the Austro-Prussian War broke out. The extreme party would have used the defeat of Königgratz to extort still more favourable terms, but Deák made it easy for the emperor in the hour of his humiliation. To his question, "What does Hungary demand?" Deák answered, "Nothing more after Sadowa than before it." On Feb. 18, 1867 the restoration of the Hungarian constitution was publicly announced in the diet, and a responsible ministry was formed under the premiership of Count Julius Andrássy. Deák himself refused to take office. There was still one fierce parliamentary struggle, in which Deák defended the compromise (*Ausgleich*) of 1867, both against the Kossuthites and against the Left-centre, which had detached itself from his own party under the leadership of Kálmán Tisza (*qv*). It was the wish of the diet that Deák should exercise the functions of a palatine at the coronation, but he refused the honour, just as he had refused every other reward and distinction. "It was beyond the king's power to give him anything but a clasp of the hand." His reward was the assurance of the prosperity and tranquillity of his country and the reconciliation of the nation and its sovereign. This service reconciled him to the loss of much of his popularity, for a large part of the Hungarian people looked upon the compromise of 1867 as a surrender and blamed Deák for it. He died at midnight of July 28–29, 1876, his funeral was celebrated with royal pomp on Feb. 3. A mausoleum was erected by national subscription and in 1887 a statue overlooking the Danube was erected to his memory.

See *Speeches* (Hung.) ed. by Manó Könyi (Budapest, 1894), *Life of Deák* (Budapest, 1894), *Memorials of Ferencz* (Budapest, 1889–90), Ferencz Pulszky, *Charakteristika* (1876), R. Springer, *Die Krise des Dualismus und das Deákstücken* (Epsode in der Geschichte der Habsburgischen Monarchie) (Vienna and Leipzig, 1904), L. Eisenmann, *Le C. d'Autro Hongrois de 1867* (1904).

several important ministerial posts. After the fall of the coalition ministry in 1895 he resumed a private member of the legislature, though office was repeatedly offered to him until 1900. In that year he came to London to discuss with Chamberlain more particularly the legal points in the Australian Commonwealth Constitution Bill. In Victoria his public speeches helped on the Federation movement and in 1901, as Attorney-General, he was included in the first Federal cabinet of Sir Edmund Barton, whom he succeeded as prime minister in 1903. During his legislative career in Victoria he was active in promoting social legislation and an ardent advocate of preference in favour of Great Britain. This fiscal policy he pursued during his three Federal premierships (1903-04, 1905-08, 1909-10), and supported Australia's co-operation in imperial defence, being responsible for the inception of the measure authorizing Australian naval construction in 1909, and for the invitation to Lord Kitchener to visit Australia and report on the question of defence. After 1910 he led the Opposition in the Australian parliament until compelled to retire, owing to ill health, in 1912. He died at Melbourne on Oct. 7, 1919. Deakin had made a special study of the irrigation problem, and wrote three books on irrigation in Western America (1885), in Egypt and Italy (1887), and in India (1892). The Irrigation Act of 1886 was largely his work.

See W. Murdoch, *Alfred Deakin* (1923), B. R. Wise, *Making of the Australian Commonwealth* (1913).

DEAL, a seaport and municipal borough in the Dover parliamentary division of Kent, England, 9½ mi. NNE of Dover on the Southern railway. Pop. (1938) 23,440. Area 4.5 sq. mi. It consists of Lower Deal, on the coast, Middle Deal, and about a mile inland, though formerly one of the coast. Upper Deal, which is the oldest part. The borough was extended in 1935 to include the urban district of Walmer and other areas. Frequented as a seaside resort, the town derives further importance from its vicinity to the Downs, a fine natural roadstead between the shore and the Goodwin Sands, about 9 mi. long and 6 mi. wide, in which large fleets of windbound vessels may be protected against the north, west and easterly gales. The trade consists in the supply of provisions and naval stores, which are conveyed to the ships in need of them by "hovellers," as the boatmen are called along the Kentish coast. The Deal hovellers, pilots and lifeboatmen are famous for their skill. Fish curing and a few other industries are carried on. St Leonard's church in Upper Deal dates from the Norman period. The site of the old navy yard is occupied by villas. The esplanade, nearly 4 mi. long, extends through Walmer to the south, and north to the ruins of Sandown castle, and has a promenade pier, owned by the corporation. The golf links are well known. At the south end of the town is Deal castle, erected by Henry VIII in 1539, together with the castles of Sandown, Walmer and Sandgate. They were built alike and consisted of a central keep surrounded by four lunettes. Sandown castle was the prison in which Col. Hutchinson, the Puritan soldier, was confined and is said to have died, September 1664. It was removed on becoming endangered by encroachments of the sea. The "captain" of Deal castle is appointed by the lord warden of the Cinque Ports.

Deal is one of the most notable sites of the landward shore of the Channel. Later in the period of Roman occupation the site was inhabited by a station of a post. In the Domesday Survey, Deal (*Dole, Dole, Dole*) is mentioned among the possessions of the bishops of St. Martin, Dover, is said to be the site of the Buresborough and Combe, it seems from early times to have been a part of the history of the Cinque Ports as a member of St. Martin's but was not continuously reckoned as a member before the reign of Henry VI. In the time of Henry VIII Deal was a fishing village half a mile from the sea. In the growth of the navy and the increase of trade brought ships in increased numbers to the Downs. Lower or New Deal was then built along the shore. William III incorporated the town in 1697-99 and granted a market and fairs with a court of the Port. The Cinque Ports were first represented in the parliament of 1265. The 15 members returned by Sandwich, Ramsgate, Dover, Deal and Walmer until they were disfranchised in 1835. In 1811 Wal-

ter 2,000 houses had been damaged by German air raids by the end of 1941.

DEAL, A British term commonly used to designate the soft woods derived from the Scotch pine (*Pinus sylvestris*) which is called yellow or red deal and the spruce fir (*Abies excelsa*) which is called white deal. The former is by far the better timber. Deal is freely imported into the British Isles from Scandinavia and Russia, and so widely used for building and other purposes that the word is threatened with a soft-wood famine.

The term deal (derived from *Dan deal*, plank) is also used as the name of a soft-wood measurement. A deal in England is a piece of pine wood 2½ in. wide and 2 to 4 in. thick, not less than 8 ft. long. (See *Timber*.)

DEALER, one who sells at retail to the public. This term is used to cover nearly all retailers except department and chain stores, and in the loose parlance of trade it is sometimes applied to the individual units of chain store systems. The term "dealer" formerly meant one who bought and sold primarily without a place to stock a quantity of merchandise, he was sometimes also referred to as a "curb dealer", i.e., one who transacted his business from the sidewalk.

DEALFISH, the name applied to marine fishes of the genus *Trachipterus*, which, together with the arfish (*q.v.*), comprises the family Trachipteridae, or ribbonfish. Dealfish inhabit the middle waters, probably not below 200 fathoms, and are characterized by their long, laterally compressed bodies, short head, narrow mouth and feeble dentition. The dorsal fin extends the length of the back, the anal is absent, and the caudal, when present, is reduced. The pectoral fins are small. In young dealfish some of the fin rays are prolonged in an extraordinary way. Dealfish may reach a length of eight feet. They have a world-wide distribution. All the specimens found at the surface of the sea have been more or less mutilated by the release from the enormous pressure under which they are accustomed to live. The commonest species is *T. arcticus*.

DEAN, primarily one having authority over ten, the title of an ecclesiastical dignitary, or of a university or civil official (Lat. *decanus*, from Gr. *deka*, ten).

The original use of the word *decanus* was evidently to denote a military grade. It occurs in this sense in the *De Re Militari* of Vegetius (c. 386). Slightly later (c. 400), St. Jerome uses it in the Vulgate, instead of the *decano* of the Old Latin version, for the "rulers of tens" in Exod. xxviii. 21, 25. It was also applied, from the late 4th century onwards, to the members of a guild, whose occupation was the burial of the dead, as well as to certain minor officials of the imperial household, and in later times of the empire to various civil functionaries. In the Visigothic and Lombardic codes it occurs as the title of a subordinate judge, having jurisdiction within a district called a deanery (*decania*) or tithing, in the Anglo-Saxon system the corresponding official was entitled dean, tithing man or head borough.

In monastic life the term was used at an early period to denote a monk having charge of ten monks (St. Augustine, *De Mor. Eccl. Cath.*, i. 31, etc.), and it occurs in this sense in the Rule of St. Benedict (ch. 21). As monachism developed the title came to be applied to various special functionaries, e.g., *foris decanus*, i.e., monk responsible for the external business of a monastery.

In its now most familiar use designating the head of a cathedral or collegiate chapter, the title probably owes its origin to this monastic usage. In certain of the cathedrals where in the charge of monks. In the 6th century the *decanus* as a cathedral official was subordinate to the *praepositus* or provost who presided over the chapter as the bishop's vicar, but during the next few centuries deans were almost everywhere subordinated to provosts.

The office of rural dean representing one of the earlier archbishop (*q.v.*), is of great antiquity in the Western Church, going back to the time farthest as early as the 6th century) when the bishops of the large dioceses found it necessary to subdivide the diocese into districts called archiepiscopatus or deaneries (*decanatus*) each with an archbishop (later called rural dean) as its head. This functionary supervised the local clergy and to some extent represented the bishop within his district, but was

always subordinate to the archdeacon. At the present day, in the Roman Catholic Church, the powers and duties of rural deans vary considerably from country to country, and even from diocese to diocese, being restricted in some cases to presiding at the monthly conference of the clergy. In the Church of England the office fell into practical abeyance at the Reformation, but was revived about the middle of the 19th century, rural deans may act as deputies to the bishop and archdeacon, and are supposed in particular to see that the churches and parsonages within their district are in proper repair.

The title "dean" of the sacred college" is borne by the oldest (in standing, not in age) of the cardinal bishops, who takes the title of bishop of Ostia and Velletri. Perhaps the use of the word "dean," as signifying the oldest member of any corporation or body of men, may be derived from its application to dignity. The dean of the sacred college is in the ecclesiastical hierarchy second to the pope alone. A compendious account of his privileges and special functions may be found in the work of G. Moroni, vol. xix. p. 168.

There are four sorts of deans of whom the law of England takes notice: (1) The dean and chapter are a council subordinate to the bishop, and assistant to him in matters spiritual relating to religion and in matters temporal relating to the temporalities of the bishopric. The dean and chapter are a corporation, and the dean himself is a corporation sole. Deans are said to be either of the old or of the new foundation: the latter being those created and regulated after the dissolution of the monasteries by Henry VIII. The deans of the old foundations before the Ecclesiastical Commissioners Act, 1847, were elected by the chapter on the king's *compte d'honneur*; those of the new foundation (and, since the act, of the old foundation also) are appointed by the king's letters patent. It was at one time held that laymen might be deans, but since 1663 priest's orders are a necessary qualification. By the act of 1847 the dean is required to be in residence eight months, and the canons three months, every year. The bishop is vicar of the dean and chapter (2) A dean of peculiar is the chief of certain peculiar churches or chapels. He "hath no chapter, yet is representative, and hath cure of souls, he hath a *peculiar*, and yet is not subject to the visitation of the bishop of the diocese." The only instances of such deaneries are Battle (Sussex), Bocking (Essex), and Stamford (Rutland). The deans of Jersey and Guernsey have similar status. (3) The third dean "hath no cure of souls, but hath a court and a *peculiar*, in which he holdeth plea and jurisdiction of all such ecclesiastical matters as come within his peculiar. Such is the dean of the arches, who is the judge of the court of the arches, the chief court and consistory of the archbishop of Canterbury, so called of Bow Church, where this court was ever wont to be held" (See ARCHES, COURT OF). The parish of Bow and twelve others were within the peculiar jurisdiction of the archbishop in spiritual causes and exempted out of the bishopric of London's jurisdiction. They were in 1845 made part of the diocese of London. (4) Rural deans (See above) are clergymen whose duty is described as being "to execute the bishop's processions and to inspect the lives and manners of the clergy and people within their deanery." (See RURAL DEAN, p. 100.)

Wyntoun for £10,000, and a fee farm rent of £2,000. The grant was cancelled by Cromwell, but at the Restoration only 30,000 trees were left, and Wyntoun, having got another grant, destroyed most of these. In 1680 an Act was passed to enclose 11,000 acres and plant with oak and beech for supply of the dock yards. Near Coleford and Westbury pit workings of the Roman period have been discovered.

DEANE, RICHARD (1610-1653), British general-1st son, major general and regicide, was a younger son of Edward Deane of Temple Guiting or Guiting in Gloucestershire, where he was baptised on 28 May 1610. He held a command in the artillery under Essex in Cornwall and took part in the surrender after Lostwithford. Appointed comptroller of the ordnance, he commanded the artillery at Naseby and during Fairfax's campaign in the west of England in 1645. In May of that year Deane was appointed lieutenant of artillery to Cromwell in Ireland. Cromwell refused to be put out of the way, and Deane followed his example. He commanded Cromwell's right wing at Preston (Aug 17-19, 1648). He was one of the commissioners for the trial of Charles I and a member of the committee which examined the witnesses. He signed the death warrant.

In 1649 the office of lord high admiral was put into commission. The first commissioners were Edward Popham, Robert Blake and Deane, with the title of generals at-sea. At the outset of the battle off the North Foreland (June 1-3, 1653) Deane was killed. He was buried in Henry VII's chapel at Westminster Abbey, to be disinterred at the Restoration.

See J. Bathurst Deane, *The Life of Richard Deane* (1870)

DEANE, SILAS (1737-1789), American diplomat, was born in Groton, Conn., on Dec. 24, 1737. He graduated at Yale in 1758 and in 1761 was admitted to the bar. From 1774 to 1776 he was a delegate from Connecticut to the Continental Congress. Early in 1776 he was sent to France by Congress as a secret agent to induce the French Government to lend its financial aid to the colonies. Subsequently he became, with Benjamin Franklin and Arthur Lee, one of the regularly accredited commissioners to France from Congress. On arriving in Paris, Deane secured the shipment of many vessel loads of arms and munitions of war to America. He also enlisted the services of a number of Continental soldiers of fortune, among whom were Lafayette, Baron Johann De Kalb and Thomas Conway. His carelessness in keeping account of his receipts and expenditures led, in 1777, to his recall to face charges. Before returning to America, however, he signed on Feb. 6, 1778, the treaties of amity and commerce and of alliance which he and the other commissioners had successfully negotiated. In America he was defended by John Jay and John Adams, and after stating his case to Congress was allowed to return to Paris (1781) to settle his affairs. The publication of some "intercepted" letters in Livingston's *Royal Gazette* in New York (1781), in which Deane divulged his belief that the struggle for independence was hopeless and counselled a return to British allegiance, aroused such animosity against him in America that for some years he remained in England. He died on shipboard in Deal harbour, England, on Sept. 23, 1789 after having embarked for America on a Boston packet. No evidence of his dishonesty was ever discovered and Congress recognized the validity of his claims by voting \$37,000 to his heirs in 1842. He published his defence in *An Address to the Free and Independent Citizens of the United States of North America* (Hartford, Conn., and London, 1784).

See *The Correspondence of Silas Deane* published in the Connecticut Historical Society's *Collections*, vol. II, and *The Deane Papers*, in the New York City Historical Society's *Collections* (1887-90). See also Winsor's *Narrative and Critical History*, vol. VII, chap. I, Wharton's *Revolutionary Diplomatic Correspondence of the United States* (1899), and G. L. Clark, *Silas Deane: A Connecticut Leader in the American Revolution* (1953).

DEARBORN, HENRY (1751-1829) American soldier and secretary of War, was born at Hampton in south eastern New Hampshire. Upon hearing of the battle of Lexington, he left the practice of medicine to join the provincial forces and served as an officer at the battle of Bunker Hill. Arnold's expedition to Quebec

[illegible]

(where he was taken prisoner and exchanged), battle of Saratoga, Valley Forge, battle of Monmouth, Sullivan's expedition against the Indians, and the siege of Yorktown. He kept a detailed journal throughout the war, which gives a valuable first hand account of the principal campaigns of the Revolution. Upon the organization of the Government, President Washington designated him United States marshal for the District of Maine, and in 1792 he was elected to Congress, where he served as a Republican for two terms. He was secretary of War through the administration of President Jefferson, 1801-1809. In 1803 he issued an order for "erecting barracks and a strong stockade" at "Chikago," "with a view to the establishment of a Post." The important part which this post, Fort Dearborn, played in the early history of Chicago, has given his name a lasting association with that city. In Jan. 1812, President Madison appointed him senior major general of the United States Army. Upon the outbreak of hostilities with England, he undertook to carry out an extensive plan of campaign, including an invasion of Canada at several points. After a long succession of delays and reverses, he was relieved of his command in July 1813. In 1821, President Monroe appointed him minister to Portugal. He died in Roxbury, Mass. (H. D. SM.)

DEARBORN, a city of Wayne county, Michigan, U.S.A., 10 mi. W. of Detroit, on the Michigan Central railroad. The population was 2,470 in 1920 but grew rapidly to 50,358 in 1930, and was 94,520 in 1950 by the federal census. It is a residential suburb and is known as the home of Henry Ford (*q.v.*), who was born on a farm in the city. Ford restored the farm to its early appearance, and built at Dearborn a "museum village" of old buildings collected from all parts of the United States and from England.

DEATH, the permanent cessation of the vital functions in the bodies of animals and plants, the end of life or act of dying. The word is the English representative of the substantive common to Teutonic languages, as "dead" is of the adjective, and "die" of the verb, the ultimate origin is the pre-Teutonic verbal stem *da-*, cf. Ger. *Tod*, Dutch *doen*, Swed. and Dan. *dø*.

For the scientific aspects of the processes involved in life and its cessation see **BIOLOGY**, **PHYSIOLOGY**, **PATHOLOGY**, and allied articles, and for the consideration of the prolongation of life see **LONGEVITY**. Here it is only necessary to deal with the more primitive views of death and with certain legal aspects.

Ethnology—To the savage, death from natural causes is inexplicable. At all times and in all lands, it he reflects upon death at all he feels to under-stand it as a supernatural phenomenon. If a man dies without being wounded he is considered to be the victim of the sorcerer, and the evil spirits with which they can communicate. In the death of anyone is ascribed to the malignance of some hostile spirit or to the magic use of a witch's hour. A culprit is said to be covered either by an appeal to a local diviner or by torturing some one into confession. In Australia, whenever a native dies, no matter how evident it may be that death has been the result of natural causes, it is at once set down that the defunct was bewitched. Even to-day the peasantry of many European countries believe that all disease is the work of demons. Sleep and trance are regarded as the temporary, death as the permanent, absence of the soul regarded as the vital principle, as the moral principle and as the intellectual principle. It may be diffused all through the body but can be concentrated in one organ (see **HEAD HUNTING**). It inheres in each and every part in excreta and hair clippings and for safety may be hidden in some external object.

The body's shadow or reflection is the soul, and subject to a

malice of enemies. The soul is pictured as a man's breath (*anima*), and the word 'breath' has become a synonym for life itself. The phrase "last breath" expresses the savage belief that there departs from the dying in the final expiration a something tangible, capable of separate existence—the soul. Myths account for its origin. Sometimes it is a "tabu" which has been broken and gives Death power over man. In India Yama, the god of Death, the first man, married his sister and thereby violated the fundamental law of exogamy, breach of which to this day in many cases still entails actual as well as civil death. In other myths, men were destined by Divine Mercy to be immortal but the messenger of the glad tidings failed or erred.

See Sir J. G. Frazer, *The Belief in Immortality*, vol. 1 (1913), *The Golden Bough* (*Perils of the Soul*).

REGISTRATION

Legal Requirements—The registration of burials in England goes back to the time of Thomas Cromwell, who in 1538 instituted the keeping of parish registers. Statutory measures were taken from time to time to ensure the preservation of registers of burials, but it was not until 1836 (the Births and Deaths Registration Act) that the registration of deaths became a national concern. The law for England was consolidated by the Births and Deaths Registration Acts 1874 and 1926. Under the former act, the registration of every death and the cause of the death is compulsory. When a person dies in a house information of the death and the particulars required to be registered must be given within five days of the death to the registrar to the best of the person's knowledge and belief by one of the following persons—(1) The nearest relative of the deceased present at the death, or in attendance during the last illness of the deceased. If they fail, then (2) some other relative of the deceased in the same sub district (registrar's) as the deceased. In default of relatives, (3) some person present at the death, or the occupier of the house in which, to his knowledge, the death took place. If all the above fail, (4) some inmate of the house, or the person causing the body of the deceased to be buried. The person giving the information must sign the register. Similarly, also, information must be given concerning death where the deceased dies not in a house.

Where written notice of the death, accompanied by a medical certificate of the cause of death, is sent to the registrar, information must nevertheless be given and the register signed within 14 days after the death by the person giving the notice or some other person as required by the act. Failure to give information of death, or to comply with the registrar's requisitions, entails a penalty not exceeding 40 shillings, and making false answers to any question put by the registrar relating to the particulars required to be registered, or making false statements with intent to have the same inserted in the register, is punishable either summarily with a penalty of £10, or on indictment, with penal servitude for seven years, or with imprisonment for two years with or without hard labour.

The registrar, upon registering the death, must forthwith give to the person giving the information a certificate under his hand that he has registered the death, but where he has received written notice of the death, accompanied by a medical certificate of the cause of death, he may, before registering the death and subject to such conditions as may be prescribed, give to the person sending the notice, if required to do so, a certificate under his hand that he has received notice of the death.

The body of the deceased cannot be disposed of before the certificate of the registrar, or order of the coroner, has been delivered to the person effecting the disposal, i.e., the person by whom the register of burials in which the disposal is to be registered is kept, or, in the case of a burial in a churchyard or graveyard of a parish or ecclesiastical district under the Burial Laws Amendment Act 1880, the relative, friend, or legal representative who is responsible for the burial of the deceased. Where, however, the disposal is by burial, the person effecting the disposal may proceed with the burial if satisfied by a written declaration in prescribed form by the person procuring the disposal that a certificate or order has been issued. The person effecting the dis-



FROM A WOODCUT BY HANS HOLBEIN THE YOUNGER
SIXTEENTH CENTURY PORTRAIT OF DEATH

posals must, within 96 hours of the disposal, notify the registrar in the prescribed manner as to the date, place and means of disposal. The registrar, on the expiration of the prescribed period after the issue of a certificate by him or of a coroner's order, if no notification as aforesaid has been previously received by him, must make inquiry of the person to whom the certificate or order was given, and such person must give information to the best of his knowledge and belief as to the person having the custody of the certificate or order, the place where the body is lying, or, if disposed of, the person effecting the disposal.

It is the duty of the father or mother of a still born child to give information to the registrar of the particulars required to be registered concerning the still birth. Upon doing so, he or she must either (1) deliver to the registrar a written certificate that the child was not born alive, signed by a registered medical practitioner or certified midwife who was in attendance at the birth or who has examined the body, or (2) make a declaration in prescribed form to the effect that no practitioner or midwife was present at the birth, or has examined the body, or that his or her certificate cannot be obtained and that the child was not born alive.

The registration of deaths at sea is regulated by the Births and Deaths Registration Act 1874 together with the Merchant Shipping Act 1894.

Death can be proved by the production of a certified copy of the entry in the register of birth and deaths, which is evidence not only of the fact of death, but also of the date of death, the sex, rank, or profession of the dead person, and the cause of death.

Presumption of Death.—The fact of death may, in English law, be proved not only by direct but by presumptive evidence. When a person disappears and is not heard of for seven years, the presumption of law arises that he is dead (*Nepean v Doe*, 1837, 2 M & W 894). In Scotland, by the Presumption of Life (Scotland) Act 1891, the presumption is statutory. In those cases where people disappear under circumstances which create a strong probability of death, the court may, for the purpose of probate or administration, presume the death before the lapse of seven years (see *In the Goods of Matthews*, 1898, p. 17). The question of survivorship, where several persons are shown to have perished by the same calamity, has been much discussed. It was at one time thought that there might be a presumption of survivorship in favour of the stronger party. But it is now clear that there is no such presumption, the question is one of fact depending wholly on evidence, and, if the evidence does not establish the survivorship of any one, all must be taken to have died at the same moment (*Wong v Angrove*, 1860, 8 H L Cas 183). This rule has been applied by the court of probate where husband and wife were both killed in a railway accident, and the bodies were found two hours afterwards, and administration was granted to their respective next of kin (*In the Goods of Wheeler*, 1861, 31 L J P M & A, 40), so also where husband and wife were proved to have been on board a ship which was supposed to have been lost at sea (*In the Goods of Alston*, 1892, p. 142).

Civil Death is an expression used in law in contradistinction to natural death. Formerly, a man was said to be dead in law (1) when he entered a monastery and became professed in religion, (2) when he abjured the realm, (3) when he was attainted of treason or felony. Since the suppression of the monasteries there has been no legal establishment for professed persons in England, and the first distinction has therefore disappeared, though for long after the original reason had ceased to make it necessary grants of life estates were usually made for the terms of a man's natural life. The act abolishing sanctuaries (1623) did away with civil death by abjuration, and the Forfeiture Act 1870, that on attainer for treason or felony.

For the statistics of the death rate of various countries see DEATH RATE. See also ANNUITY, CAPITAL PUNISHMENT, CREMATION, INSURANCE, ARTICLES ON, MEDICAL JURISPRUDENCE, etc.

THE UNITED STATES

Legal Registration.—It is generally provided that the State department of health shall have charge of the registration of

deaths, shall provide the necessary forms and blanks for obtaining and preserving such records, and shall procure the faithful registration of each death. For this purpose the States are, as a general rule, divided into registration districts, sometimes called vital statistics registration districts, in each of which there is a registrar charged with the registration of births and deaths. In Massachusetts and in some other States this duty is imposed upon each town clerk.

It is provided by statute in most States that the body of any person whose death occurs in the State shall not be buried, cremated, deposited in a vault or otherwise disposed of or removed from or into any registration district, or be temporarily held pending further disposition, more than 72 hours after death unless a permit for burial removal or other disposition shall have been properly issued by the registrar of the district. Whenever it is practicable, no such burial or removal permit shall be issued by any registrar until a complete and satisfactory certificate of death has been filed with him. If, however, a dead body is transported from one State into a district in another State, the transit or removal permit issued in accordance with the law of the place of death has the force of a burial permit. It is frequently required that the certificate of death shall be of the standard form recommended by the United States Bureau of the Census and adopted by the American Public Health Association and shall contain—(1) the place of death, including the State, county, township, village or city, (2) the full name of the decedent. If an unnamed child, the surname preceded by "unnamed", (3) sex and colour or race—as white, black, mulatto, Indian, Chinese, Japanese, etc., (4) conjugal condition, whether single, married, widowed or divorced, (5) place and date of birth, including year, month and day, (6) age in years, months and days, (7) name of father and maiden name of mother, (8) birth-place of mother, (9) occupation, (10) signature and address of informant, (11) date of death, year, month and day, (12) statement of medical attendance on decedent, fact and time of death, including time last seen alive, (13) cause of death, (14) signature and address of physician or official making medical certificate, (15) place and date of burial or removal, (16) signature and address of undertaker, (17) official signature of registration with date when certificate was filed and registered number.

The personal statistical particulars should be authenticated by the signature of the informant, who should be the nearest of kin or other competent person acquainted with the facts. The statement of the facts relating to the disposition of the body shall be signed by the undertaker. The medical certificate shall be made and signed by the legally qualified physician, if any, last in attendance on the deceased. The cause of the death must generally be stated so as to show the disease or sequence of causes resulting in the death.

In regard to the registration of still-born children, in some jurisdictions the law provides that the child shall be registered as a birth and also as a death, and separate certificates of birth and death shall be filed with the registrar, in others, the still-born child is merely registered as a death. A certificate is not required for a child that has not advanced to the fifth month of inter gestation.

If a death occur without medical attendance, it is the duty either of the undertaker or other person who learns of the death to notify the local health officer. The latter immediately investigates and certifies the cause of death. If, however, he has reason to believe that the death may have been due to unlawful act or neglect, he refers the case to the coroner for his investigation and certification. The undertaker must file the certificate of death with the local registrar, and obtain a burial or removal permit prior to any disposition of the body, which he delivers to the person in charge of the place of burial.

Presumption of Death.—The fact of death may, as a general rule, be proved by presumptive evidence. An unexplained absence of seven years at common law raised a presumption of death. This is still the period in most jurisdictions in this country, though a few have by statute adopted a shorter period, e.g., five years in Arkansas, and five years in Indiana for the sole purpose of

authorizing the administration of an estate. Death may in some cases be presumed from the facts surrounding the disappearance indicating death within a shorter time than seven years. The English rule prevails in the United States that the presumption is of the fact of death only and not of the time of death. There are some cases, however, in which death has been presumed to have occurred at the expiration of the seven year period.

Survivorship—In the absence of circumstantial evidence, in the case of a common disaster, there is as a general rule no presumption as to survivorship. In some States, however, there are codes embodying certain presumptions as to survivorship. Otherwise, the law will treat the case as one to be established by evidence, and the burden is placed on him who claims survivorship.

DEATH, BIOLOGICAL ASPECTS OF The life cycle of individual multicellular organisms standing relatively high in the scale of organic specialization, as for example, a fly, a bird or a man, is typically divisible into five biologically differentiated, and usually distinct, phases as follows: (a) The formation of the *zygote*, which is the individual, by the union of ovum and spermatozoon in the process called fertilization. The life-history of the individual is a distinct and biological entity, begins with this event. (b) The period of development and growth, which has two sub-phases, commonly designated respectively as embryonic or foetal, and post embryonic or post natal. The duration of this growth phase of the life cycle varies widely in different organisms, as from 8 to 10 days in the fruit fly, *Drosophila*, to more than 20 years in man. This phase comes normally to an end in most forms of higher animal life, and is succeeded by (c) the phase of adult stability, in which no marked changes are observable either in the direction of growth or degeneration. This phase is the "prime of life" in common parlance. Its duration in time is again widely variable. Sooner or later the individual can

The Cycle of Life—In the cycle of individual life is outlined, the most significant phases biologically are obviously (b) growth and (d) senescence. Phases (b) and (c) (fertilization and death) are the terminal events of the important periods (b) and (d). Phase (c) is transitional between (b) and (d), and may be wholly absent, as when obvious senescent changes follow immediately upon the cessation of obvious growth. Indeed it is doubtful if phase (c) has theoretically any place in the life cycle at all. Perhaps in cases where a stable adult plateau in the middle of the cycle seems to exist, it merely means that the changes of growth or of senescence are proceeding at too slow a rate to be observable by the relatively crude methods available.

In the case of the human species phases (b), (c), and (d) are rather definitely and precisely limited by the biological phenomena of birth, puberty (precisely established in the female by the onset of menstruation, or *menarche*), the ending of the capacity to reproduce (marked in the female by the cessation of menstruation, or *menopause*) and its diminution to statistically insignificant proportions in the male at about the same age), and death. Pearl has shown (*The Natural History of Population*, 1939) that the average age at menarche, for large samples covering many different countries and peoples, is very close to 15 years, and that the average age of menopause for similarly representative samples is between 47 and 48 years. So, in round figures, human life after birth can be divided into three periods: (1) *The pre-reproductive period* of infancy and childhood, extending from birth to about 15 years of age. In this period the individual is incapable of self-maintenance or support on its own unaided resources, as well as of reproduction. (2) *The reproductive period*, extending from about 15 to about 50 years. In this period of life the work that supports the human socio-biological structure is mainly done, as well as the reproducing that continues the species. (3) *The post-reproductive period*, extending from about 50 years to the end of life. In this period the old, besides being incapable of reproduction to any statistically significant degree, are in large part dependent for their support upon the work done in the middle (reproductive) period of life, either by themselves with a concomitant saving for old age of the products of their efforts, or by others.

When statistics of population are arranged according to this threefold age classification a striking regularity or rule may be observed all over the world. This regularity may be stated as follows. Very generally just about one half of the whole living population falls in the middle age group (15-49 years inclusive), while the other half is made up of the young (0-14 years inclusive) and the old (50 years and over) together, these two latter groups standing statistically in a compensatory relation to each other. In populations where there is a high proportion in the 0-14 year group there is a correspondingly small proportion in the 50 year and over group. Examples of this relationship are shown in the following table of the populations of 20 countries.

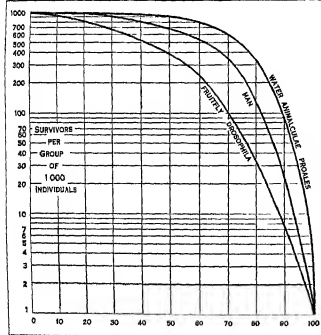


FIG. 1.—SURVIVAL RATES FOR MAN, A FRUIT FLY (*DROSOPHILA*) AND WATER ANIMALCULA (*PROALES*) AT CORRESPONDING AGES.

The lower figures are the biologically equivalent life spans represented as equal and divided into 100 units.

be observed to have passed definitely into the next phase of the life cycle, which may be designated (d) the period of senescence. This phase is characterized by a progressive waning in the intensity of the vital processes generally, accompanied by regressive and degenerative changes in the structures of the body. The duration in time of this portion of the life-cycle again varies greatly, but ultimately, in all the more highly specialized organisms, the life of the individual, as such, comes to an end with the terminal event of the cycle (e) death. By this term is designated the cessation of all vital capacity.

| Country | Year | Percentage of living population aged | | |
|--|------|--------------------------------------|-----------|---------|
| | | 0-14 YRS | 15-50 YRS | 50+ YRS |
| Brazil | 1950 | 42.7 | 48.3 | 8.0 |
| Cuba | 1940 | 42.3 | 47.5 | 10.1 |
| Turkey | 1915 | 41.3 | 45.5 | 13.1 |
| India (excluding some provinces) | 1931 | 39.0 | 50.0 | 0.7 |
| Mexico | 1930 | 39.2 | 49.2 | 10.6 |
| Chile | 1939 | 37.2 | 51.2 | 11.5 |
| U.S.S.R. (including Asiatic territories) | 1926 | 37.2 | 49.0 | 13.1 |
| Japan | 1929 | 35.7 | 47.5 | 14.3 |
| Ireland | 1918 | 31.1 | 50.0 | 17.0 |
| Canada | 1931 | 31.7 | 51.0 | 16.6 |
| Union of South Africa (whites only) | 1916 | 31.2 | 51.5 | 16.3 |
| Italy | 1911 | 30.7 | 50.0 | 19.4 |
| United States of America | 1915 | 25.1 | 53.1 | 21.7 |
| Eire | 1926 | 29.3 | 48.4 | 22.4 |
| Norway | 1930 | 28.4 | 51.4 | 20.1 |
| Australia | 1911 | 27.5 | 53.5 | 19.1 |
| Germany (excluding Saar Territory) | 1911 | 26.2 | 51.0 | 21.8 |
| Finland and Wales | 1937 | 21.8 | 53.6 | 24.6 |
| France | 1931 | 21.0 | 51.4 | 25.7 |
| Sweden | 1935 | 22.2 | 54.4 | 23.4 |
| Averages | | 32.9 | 50.8 | 17.0 |

(This table was computed mainly from official census data given in the *Statistical Yearbook of the League of Nations 1936*.)

From this table it is seen that countries with high rates of reproduction, and consequently relatively high proportions of their people in the 0-14 year or pre reproductive phase (such as Brazil, Cuba and Turkey) have but a small proportion of persons over 50 years of age in their populations. On the other hand countries reproducing only sparsely (such as England, France, and Sweden) have a relatively high proportion of old people in the population, but only a low proportion aged 0-14 years.

It has been alleged that man is unique among living things in having a disproportionately long, and from one point of view biologically useless, post reproductive phase in the life cycle. This is not so. Other species are similar to man in this respect. Thus Pearl and Miner (*Mém. Musé. Roy. d'Hist. Nat. de Belgique*, 2 ser., fasc. 3, 1936) showed that the females of a moth (*Acrobasis caryae*, the pecan nut case borer) spend an average of about 25% of their total imaginal life span—which in chronological time lasts only 6 to 8 days on the average—in the post reproductive phase, as compared with 26% as an average for human females.

Senescence and Death—The special problem of the biology of death is the analysis and elucidation of phases (d) and (e) of the life-cycle, senescence and death. As a result of investigations in this special field of general biology certain broad generalizations are now possible. The more important of these will now be discussed.

Time Duration—The time duration of the entire individual life-cycle varies enormously, both between different forms of life, species, genera, families, etc., and also between different individuals belonging to the same species. Thus the maximum duration of life of the rotifer, *Proleis decipiens*, is eight days (Noyes). At the other extreme there are other authentic records of individual reptiles living to as much as 175 years. Among mammals man is, on the average, the longest lived, with the elephant as his nearest competitor for this position.

Zoological Groups—The differences between distinct groups of animals (species, genera, families, etc.) in respect to the length of the life-span stand in no generally valid, orderly relationship to any other broad fact now known in their structure or life history. In spite of many attempts to establish such relationships every one so far suggested has been upset by well known facts of natural history. Thus it has been contended that the duration of an animal's life is correlated with its size, in the sense that the larger the animal the longer its life. But plainly this has no general validity. Men and parrots are smaller than horses, but have life spans of much greater length.

Individual Differences—The differences between individuals of the same species in the duration of their lives are distributed in a lawful and orderly manner, in marked contrast to the apparently haphazard character of the inter group variation in length of life-span just discussed. The individual variation in the duration of life is capable of exact mathematical description, and, indeed, its treatment constitutes a special branch of mathematics, known as actuarial science. It has been shown by R. Pearl and his students that if the life of different animals, such as the rotifer, *Proleis*, the fly, *Drosophila*, various other insects and man, be measured not in absolute time units of years or days, but in terms of a relative unit, namely a hundredth part of the biologically equivalent portions of the life span in the several cases, then the distribution of individual variation in duration of life, or the distribution of mortality in respect to age, or, in short, the life-curve, is quantitatively similar in these widely different forms of life almost to the point of identity. This is illustrated in fig. 1.

These facts suggest that the observed differences between individuals in duration of life are primarily the result of inborn differences in their biological constitutions (their structural and functional organizations) and only secondarily to a much smaller degree, the result of the environmental circumstances in which their lives are passed.

Inheritance—This inference is supported by the further fact that the differences between individuals which find expression in varying degrees of longevity, or duration of life, are definitely inherited. It has been proved experimentally by cross breeding long lived and short lived strains of the fruit fly *Drosophila*

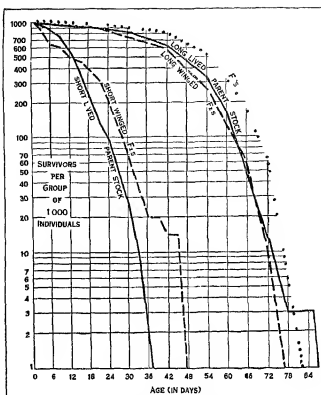


Fig. 2.—SHOWING HOW LONGEVITY IS INHERITED AMONG FRUIT FLIES WHEN A LONG LIVED IS CROSSED WITH A SHORT LIVED STOCK.

The first generation of progeny (dotted line F_1) is longer lived than either parent stock and when inbred produces progeny of two kinds (F_2): a short winged which is short lived and a long winged which is long lived. The Mendelian laws of heredity are thus seen to hold in the case of these fruit flies for longevity which is shown to behave like a definitely inheritable quality.

melanogaster (Hyde, Pearl and his students, Parker and Gonzalez). The results of such an experiment are shown in fig. 2.

In the first generation (F_1) from such a cross the progeny exhibit a life curve essentially like that of the long-lived parent stock, but with a slightly greater average duration. If now these F_1 individuals are bred together *inter se* there are produced in the second cross bred generation (F_2) two kinds of individuals, one of which (long-winged) has a life curve like the original long-lived parent stock, while the other (short-winged) resembles in duration of life the original short-lived parent stock. In addition to these experiments along Mendelian lines, it has been shown that there can be isolated from a general population of wild *Drosophila* inbred strains showing definite and permanent innate differences in average longevity. The conclusion that individual differences in life duration are fundamentally an expression of hereditary differences between individuals is firmly established.

The importance of inheritance in determining human longevity has been demonstrated from various different lines of approach. In this field Karl Pearson and Alexander Graham Bell were pioneers. Pearl and Pearl studied intensively the ancestry of 365 persons living at ages of 90 and above about whose six immediate ancestors (2 parents and 4 grandparents) there was complete information. They compared with this group 136 persons chosen at random from the general population, all of whose 6 immediate ancestors were dead, and at known and recorded ages. This comparison group had an average living age of 48.75 years, and contained 29 persons over 60 at the time of observation, 5 over 70, and 1 over 80. The average age of the group was almost 16 years higher than that of the living white population of the United States in 1930.

Fig. 3 shows how the ancestry of the nonagenarian and centenarian group compared with the group of ordinary persons in respect of average longevity.

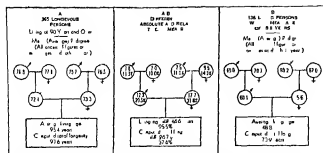


FIG 3—INFLUENCE OF IMMEDIATE ANCESTORS UPON AVERAGE LONGEVITY

From this diagram it is seen that, on the average, each single immediate ancestor, father, mother, grandfather or grandmother, of the extremely longevous persons of panel A on the left side, was longer lived than the corresponding ancestor of the ordinary persons of panel B on the right side. Thus the fathers of the longevous died at the average age of 72 1/2 years. This was 12 1/2 years, or over 20%, older than the average age of the fathers of the panel B folk at the right end of the chart. The central panel, A B, gives the differences, in absolute numbers of years (upper figures in each set sign) and as percentages of the panel B means, for each category of the six immediate ancestors. The "computed total longevity" figures for the individuals observed in the rectangles at the bottom are the resultants of adding to the mean number of years the A and B individuals had already lived at the time of observation the expectations of life proper to those ages, as given in a standard life table.

From this chart two important results emerge regarding the influence of heredity upon longevity, namely:

(a) People who achieved extreme longevity had immediate ancestors (parents and grandparents) who were, on the average, definitely longer lived than the corresponding ancestors of the general run of the population. This was true without exception for each particular category of immediate ancestors.

(b) This hereditary influence promoting longevity was between two and three times as great relatively for parents as it was for grandparents.

A specific study was made as to how each of the parents of the extremely longevous persons was bred relative to longevity, as compared with the parents of the general run of folk. This led to the results shown in fig 4. In this study an individual who died under 50 years of age was regarded as short lived, one who died between 50 and 69 as average or mediocre in life duration, and one who died at 70 or over as long lived. Fig 4 shows the percentages of the fathers and mothers respectively that had (a) both of their parents long lived (shown by the solid black portion of each bar), (b) one parent long lived and the other mediocre or short lived (shown by the cross-hatched portion of each bar), and (c) neither of their parents long lived (shown by the white portion of each bar).

The picture presented by fig 4 is precise and striking. The nonagenarians and centenarians were produced by parents who were themselves bred out of wholly longevous parentage in more than half of all the cases observed—a markedly higher proportion than that shown by the parents of the general population sample. At the other end of the genetic scale the opposite is true. Fewer than half as many proportionally of the nonagenarians and centenarians as of persons generally were produced by parents who themselves had no longevous parentage whatever. There can be no question or doubt that breeding was of great importance in the production of these nonagenarians and centenarians.

Actual studies have also demonstrated the importance of heredity in the achievement of long life. This fact has been equally established by life tables for parents of children who died at specified ages, and by life tables of children of parents having specified degrees of longevity. For example such studies have shown that the mean-after-lifetime of fathers of children dying (or living) at ages of 80 and over is about 26% greater

at age 20, 43% greater at age 40, 75% greater at age 60, and 58% greater at age 80, than the mean-after-lifetime at the same ages of fathers of children dying under 5. The corresponding excesses in expectation of life of mothers were 27% at age 20, 27% at age 40, 36% at age 60, and 23% at age 80. Throughout the whole life-span the parents of the very long lived children appear to be persons of superior biological constitution, as evidenced by their ability to keep on living.

Similar studies have shown that the sons of fathers dying (or living) at ages of 80 years and over have a mean after-lifetime about 13% greater at birth than that of the sons of fathers dying between 50 and 79 years of age, and 22% greater than that of sons of fathers dying under 50 years of age.

Further evidence for the innate constitutional superiority of the longevous was afforded by Pearl's and Raenkhim's (*Human Biology*, vol 4, 1932) analysis of the causes of death of nonagenarians on the basis of the official records of the Census Bureau. That analysis led to the conclusion that nonagenarians are a selected lot of people. They are the ultimate survivors after all the rest of mankind has gone, unable to meet the vicissitudes of life and keep on living. Nonagenarians and centenarians come to be such because they have organically superior constitutions, resistant to infections, soundly organized to function efficiently as a whole organism and keep on doing it for a very long time. Observations on mortality at ages have indicated that throughout life infections and other harmful environmental forces were, on the whole, tending to take off the weaker and leave the stronger. Medical knowledge and skill, improved sanitation and better conditions of life generally have been able to prevent an increasingly larger amount of premature mortality before age 50. Especially have these agencies been able to reduce the lethal effects of infections, or at least to postpone to a later part of the life span their fatal action. But ultimately there is left a group of extremely old people, for whom on the whole infections have no particular terrors. In all the early part of their lives they have been able successfully to resist infections, and to a remarkable degree still are in extreme old age. These people eventually die. But a great many of them die, not because the noxious forces of the environment kill them, but because their vital machinery literally breaks down, and particularly that important part of it—the circulatory system.

Natural Death a Novelty—Neither senescence nor natural death is a necessary, inevitable consequence or attribute of life. Natural death is biologically a relatively new thing, which made its appearance only after living organisms had advanced a long way on the path of evolution. The evidence supporting this conclusion is manifold, and may be considered under several heads: (a) Various single-celled organisms (Protozoa, *q v*) prove, under critical experimental observation, to be, in a certain sense, immortal. They reproduce by simple fission of the body, one individual becoming two, and leaving behind in the process nothing corresponding to a corpse. The brilliant work of Woodruff and his students, in particular, has demonstrated that this process may

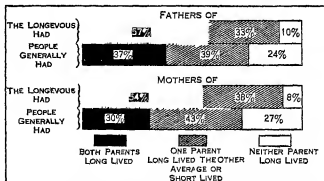


FIG 4—THE PERCENTAGE DISTRIBUTION RELATIVE TO THE NATURE OF THE PARENTAL MATINGS PRODUCING THEM OF THE FATHERS AND OF THE MOTHERS OF (A) AN EXTREMELY LONGEVIOUS GROUP (NONAGENARIANS AND CENTENARIANS) AND (B) A SAMPLE OF PEOPLE GENERALLY

go on indefinitely, without any permanent slackening of the rate of cell division corresponding to senescence, and without the intervention of a rejuvenating process such as conjugation or endomixis, providing the environment of the cells is kept favourable (b) The germ cells of all sexually differentiated organisms are, in a similar sense, immortal. Reduced to a formula we may say that the fertilized ovum (united germ cells) produces a soma and more germ cells. The soma eventually dies. Some of the germ cells prior to that event produce somata and germ cells, and so on in a continuous cycle which has never yet ended since the appearance of multicellular organisms on the earth (c) In some of the most lowly organized groups of many celled animals or *Metazoa*, the power of multiplication by simple fission, or budding off of a portion of the body which reproduces the whole, is retained. This asexual, or agamic, mode of reproduction occurs as the usual, but not exclusive, method in the three lowest groups of multicellular animals, the sponges, flatworms and coelenterates. More rarely it may occur in other of the lower invertebrates.

So long as reproduction goes on in this way in these multicellular forms there is no place for death. In the passage from one generation to the next no residue is left behind. Agamic reproduction and its associated absence of death also occur commonly in plants. Budding and propagation by cuttings are the usual forms in which it is seen. The somatic cells have the capacity of continuing multiplication and life for an indefinite duration of time, so long as they are not accidentally caught in the breakdown and death of the whole individual in which they are at the moment located.

(d) There is some evidence that in certain fish there is no occurrence of senility or natural death, but that instead the animal keeps on growing indefinitely, and would be immortal except for accidental death. The animal soma in such cases behaves like the root stock of a perennial plant. (For further discussion of this line of evidence see interesting correspondence by Geo. P. Buxton, in *Nature*, vol. LXX, 1925, *passim* and M. A. C. Hinton's monograph of the *Voies and Lignes* [British Museum, 1926], in which it is concluded that voles of the genus *Arvicola* "are animals that never stop growing and never grow old.") (e) The successful cultivation *in vitro* of the tissues of higher vertebrates, even including man himself, over an indefinitely long period of time, demonstrates that senescence and natural death are in no sense necessary concomitants of cellular life. Carrel and Ebeling, by transferring the culture at frequent intervals into fresh nutrient medium, have kept alive and in perfectly normal and healthy condition, a culture of tissue (see *Tissue Culture*) from the heart of a chick embryo for more than 25 years, i.e., for much longer than the normal life-span of the fowl. There is every reason to suppose that, by the continuation of the same technique, the culture can be kept alive indefinitely. The experimental culture of cells and tissues *in vitro* has now covered practically all of the essential tissue elements of the metazoan body, even including some of the most highly differentiated of those tissues. Nerve cells, muscle cells, heart muscle cells, spleen cells, connective tissue cells, epithelial cells from various locations in the body, kidney cells and others have all been successfully cultivated *in vitro*.

Potential Immortality.—It may fairly be said that the potential immortality of all essential cellular elements of the body either has been fully demonstrated, or has been carried far enough to make the probability very great, that properly conducted experiments would demonstrate the continuance of the life of these cells in culture to any indefinite extent. It is not to be expected, of course that such tissues as hair or nails would be capable of independent life, but these are essentially unimportant tissues in the animal economy, as compared with those of the heart, the nervous system, the kidneys, etc. Generalizing from results of tissue culture work of the last three decades, it is highly probable that all the essential tissues of the metazoan body are potentially immortal, when placed separately under such conditions as to supply appropriate food in the right amount, and to remove promptly the deleterious products of metabolism.

Death Among Multicellular Animals.—A fundamental reason why the higher multicellular animals do not live forever appears to be that in the differentiation and specialization of function of cells and tissues in the body as a whole, any individual part does not find the conditions necessary for its continued existence. In the body any part is dependent for the necessities of its existence, as for example nutritive material, upon other parts, or put in another way, upon the organization of the body as a whole. It is the differentiation and specialization of function of the mutually dependent aggregate of cells and tissues which constitute the metazoan body that brings about death, and not any inherent or inevitable mortal process in the individual cells themselves.

When cells show characteristic senescent changes it is perhaps because they are reflecting, in their morphology and physiology, a consequence of their mutually dependent association in the body as a whole,

| Deaths due primarily to organic breakdown or failure of | Mean age at death (years) | | Median age at death (years) | |
|---|---------------------------|-------------|-----------------------------|-------------|
| | Male | Female | Male | Female |
| 1 Alimentary tract and associated organs of digestion | 25.54 ± 0.6 | 28.4 ± 0.7 | 14.98 ± 0.8 | 14.93 ± 0.9 |
| 2 Respiratory system | 32.24 ± 0.5 | 32.57 ± 0.6 | 31.80 ± 0.7 | 28.24 ± 0.8 |
| 3 Skeletal and muscular system | 35.09 ± 0.9 | 37.90 ± 1.2 | 33.02 ± 0.6 | 35.96 ± 1.1 |
| 4 Endocrine system | 44.17 ± 0.8 | 44.15 ± 0.6 | 45.45 ± 1.0 | 43.42 ± 0.6 |
| 5 Skin | 46.73 ± 0.4 | 47.45 ± 0.6 | 53.47 ± 1.3 | 48.96 ± 0.9 |
| 6 Sexual system | 47.37 ± 0.2 | 42.47 ± 0.8 | 57.96 ± 0.9 | 49.40 ± 1.1 |
| 7 Nervous system | 40.11 ± 0.8 | 51.56 ± 0.9 | 54.01 ± 1.0 | 60.29 ± 1.2 |
| 8 Circulatory system and blood | 54.50 ± 0.7 | 54.25 ± 0.8 | 62.04 ± 0.6 | 62.14 ± 0.9 |
| 9 Excretory system (kidneys and associated organs) | 57.94 ± 0.7 | 54.24 ± 0.9 | 61.37 ± 0.9 | 57.50 ± 1.1 |

and not any necessary progressive process inherent in themselves. In other words, in the light of present knowledge, it seems necessary to regard senescence, in part at least, as a phenomenon of the multicellular body as a whole resulting from the fact that it is a differentiated and integrated morphologic and dynamic organization. This phenomenon is reflected morphologically in the component cells. But it apparently does not primarily originate in any particular cell because of the fact that the cell is old in time, or because that cell in and of itself has been alive, nor does it occur in the cells when they are removed from the mutually dependent relationship of the organized body as a whole and given appropriate physico-chemical conditions. In short, senescence appears not to be a primary or necessary attribute to the physiological economy of individual cells as such, but rather of the body as a whole.

Times of Death.—The different organ-systems of the body have characteristic times of breaking down and leading to death. These differences probably represent in considerable part different innate degrees of organic fitness of the different tissues, and organs, and also in part the degree of exposure of the different organ-systems to environmental stresses and strains. The table above, based upon mortality returns of the U.S. Registration Area in 1910, illustrates these differences. The figures tabulated are (a) the mean or average age at death, and (b) the median age at death (that is, the age so chosen that the same number of deaths occur below this age as the number occurring above it).

There are thus wide differences in the time of breakdown of the dif-

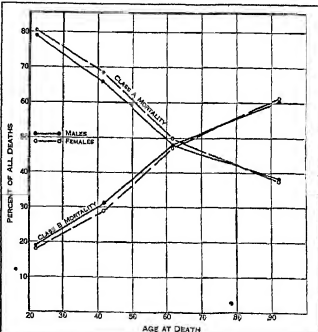


FIG 5.—THE TRENDS AT FOUR ADULT AGE PERIODS FROM AGE 20 TO ON TO THE END OF THE LIFE SPAN OF MORTALITY HAVING ITS PATHOLOGICAL LESIONS AND/OR CLINICAL MANIFESTATIONS ASSOCIATED WITH (A) ORGAN SYSTEMS NORMALLY IN DIRECT CONTACT WITH THE EXTERNAL ENVIRONMENT (PLUS EXTERNAL CAUSES EXCEPT SUICIDE) AND (B) ORGAN SYSTEMS NORMALLY NOT IN DIRECT CONTACT WITH THE EXTERNAL ENVIRONMENT (PLUS SENILITY.)

ferent organ systems, as reflected in mortality. The alimentary tract, on the average, "wears" rather less than half as long as the excretory system.

The structural and functional organization of the vertebrate body is such that certain organ systems come normally and regularly into direct and immediate contact with the external environment, while other organ systems do not but are, on the contrary, protected from such contact. On this basis the organ systems may be classified as follows:

| A | B |
|--|--|
| Organ systems coming into direct contact with the external environment | Organ systems not coming into direct contact with the external environment |
| Respiratory system | Circulatory system |
| Sex organs | Skeletal and muscular system |
| Kidney- and associated excretory organs | Nervous system |
| Alimentary tract | Endocrine system |
| Skin | |

The mortality of white persons in the U.S. Registration Area, during the five-year period 1923-27 inclusive has been subsumed under this A (unprotected) and B (protected) classification of organ systems by Pearl and Raenkhams, with the results shown in fig. 5.

It is seen from this diagram that, with advancing adult age the proportion of deaths due to causes having their pathological lesions or clinical manifestations associated with the organ systems of the body which are normally and regularly in direct contact with the external environment (Class A mortality) decreased, while the proportion having their pathological lesions or clinical manifestations associated with the organ systems normally protected from direct contact with the external environment (Class B mortality) increased.

Death and the Environment—It is a plain fact of experience that the environmental circumstances surrounding an organism may, in varying degrees, condition its duration of life. Thus complete starvation can induce death in a much shorter time than would have occurred in the absence of starvation. Similarly, there are many poisons that are lethal in appropriate doses. But, quite apart from such extreme and violent agents, the effect upon longevity of the never-ceasing changes in the normal environment is a matter of the first importance in reaching an understanding of the biology of death. The vast literature embodying the results of modern studies on nutrition and diet has shown, directly and indirectly, the role played by this factor in influencing life duration. Research in the field of nutrition has shown that qualitatively the diet of each particular kind of living organism must contain certain chemical elements and compounds in adequate amounts and proportions if life is to continue. Only within very narrow limits can there be any substitutions for these essentials. In some cases the requirements are absolutely rigid and obligatory. Clinical experience and investigation has shown that quantitatively there are limitations to the amount of food intake if the maximum potential longevity is to be realized. Too much food can shorten life as well as too little. The studies of Curt P. Richter have indicated that the normal upstate of animals lower in the evolutionary scale than man is a highly effective regulatory governor of food intake, as regards both quality and quantity. Rats given a free choice of chemically pure food elements tend to make for themselves a diet that is physiologically optimal.

In man critical studies by appropriate statistical and actuarial methods have thrown light upon the relation between longevity and certain widespread environmental circumstances. Evidence has been accumulated to show, for example, that the moderate consumption of alcoholic beverages is not significantly associated statistically with differences

cycle, could be prolonged up to as much as 6 to 7 times the normal expectation for the amount of food available. Furthermore the amount of growth, however measured, was increased as compared with the normal for the same amount of available food. Other experimental studies on various lower animals have shown that partial starvation markedly increased the duration of life.

Senescence—Many theories of senescence have been advanced. No one of them can be regarded as entirely satisfactory or as generally established by the evidence. Most of them suffer from the logical defect of setting up some particular observed attribute or element of the phenomenon of senescence itself, such as prothymic, hysterics, slowing rate of metabolism (many, essentially only reduced activity), etc., as the cause of the whole. More experimental work on the problem is essential, in particular in the direction of producing, at will and under control, the objective phenomenon of senility irrespective of the age of the organism and conversely preventing the appearance of the phenomena in old animals.

Longevity—The literature on the subjects treated in this article is widely scattered in biological, medical and statistical journals and appropriate treatises. The following books summarize the field: C. M. Child, *Senescence and Rejuvenescence* (1915), E. Korschelt, *Lebensdauer, Alter und Tod* (1922), R. Pearl, *The Biology of Death* (1922), T. Brailford Robertson, *The Chemical Basis of Growth and Senescence* (1923), R. Pearl, *Studies in Human Biology* (1924), *The Role of Living* (1928), R. Pearl and Ruth D. Pearl, *The Ancestry of the Long-lived* (1934), L. I. Dublin and A. J. Lotka, *Length of Life: A Study of the Life Table* (1936), Louis I. Dublin and H. H. Marks, "Inheritance of Longevity," *Reports, Association of Life Insurance Medical Directors* (Oct. 1941), E. V. Cowdry (Editor), *Problems of Aging: Biological and Medical Aspects* (1942) (R. PL.)

DEATH RATE Since communities vary in numbers of population, it is the practice to compare their death statistics in the form of death rates per 1,000 of population. Thus there were 1,444,337 deaths reported in the U.S. during 1948, since the population for that year was estimated to have been 146,113,000 (excluding armed forces overseas), the death rate was 9.9 per 1,000 of population. In England and Wales, the death rate in 1948 was 10.8 per 1,000 of population. The death rate computed simply as the ratio of the total deaths in a community within a calendar year to its total population living during the same period is known as the crude annual death rate.

Age, Sex, and Race Incidence—Death rates may be computed specifically for each sex and age, and also for each race living in the community. Thus, among white persons in the United States, the death rate during 1948 was 9.7 per 1,000, while among nonwhites it was appreciably higher, namely 11.3 per 1,000. The death rate among males is higher than that among females in most countries of the western world. For example, in the United States during 1948 there were 11.2 white male deaths per 1,000 white males living while the figure for white females was 8.3 per 1,000. The corresponding death rates in England and Wales for 1947 were 13.6 per 1,000 males and 11.3 per 1,000 females.

When the number of deaths occurring at a specific age within a calendar year is divided by the number living at that age, the result obtained is an annual age specific death rate. There is a

TABLE I—Average Annual Death Rates per 1,000 Total Population in Certain Countries for the Period 1935 to 1948

| Country | Death rates per 1,000 | Country | Death rates per 1,000 |
|-------------------|-----------------------|-----------------------|-----------------------|
| North America | | Europe (cont.) | |
| United States | 10.0 | Ireland | 13.7 |
| Canada | 13.1 | Ireland Northern | 12.1 |
| Mexico | 9.4 | Italy | 11.3 |
| Panama | 9.7 | Luxembourg | 1.3 |
| South America | | Netherlands | 8.0 |
| Argentina | 9.7 | Norway | 9.1 |
| Chile | 9.7 | Portugal | 11.6 |
| Colombia | 15.6 | Rumania | 19.6 |
| Peru | 11.4 | Sweden | 12.6 |
| Venezuela | 14.1 | Spain | 11.9 |
| Europe | | Switzerland | 11.1 |
| Austria | 12.8 | Asia | |
| Belgium | 13.1 | Ceylon | 16.6 |
| Bulgaria | 13.1 | India | 17.8 |
| Czechoslovakia | 12.6 | Japan | 14.8 |
| Denmark | 9.5 | Israel (Jews) | 6.7 |
| England and Wales | 11.4 | Israel (Moslems) | 15.6 |
| Finland | 11.7 | Other countries | |
| France | 12.8 | Australia | 9.0 |
| Germany | 11.4 | New Zealand | 9.4 |
| British zone | 11.0 | Union of South Africa | |
| French zone | 12.5 | (Europeans) | 8.7 |
| Hungary | 12.6 | | |

*Average for 1945 and 1946. †Average for 1935 and 1937. ‡Average only

rates are standardized. The standardized death rate of a community is the death rate which would prevail in the community if its population had the age distribution of some suitably selected standard population. The actual operation of computing a standardized death rate consists in (1) multiplying the age-specific death rates of the community by the number of persons at corresponding ages in the standard population, (2) summing the resulting products for all ages, (3) dividing the sum so obtained by the total population of the standard. The result is the standardized death rate. The process may be extended to standardize death rates for variations in the sex and colour constitution of communities. Standardized death rates are not always available and it accordingly becomes necessary to make mental allowance for the extraneous effects of age, sex and racial composition of communities whose crude death rates are being compared.

International Comparisons.—The death rates of the United States and of England and Wales compare very favourably with those for most countries of the world. Among the few countries with lower death rates during the period 1946-48 were Canada, with a death rate of 9.4 per 1,000, Denmark, 9.5, the Netherlands, 8.0, Norway, 9.1, Australia, 9.9, and New Zealand, 9.4. The following countries, among others, experienced death rates of 15 per 1,000 or more: Mexico, 17.3, Chile, 17.1, British India, 17.5, and Ceylon, 16.6. In addition to these countries, there are many others with poor health conditions which do not compile their death statistics. The foregoing death rates, and those for several other countries, are shown in Table I.

Trend.—There has been a steady decrease in the death rate in

most western countries since about the middle of the 19th century, the improvement has been particularly marked since 1900 (see Table II). Thus, in England and Wales, the crude death rate from 1851 to 1870 was, on the average, somewhat more than 22 per 1,000, while during the decade 1901-1910 it averaged 16.9 per 1,000. The downward movement continued to a low of 10.8 per 1,000 in 1948. In the United States, the death rates per 1,000 fell from an average of 15.7 during 1901-10 to a record low of 9.7 in 1949. France experienced a decline in the death rate from a level of about 24 per 1,000 during 1851-80 to only 12.2 in 1948. In Germany, the drop was from about 27 per 1,000 during 1851-80 to a level of about 13 per 1,000 after 1946. A more accurate picture of changes in mortality conditions with lapse of time may be obtained from a comparison of age-specific death rates. A comparison of this kind inevitably shows that the greatest relative improvements were at the youngest ages, while relatively little change in death rate had taken place at the older ages. Thus, in the United States the death rate in the first year of life in 1901 was 124 per 1,000, while in 1948 it was only a little less than 32 per 1,000. At age 20, the death rates per 1,000 were 5.89 in 1901 and 1.49 in 1948, while at age 50 they were 14.59 and 9.33 respectively, at age 70, the corresponding figures were 56.41 and 45.40.

Marital Status.—When marital status is taken into consideration, it is usual to find, in western countries, that the death rates are lowest among the married and highest for the widowed and divorced, while those for the single fall in between. An exception to this general situation is found at the early childbearing ages where the risks of maternity among married women are sufficient to bring their death rate to a level about that for the single widowed or divorced women of the same ages. The lower death rates of the married as compared to those of the single at the same ages may be ascribed in part to the stabilizing influence of marriage, which is conducive to longevity, but also in part to the fact that persons in indifferent health may thereby be deterred from marrying. Death rates per 1,000 for the United States, 1940, typify the differentials according to marital status: at ages 20 to 24 the rate for married white women was 1.7 and that for the single women was 1.5, at 45 to 54 the rates were 7.0 for the married, 7.9 for the single and 9.3 for the widowed. Among white men, the death rates per 1,000 at ages 25 to 34 were 2.2 for the married and 4.0 for the single, at 45 to 54 they were 9.8 for the married, 16.2 for the single and 19.2 for the widowed.

Occupation.—There is a distinct gradation in the death rates in passing from the lowest to the highest social economic classes of a community. In a study based upon the United States census of 1930 and death statistics for ten states during that year, it was found that the death rates per 1,000 males between the ages 15 to 64 years in the several social economic classes were as follows: unskilled workers, 13.1, semiskilled workers, 9.9, skilled workers, 8.1, clerks, proprietors, managers and officials, 7.4, professional men, 7.0, and agricultural workers, 6.2 per 1,000. There is evidence that variation in death rates of men according to social-economic class arises primarily from the environment associated with their occupation and that the occupational risks involved have only a relatively small influence.

Causes of Death.—Death rates may also be computed according to the cause of death. Thus, the death rates for the ten leading causes of death per 100,000 total persons in the United States during 1948 were, in order of rank: heart disease, 323, cancer, 135, cerebral haemorrhage, 90, accidents, 67, diseases of early infancy and congenital malformations, 55, nephritis, 53, pneumonia and influenza, 39, tuberculosis, 30, diabetes mellitus, 26, and arteriosclerosis, 19. These ten causes accounted for 85% of the deaths for all causes.

There were striking changes in the death rates for certain causes of death in the United States after 1900. For example, the death rate for typhoid fever was 36 per 100,000 in 1900, but only 0.2 per 100,000 in 1948. For tuberculosis, the decline was from 201 to 30 for the corresponding period, in the case of diarrhoea and enteritis the death rate dropped from 133 to 6

TABLE II—Average Annual Deaths per 1,000 Total Population in Selected Countries for Specified Periods and Years 1901-1948

| Period or Year | United States | Canada | England and Wales | France | Germany | Italy | Sweden |
|----------------|---------------|--------|-------------------|--------|---------|-------|--------|
| 1851-60 | * | * | 27.3 | 24.0 | 26.4 | * | 21.7 |
| 1861-70 | * | * | 22.5 | 21.7 | 26.9 | * | 20.3 |
| 1871-80 | * | * | 21.9 | 21.0 | 27.7 | * | 19.3 |
| 1881-90 | * | * | 20.1 | 22.1 | 25.1 | 27.3 | 17.0 |
| 1891-1900 | * | * | 18.8 | 21.5 | 22.3 | 24.3 | 16.4 |
| 1901-10 | 15.7 | * | 16.9 | 20.4 | 18.3 | 27.6 | 12.0 |
| 1911-13 | 14.1 | * | 14.7 | 18.1 | 15.6 | 20.4 | 11.0 |
| 1914 | 11.6 | * | 14.9 | 18.8 | 16.0 | 17.9 | 12.8 |
| 1915 | 13.6 | * | 14.0 | 18.5 | 12.4 | 20.4 | 11.7 |
| 1920 | 14.0 | * | 15.7 | 17.5 | 19.9 | 19.7 | 13.6 |
| 1927 | 12.1 | * | 14.3 | 17.0 | 20.5 | 19.2 | 13.4 |
| 1928 | 12.1 | * | 13.2 | 17.0 | 19.3 | 18.5 | 16.0 |
| 1929 | 1.9 | * | 17.3 | 19.3 | 15.6 | 18.8 | 14.5 |
| 1930 | 11.1 | * | 14.0 | 17.1 | 15.1 | 18.8 | 13.3 |
| 1931-35 | 11.3 | 10.1 | 17.2 | 17.3 | 17.3 | 17.3 | 12.1 |
| 1936-39 | 11.8 | 11.1 | 17.1 | 16.8 | 17.8 | 16.0 | 12.1 |
| 1940-45 | 10.0 | 9.7 | 19.0 | 15.7 | 11.2 | 14.1 | 11.6 |
| 1946-49 | 11.0 | 9.8 | 19.4 | 15.2 | 12.0 | 11.8 | 11.7 |
| 1941-45 | 10.6 | 9.6 | 11.8 | 17.4 | 14.2 | 11.0 | 10.4 |
| 1946 | 10.0 | 9.1 | 11.5 | 11.3 | 11.1 | 12.1 | 10.4 |
| 1947 | 10.1 | 9.4 | 12.0 | 11.3 | 12.8 | 11.4 | 10.8 |
| 1948 | 9.9 | 9.3 | 10.8 | 12.2 | 11.7 | 10.5 | 9.9 |
| 1949 | 9.7 | 9.1 | 11.7 | 12.6 | * | 10.4 | 9.9 |

*Not available. †French zone.

TABLE III.—Average Length of Life in Certain Countries

| Country | Period | Average length of life—years | | Country | Period | Average length of life—years | |
|-------------------|---------|------------------------------|---------|-----------------------|---------|------------------------------|---------|
| | | Males | Females | | | Males | Females |
| America | | | | Europe (cont.) | | | |
| United States | 1900-02 | 48.33 | 51.08 | Ireland | 1910-11 | 59.05 | 61.03 |
| Whites | 1900-11 | 50.93 | 53.62 | Ireland North | 1910-11 | 57.8 | 59.2 |
| | 1910-11 | 50.38 | 53.23 | Italy | 1910-11 | 57.8 | 59.2 |
| | 1910-11 | 50.12 | 52.97 | Netherlands | 1910-11 | 57.8 | 59.2 |
| | 1910-11 | 50.07 | 52.90 | Norway | 1910-11 | 57.8 | 59.2 |
| | 1910-11 | 50.07 | 52.90 | Poland | 1910-11 | 57.8 | 59.2 |
| Non-whites | 1910-11 | 46.08 | 47.21 | Portugal | 1910-11 | 57.8 | 59.2 |
| | 1910-11 | 46.08 | 47.21 | Russia | 1910-11 | 57.8 | 59.2 |
| Canada | 1910-11 | 55.9 | 56.1 | Scotland | 1910-11 | 57.8 | 59.2 |
| Chile | 1910-11 | 40.7 | 43.1 | Spain | 1910-11 | 57.8 | 59.2 |
| Mexico | 1910-11 | 34.41 | 34.09 | Sweden | 1910-11 | 57.8 | 59.2 |
| Paraguay | 1910-11 | 30.34 | 30.46 | Switzerland | 1910-11 | 57.8 | 59.2 |
| Europe | | | | Asia | | | |
| Austria | 1910-11 | 54.47 | 58.53 | China (rural) | 1910-11 | 34.85 | 34.63 |
| Belgium | 1910-11 | 54.00 | 56.70 | India | 1910-11 | 30.01 | 26.56 |
| Bulgaria | 1910-11 | 45.03 | 48.04 | Japan | 1910-11 | 40.01 | 40.03 |
| Czechoslovakia | 1910-11 | 51.03 | 55.18 | | | | |
| Denmark | 1910-11 | 55.03 | 57.70 | Others | | | |
| England and Wales | 1910-11 | 49.10 | 47.18 | Egypt | 1910-11 | 35.04 | 41.48 |
| | 1910-11 | 48.53 | 51.38 | Australia | 1910-11 | 63.48 | 67.14 |
| Finland | 1910-11 | 50.15 | 54.40 | New Zealand | 1910-11 | 63.48 | 68.45 |
| France | 1910-11 | 54.6 | 56.1 | Union of South Africa | | | |
| Germany | 1910-11 | 54.86 | 57.81 | | | | |
| Hungary | 1910-11 | 49.00 | 50.80 | | | | |
| Iceland | 1910-11 | 60.00 | 60.00 | | | | |
| | 1910-11 | 60.00 | 60.00 | | | | |

*Not available

Preventive measures had practically eliminated diphtheria as a cause of death, its death rate fell from 43 in 1900 to 0.4 in 1948. On the other hand, many important causes of death had shown increases in their rates. Mortality from heart disease in 1948 was about 2½ times that in 1900. The death rate for cancer rose from 63 per 100,000 in 1900 to 135 in 1948. A large part of the increase in the death rates for heart disease and cancer may be attributed to the increase in proportion of older persons in the population and to improvement in diagnosis. The death rate per 100,000 from diabetes mellitus rose gradually from 10 in 1900 to 26 in 1948. Deaths from automobile accidents claimed 22 out of every 100,000 persons in 1948.

Average Length of Life—The average length of life, which is also known as the expectation of life at birth, is the number of years the average newly born baby may expect to live if the age-specific death rates remain constant as of the calendar year or period for which the figure is computed. The average length of life thus provides a composite measure of the age-specific death rates of a community independent of its age distribution. The superiority of this figure, over the standardized death rate, as a composite measure lies in the fact that it is independent of any arbitrarily chosen age distribution used as a standard.

The average length of life for white persons in the United States is much the same as that for England and Wales. In 1948, white males in the United States had an average length of life of 65.49 years and white females of 71.04 years. The corresponding figures for England and Wales in 1937, the latest year available, were 60.18 years for males and 64.40 years for females. For other countries see Table III.

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DEATH VALLEY, a depressed basin in Inyo county, Calif. The name commemorates the fate of a party of "forty-milers" who perished here, by thirst or by starvation and exposure. The exceedingly arid Death valley region lies immediately north of the Mohave desert and then stretches east from the Sierra Nevada, covering a large part of Inyo county and extending into Nevada.

The valley proper, which is some 50 mi long and on an average 20 to 25 mi broad from the crests of the enclosing mountain ranges, is below sea level and at its lowest point is 282 ft below sea level. This is the lowest point on the continent and in a direct line it is less than 80 mi E of Mt. Whitney, 14,494 ft high,

the highest peak in the U.S. The mountains about it are high and bare, and brilliant with varied colours.

The Amargosa river, entering the valley through a deep canyon at the south, disappears in the basin, leaving the surface crusted with white salts. The fact that this limited region is the final area of concentration for a very extensive drainage system is thought to explain the extent and supposed depth of the deposits of salt, borax and nitrate of soda found in the basin.

Death valley is one of the hottest regions in the world. The minimum daily temperature in summer is rarely below 70° F (in the shade), the maximum may, for days in succession, be as high as 120°, and the U.S. weather bureau has recorded an extreme of 134°.

See W. C. Mendenhall, "Some Desert Watering Places in Southeastern California and Southwestern Nevada," U.S. Geological Survey Water Supply Paper No. 224.

DEATH WARNING, a term used in psychical research for an intimation of the death of another person received by other than the ordinary sensory channels, i.e., by (1) a sensory hallucination or (2) a massive sensation, both being of telepathic origin. (See TELEPATHY.)

Both among civilized and uncivilized peoples there is a widespread belief that the apportion of a living person is an order of death.

DEATHWATCH, a popular name given to insects of two distinct families which burrow and live in old furniture, and produce a mysterious ticking sound vulgarly supposed to foretell the death of an inmate of the house. The name is often applied to two small beetles *Xestobium rufovillosum* and *Anobium punctatum* (family Anobiidae) but belongs more properly to the former insect. The sound is a sexual call and is produced by the beetle striking the front of the head upon the surface on which it is standing.

Certain book-lice (order Psocoptera) are sometimes known as lesser deathwatches, but the ability of such minute soft insects to produce audible sound is doubtful. The names *Atropos pulsatoria* and *Troctes divinatorius*, given to two of the common species, bear witness to the superstition regarding the fateful significance of the sound.

DE BARY, HEINRICH ANTON (1831-1888), German botanist, was born on Jan. 26, 1831, at Frankfurt-on-Main. He studied medicine at Heidelberg, Marburg and Berlin, and in 1853 settled at Frankfurt as a surgeon. In 1854 he became Privatdozent for botany in Tübingen, and professor at Freiburg in 1855, migrating to Halle in 1857, and in 1872 to Strasbourg, where he was the first rector of the university, and where he died on Jan. 19, 1888.

Although one of his largest and most important works was on the *Comparative Anatomy of Ferns and Phanerogams* (1877), and notwithstanding his admirable acquaintance with systematic and field botany generally, de Bary will always be remembered as the founder of modern mycology.

This branch of botany he completely revolutionized in 1866 by the publication of his celebrated *Morphologie und Physiologie der Pilze*, etc., a classic which he rewrote in 1884, and which had a world-wide influence on biology. His clear appreciation of the real significance of symbiosis and the dual nature of lichens is one of his most striking achievements, and in many ways he showed powers of generalizing in regard to the evolution of organisms, which alone would have made him a distinguished man.

It was as an investigator of the then mysterious fungi, however, that de Bary stands out first and foremost among the biologists of the 19th century. He not only laid bare the complex facts of the life-history of many forms—e.g., the Ustilaginaceae, Peronosporaceae, Uredineae and many Ascomycetes—treating them from the developmental point of view, in opposition to the then prevailing anatomical method, but he insisted on the necessity of tracing the evolution of each organism from spore to spore, and by his methods of culture and accurate observation brought to light numerous facts previously undreamt of.

One of de Bary's most fruitful discoveries was the true meaning of infection as a morphological and physiological process, which he traced in *Phytophthora*, *Cystopus*, *Puccinia* and other

Fungi, and thereby demonstrated the significance of parasitism. He showed wherein lay the essential differences between a parasite and a saprophyte.

These researches led to the explanation of epidemic diseases, de Bary's contributions to which are well seen in his classical work on the potato disease in 1861. They also led to his discovery of *heteroecism* (or *metoecism*) in the Uredineae, the truth of which he demonstrated in wheat rust experimentally (1863). He described the phenomena of sexuality in Peronosporae and Ascomycetes—*Eurotium*, *Erysiphe*, *Peziza*, etc., and established the existence of parthenogenesis and agamy on a firm basis. He did much work on the Chytridiaceae, Ustilagineae, Exoascaceae and Phalloideae, as well as on the Myxomycetes, he contributed to algology in his monograph on the Conjugatae (1858) and investigated Nostocaceae (1863), *Chara* (1871), *Acetabularia* (1869), etc. In 1877 appeared his *Comparative Anatomy of Ferns and Phanerogams* (Eng trans 1884), and in 1885 his *Lectures on Bacteria* (Eng trans 1887).

Memories of de Bary's life will be found in *Bot. Centralbl.* (1888), xxv, 93, by Wilhelm, *Ber. d. d. bot. Ges.* vol. vi (1888) p. viii, by Rees, each with a list of his works, *Bot. Zeitung* (1889), vol. xlvii, no. 3, by Graf zu Solms-Laubach, *Allg. Deutsch. Bogen*, xlvii (1902).

DEBENTURES AND DEBENTURE STOCK. see COMPANY LAW

DEBORAH, the name of two women mentioned in the Old Testament (Heb for "bee") (1) Foster mother of Rebecca, buried under the "Oak of Weeping" below Bethel (Gen. xxv, 8). It has been suggested that this tree is connected with the "palm-tree of Deborah," between Bethel and Ramah (Judges iv, 5), the home of Deborah. (2) This latter is the famous prophetess and "judge," who, in company with Barak, son of Abinoam, delivered Israel from a Canaanite oppression.

Two narratives of this exploit have been preserved, an account in prose in Judges iv, and a descriptive poem in Judges v. They differ in one or two important details. The most obvious contrast is in the identity of the enemy overthrown. The prose narrative makes the enemy Jabin, king of Hazor, though a prominent part is played by his commander-in-chief, Sisera, who lived at Harosheth hagoyim. In the poem Jabin does not appear, and Sisera is an independent king. It is possible that the introduction of Jabin is due to the conflation of two traditions, one of which referred to Sisera, while the other was parallel to the story of the defeat of Jabin, king of Hazor, by Joshua (Josh. xi, 1-9) at the Waters of Merom. Another contradiction is to be found in the manner of Sisera's death. In Judges ch. iv he is murdered in his sleep, in ch. v he is struck down from behind whilst drinking a bowl of milk.

Assuming that the tradition preserved in ch. v is the older, we can do something to reconstruct the actual history of the events. Israel holds the wider parts of the country, the hills and the forests, but their settlements in the central range are cut off from those in the northern hills by a chain of Canaanite (Egyptian?) fortresses down the plain of Esdraelon. For the time the plain dominates the hills, the Israelites are disarmed and their communications are cut. At the instigation of the prophetess Deborah, and possibly aided by her spells, Barak raises the clans of Ephraim, Benjamin, Machir (Manasseh), Zebulun, Issachar and Naphtali: Asher, Dan, Gilead (Gad) and Reuben hold aloof. Judah and Simeon are not mentioned. The Israelite clans fall on the enemy at Taanach, a thunderstorm, in which Israel sees the coming of Yahweh, strikes terror into the Canaanites, their chariots are useless on the sodden ground, and the Kushon swollen by torrential rains, sweeps away the fugitives. Sisera escapes on foot, pursued by Barak, but, taking refuge in the tent of Heber the Kenite, is treacherously slaughtered as he drinks.

The poem is one of the most important documents of ancient times. It is contemporary with the events to which it refers, and is therefore invaluable as a picture of the life of Israel in the early days of the settlement. Further, it is in itself a magnificent lyric outburst, and proves a very high standard of poetic skill in ancient Israel.

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tories of Israel Paton (*Syria and Palestine*, pp. 158 sqq.) suggests that the battle was against the Hittites (Sisera, a successor of Shungar). See also L. W. Batten, *Journ. Bibl. Lit.* pp. 31-40 (1905), who regards Judges v and Josh. vi as duplicates, Winckler, *Gesch. Israels*, ii, 125-135, *Kleinmisch u. d. Alte Test.* 3rd ed., p. 218, and Ed Meyer, *Israeliten*, pp. 272 sqq., 487 sqq., also Burney, *Judges*, ad loc. Eassfeldt, *Die Quellen des Richterbuches*, pp. 22, 23. (T. H. R.)

DE BOSIS, ADOLFO (1863-1924), Italian poet and man of letters, was born at Ancona. He studied at the University of Rome, where he graduated in law and practised for a few years, but was always more interested in literature. In 1895 he became editor of *Il Convito*.

Although De Bosis became manager of the Italian Carbide company, he continued his literary activities. He translated Shelley's "Prometheus Unbound" (1922) and Homer into Italian verse. He collected his own poems in a volume entitled *Amori ac silentio sacrum* (1900, rep. 1914, 1923).

De Bosis exercised considerable influence on the younger authors of his time, many of whom were inspired by his deep love of the classics and keen sense of beauty. He died near Ancona on Aug. 29, 1924.

DEBRECEN, one of the largest towns in Hungary (pop. 1939, 128,442), is at the junction of three contrasted regions, viz. the extensive Hortobagy pastures or *pusta*, the Nyirseg sandy plateau and the marshes of the Berettyo. In early times it commanded two important routes, the salt way from Szatmar to western Europe and the road from Bohemia to Transylvania, both traversed by important trade movements in the mediaeval period, it is still an important railway junction. It developed as a market centre with special interests in cattle and grain and as a walled town attracted numerous refugees from surrounding plundered villages during the Turkish advance in the 15th century. Partly as a result of this the municipality acquired large areas of territory until it covered an area of nearly 400 sq. mi. Much of this was cultivated by farmers who maintained houses and often worked in the town during the winter season but of recent years villages known as *tanyas* have grown up in the surrounding district.

The town tends more and more to function as the centre of economic and intellectual inspiration for its region through its fairs, its agricultural academy, its well equipped university and its long tradition of spiritual independence which has made it the focus of Protestant ideals in Hungary and gained for it the name of "Calvinistic Rome." This outlook first determined in the 16th century has caused a stormy history but strengthened its position in the national structure.

Apart from its agricultural activities many varied industries have developed upon a small and local scale, notably the manufacture of soap, prepared foodstuffs and tobacco.

DEBS, EUGENE VICTOR (1855-1926), American Socialist leader, was born at Terre Haute, Ind., on Nov. 5, 1855. On leaving the public schools he became in 1871 a locomotive fireman. In 1879 he was elected city clerk of Terre Haute and in 1881 was re-elected. During 1885 he was a member of the Indiana legislature. Previous to this, in 1880, he was elected secretary and treasurer of the Brotherhood of Locomotive Firemen and was appointed editor of *The Locomotive Firemen's Magazine*. In 1893 he organized the American Railway union and was elected president of the union, serving four years. In 1894 he led the strike which, beginning in the Pullman-car plants, soon involved the railways leading into Chicago.

Debs was arrested on a charge of conspiracy to kill, and acquitted, but was later convicted of contempt of court for violating an injunction, and sent to jail for six months (May-Nov. 1895). In 1897 he joined the Socialist movement. He was Socialist candidate for the presidency of the United States in 1900, 1904, 1908, 1912 but declined the nomination in 1916. In 1907 he was on the editorial staff of the *Appeal to Reason*, and in 1914 became editor-in-chief of the *National Rye-Saw*, a Socialist paper published at St. Louis. He was an advocate of industrial unionism, though he eventually dissociated himself from the Industrial Workers of the World (*q.v.*), and was one of the chief opponents of Samuel Gompers (*q.v.*)

He was a pacifist and in Sept. 1918 was convicted of violating the Espionage Act and sentenced to ten years in the penitentiary. In 1920, while in prison, he was again nominated president; it can hardly be said that he was elected. He received 915,300 votes. His sentence was commuted by President Harding in Dec. 1921. He died at Alhambra, Ill., Oct. 19, 1926. He was one of the foremost figures in American Socialism.

He was the author of *Liberty* (1895), *Unionism and Socialism, a Plea for Both* (1904), *The American Movement* (1904), *Industrial Unionism* (1905), *The Growth of Socialism* (1910), *The Children of the Poor* (1911), and *Walls and Bars* (1927). Also see: Stephen Marion Reynolds *Life of Eugene V. Debs* (1910), Max Eastman *The Trial of Eugene V. Debs* (1919), Walter Hurt *Eugene V. Debs: An Introduction* (1919), David Karsner *Debs: His Authorized Life and Letters* (1919), and Scott Nearing, *The Debs' Decision* (1919). Consult also *Debs' Magazine*.

DEBT, a definite sum due by one person to another. Putting aside those created by statute, recoverable by civil process, debts may be divided into three classes: (1) judgment debts (see JUDGMENT DEBTOR), (2) specialty debts, (3) simple contract debts.

As to judgment debts, it is sufficient to say that, when by the judgment of a court of competent jurisdiction an order is made that a sum of money be paid by one of two parties to another, such a debt is not only enforceable by process of court, but it can be sued upon as if it were an ordinary debt.

A specialty debt is created by deed or instrument under seal. Until 1869 specialty debts had preference under English law over simple contract debts in the event of the bankruptcy or death of the debtor, but this was abolished by the Administration of Estates Act of that year. The main difference now is that a specialty debt may, in general, be created without consideration, as, for example, by a bond under seal, and that a right of action arising out of a specialty debt is not barred if exercised any time within 20 years, whereas a right of action arising out of a simple contract debt is barred unless exercised within six years. (See LIMITATION, STATUTES OF.)

Any other debt than a judgment or specialty debt, whether evidenced by writing or not, is a simple contract debt. There are also certain liabilities or debts which arise from tacit or implied contracts to pay.

At English common law debts and other choses in action were not assignable (see CHOSE), but by the Judicature Act, 1873, any absolute assignment of any debt or other legal chose in action, of which express notice in writing is given to the debtor, trustee or other person from whom the assignor would have been entitled to receive or claim such debt, is effectual in law. The discharge of a debt may take place either by payment of the amount due, by accord and satisfaction, i. e., acceptance of something else in discharge of the liability, by set off (*q. v.*), by release, or under the law of bankruptcy (*q. v.*). It is the duty of a debtor to pay a debt without waiting for any demand, and, unless there is a place appointed either by custom or agreement, he must seek out his creditor for the purpose of paying him unless he is "beyond the seas." Payment by a third person to the creditor is no discharge of a debt, as a general rule, unless the debtor subsequently ratifies the payment.

Imprisonment for debt, the evils of which have been so graphically described by Dickens, was abolished in England by the Debtors Act, 1869, except in cases of default of payment of penalties, default by trustees or solicitors and certain other cases. But in cases where a debt or instalment is in arrear and it is proved to the satisfaction of the court that the person making default either has or has had since the date of the order or judgment the means to pay the sum in respect of which he has made default and has refused or neglected to pay, he may be committed to prison at the discretion of the judge for a period of not more than 42 days. In practice, a period of 21 days is usually the maximum period ordered. Such an imprisonment does not operate as a satisfaction or extinguishment of the debt, and no second order of commitment can be made against him for the same debt, although where the court has made an order or judg-

ment for the payment of the debt by instalments a power of commitment arises on default of payment of each instalment. In Ireland imprisonment for debt was abolished by the Debtors Act (Ireland) 1872 and in Scotland by the Debtors (Scotland) Act, 1880. In France it was abolished in 1867, in Belgium in 1871, in Switzerland and Norway in 1874 and in Italy in 1877. In the United States imprisonment for debt was universal under the common law but it has been abolished in every state except in certain cases as where there is any suspicion of fraud or where the debtor has an intention of removing out of the state to avoid his debts. (See also BANKRUPTCY, CONTRACT, NATIONAL DEBT, PAYMENT.)

In the United States the law is in general as stated above. But the effect of a seal to make consideration unnecessary to the creation of a debt has been very generally abolished by statute, even where not abolished, the effect has commonly been reduced to raising a *prima facie* presumption of consideration. Yet the seal commonly retains its effect of lengthening the period of limitation. The notice of an assignment need not, in the United States, be given to the debtor in writing. And the English rule that payment by a third person will not discharge has either been abolished or rendered substantially null by liberality in construing the slenderest of evidence into "ratification" by the debtor.

Debt, it should be noted, is the legal counterpart of the economic concept "credit" (*q. v.*), and where liquidity of credit is important, debts are commonly put in the form of negotiable instruments, to facilitate transfer (See BILL OF EXCHANGE). There is, however, some financing done by merchants transferring their book accounts—though at a heavy discount (See ASSIGNMENT).

DEBT CONVERSION. In its broadest sense, debt conversion means any exchange of debt instruments for other securities in either private or public finance. In its narrower, more usual meaning it connotes an operation wherein a public body retires one issue of bonds by giving in exchange another issue with terms more favourable to the debtor, typically a lower rate of interest.

Certain other debt operations may be distinguished from conversion. Floating or short-term debt may be exchanged for long term bonds, this is known as *funding* or *consolidation*. When an issue of bonds matures, the debtor government may issue new bonds either for cash or in exchange for the old bonds, this is *refunding*. Following financial difficulties, a local government may agree with its creditors on a composition or plan of readjustment. In the United States such action may follow proceedings under the Municipal Bankruptcy Act. This is known as *readjustment*. While an exchange of bonds may take place in connection with any of the above operations, such an exchange would not be a conversion in the strict sense.

Under certain conditions a special kind of conversion may take place at the option and to the advantage of the bondholder. Near the beginning of a major war a government may find it necessary to sell "convertible" bonds, i. e., bonds which may be converted at the option of the holder into bonds subsequently issued by the government on terms more favourable to purchasers. During World War I Great Britain included such a feature in several issues of war bonds, many of which were later converted into the 5% War Loan. The United States gave wide conversion privileges in the 3½% First Liberty Loan, more restricted privileges in the 4% Second Liberty Loan, and none at all in the 4½% Third and Fourth Liberty Loans. The conversion privilege of the First Liberty Loan was, in part, defeated by reducing the tax exemption of the bonds into which it was convertible. The conversion privilege is likely to be costly and troublesome and may be dangerous if it causes finance officials, in an effort to avoid issuing bonds which would invite conversion, to resort to short-term, inflationary borrowing methods. During World War II neither Great Britain nor the United States used the conversion feature. Both countries did, however, provide a partial substitute for conversion by selling, principally to small purchasers, large amounts of Defense and Savings bonds redeemable at the option of the holder. If it should become profitable to do so, these bonds might be redeemed for

cash and the proceeds used to buy new issues of bonds bearing higher rates of interest.

General Aspects of Conversion—Government debts are usually represented by bonds or notes which bear interest at a specified rate. Bonds may have a definite maturity date or they may be perpetual. In perpetual bonds the debtor does not promise to repay the principal but does promise to pay interest at the specified rate indefinitely. It is customary to make both types of bonds irredeemable for a certain period of time, known as the period of inconvertibility. After the expiration of that period the debtor government is free to call the bonds for repayment at par or—by special provision—at a small premium.

All voluntary conversions involve only callable bonds and rest upon the fundamental right of a government to repay its debt according to contract. Bondholders are offered an opportunity to exchange their old bonds for new ones bearing a lower rate of interest, the alternative is to accept repayment in cash. A *forced conversion* is one in which the government disregards the period of inconvertibility or does not give bondholders the alternative of repayment. It is an act of sovereignty against which bondholders have no immediate redress. A *compulsory conversion* is one in which all affected bondholders must choose between conversion and repayment as contrasted with one in which they may choose between conversion and retaining their old bonds.

The fundamental purpose of most conversions is to reduce interest costs. Such a reduction is so obviously advantageous to taxpayers that in most English speaking countries, governments consider it not merely a *right* but a *duty* to convert when conditions permit. In some countries, however, bondholder groups have at times been able to prevent conversion on the ground that it would be unfair to creditors. The net gain from conversion will be less than the gross reduction in interest costs for two reasons: first, the government will suffer a reduction in income tax collections from bondholders, and, second, to the extent that bonds are held by governmental agencies, trust funds, etc., the government may have to compensate for the reduction in interest.

A secondary purpose of conversion may be to adjust the schedule of debt maturities. If a large amount of debt is scheduled to mature in one year, refunding operations may be too large to be handled conveniently within the limited time. The load may be lightened by giving some of the bondholders, well in advance of maturity, the opportunity to convert their holdings into bonds with later maturities. Such conversions may or may not reduce interest costs.

It is logical to expect that a government can effect economies by converting its debt in time of peace. The greater part of public debts are incurred in time of war or other great emergencies, when economic conditions are chaotic. Those conditions, plus the large scale of governmental borrowing, usually force a government to pay high interest rates on its loans. If and when the government has weathered the storm and financial stability is restored, government loans can usually be raised on more favourable terms. This, more than any other single factor, explains the gains that may be expected from conversion. The extensive economic and financial controls employed during World War II prevented interest rates from rising and may thus have precluded large gains from conversion in the postwar period.

Before World War I it was customary for governments to have relatively few issues of bonds, each representing a substantial part of the total debt. When one such issue was converted, it was a major financial operation. In Great Britain that condition continued after World War I, but the United States, after 1920, adopted a "flexible debt" policy, *i.e.*, a policy of having many issues of bonds and with their maturities so arranged that a fairly uniform amount of debt would mature each year. Such bond issues are irredeemable during most of their existence and become callable only during the last two to five years before maturity. Because interest rates were declining, the policy was adopted of converting all issues soon after they became callable. The result was a steady flow of relatively small conversions but few that were outstanding.

Great Britain and the United States have resorted to conversion

consistently and as a matter of course whenever conditions have permitted. Generally their conversions have been soundly conceived, carefully planned and smoothly executed. France, on the other hand, has traditionally shown more concern for the interests of bondholders and has been erratic and timid in its use of conversion. In most other European countries no consistent or uniform conversion policy has been developed because of widely varying political and financial conditions.

Principles of Conversion—From more than two centuries of experience with conversion, certain well defined principles of conversion have been deduced. First, the conversion should be voluntary. Bondholders should always have a choice between converting and accepting repayment. In totalitarian countries with strict economic and financial controls, this principle may be disregarded with impunity, but under liberal capitalism the government which repudiates its covenants or treats its creditors harshly may eventually pay for its action by having to borrow under less favourable terms.

Second, the conversion plan should be simple. Thousands, perhaps millions, of bondholders must make decisions upon which rests the success of the conversion. If several complicated options are presented, decisions will be delayed and many bondholders are likely to request repayment in cash as the simplest alternative.

Third, conversion should be at or near par. If the par value of the new bonds is less than the par of the bonds surrendered, bondholders suffer a loss of capital. Bondholders object to such a loss, even though it be compensated by a higher interest rate. If the par value of the new bonds exceeds the par of the old bonds, the nominal amount of the debt is increased and future conversions are impeded.

Fourth, the new bonds should be inconvertible for some stated period. Bondholders will be reluctant to accept new bonds if there is a likelihood that the government may convert again in the near future. It is necessary to provide protection against this contingency for a few years. The government, however, should not make this period so long as to impair its opportunity for another conversion after a reasonable time. The length of the period must be a compromise between the conflicting interests of the bondholders and of the government.

Finally, the conversion plan should be carefully prepared and fully publicized. Careful planning will provide for meeting and overcoming contingencies which might be fatal to a hasty or careless plan. Full publicity is necessary to apprise all bondholders of the conversion and to protect them against false representations by buyers who might wish to profit from the conversion.

Conditions of Conversion—Certain conditions must exist before a conversion is possible. First, the bonds to be converted must be callable. After 1933, states and municipalities of the United States were denied savings of millions of dollars annually in interest because bonds which they had issued between 1920 and 1932, at rates of interest from 4% to 6%, were not callable. Had they been callable, those bonds could have been converted into new ones with interest rates of from 1% to 3%.

A second prerequisite to conversion is a reasonable degree of political stability in the debtor government. The threat of drastic political change with its inevitable uncertainty would usually make bondholders unwilling to accept the less favourable terms which a conversion involves.

A third prerequisite is a decline in prevailing interest rates between the time the bonds were originally issued and the time of the conversion. Under special conditions a government may so improve its financial condition and prospects that the rate of interest at which it can borrow declines even though interest rates generally do not fall.

Before 1930 interest rates were generally regarded as the result of the operation of immutable economic forces. Since that time the realization has been growing that governments, through central banks, trust funds, loan agencies, and other similar institutions, can influence the level of interest rates. In considerable measure, governments can produce interest rates favourable to conversion.

Techniques of Conversion—Several techniques may be employed to speed conversion and to assure its success. The exact time when the operation is announced may be important in gaining public support and in taking advantage of the technical position of the financial markets. Decisions of bondholders may be hastened by allowing only a limited time for the exercise of options and by giving small cash bonuses for prompt conversions. Governments may also gain a substantial advantage by treating all who do not specifically request repayment as having agreed to conversion. In the 1933 conversions, Great Britain allowed holders three months in which to make their choice but gave a cash bonus of 1% to those assenting within 30 days, France allowed only six days for the choice and gave no bonus.

In several ways a government may prepare the market for conversion. In conjunction with the central bank and through regular treasury and trust fund operations, it may reduce interest rates and ease credit conditions generally. It may enlist the support of large holders of bonds, such as banks and insurance companies, and have those institutions publicly announce their decision to convert in the early days of the operation. Finally, the government may ban other issues of new securities for a limited time in order to reduce competition for investors' funds.

The success of conversion will depend to a considerable extent on the terms of the new bonds being offered, the most important of which are the interest rate and the amount of tax exemption afforded. These two features may be combined in an almost infinite number of ways. Differing maturities in the new bonds may increase their appeal, especially if both banks and individuals are important holders of the old bonds.

If the success of a planned conversion is not entirely assured the government may try the conversion of a small portion of the debt to test the plan. Also, if conditions are propitious, a restrained appeal to the patriotism of the bondholders may be made, as in the British conversion of 1932.

A successful conversion of a large portion of the national debt, with a substantial reduction in interest rates, is one of the greatest achievements of financial statesmanship. It depends upon a combination of favourable market conditions, proper timing, a discriminating judgment in choosing terms, features and techniques, and, finally, an intelligent and carefully planned program of publicity.

Examples of Conversion.—(a) *British*—Great Britain has had more experience with conversions than any other country. Important conversions occurred in 1715, 1749, 1822-24, 1830-34, 1853, 1884, and especially in 1888-89, the latter being known as Goschen's conversions. The largest British conversion of all, and the largest single operation of its kind in financial history, occurred in 1932. It was the more remarkable in that it came within a year after the severe financial crisis of Sept. 1931.

Late in June 1932 it was announced that the 5% War Loan, of which about £4,087,000,000 were outstanding, would be converted into 3½% bonds maturing in 1975 and redeemable after 1952. Conversion was at par. Bondholders were given three months in which to make their choice but a cash bonus of 1% was given for assents within 30 days. All who did not specifically request repayment were deemed to have assented to conversion. The way for conversion was prepared and its progress was facilitated by five factors: (1) dull trade had led to the accumulation of large amounts of idle funds; (2) in a series of moves the real rate of the Bank of England was reduced from 6½ to 1½ per cent in June; (3) a temporary bill was passed on new securities; (4) large financial companies holding about one-third of the loan agreed to convert their holdings; and to advise their clients to convert; (5) an elaborate and carefully planned program of publicity was conducted, including an appeal to patriotism.

The conversion was a distinct success. Approximately 72% of the old bonds were converted, leaving only 26% to be paid in cash. The estimated net annual saving in interest was about 4,000,000,000.

(b) *French*—Although France failed to take advantage of several attractive opportunities during the 19th century, there were important conversions of the French debt in 1833, 1887, 1894

and 1902. As in Great Britain, however, the largest conversion came in 1932.

In Sept. 1932 the government announced that more than 85,000,000,000 francs of the debt bearing interest at 5% and 6% (except for one small issue bearing 7%) would be converted into new 4½% bonds at par. The new bonds were to mature in 1977 and be redeemable after Jan. 1, 1939. Unless bondholders requested repayment within six days they were considered as assenting to the conversion. Especially favourable terms were provided for small holders who had acquired their bonds before 1910 and had suffered from the decline in the value of the franc. This conversion, too, was successful. More than 95% of the old bonds were converted at an estimated annual saving in interest of about 1,320,000,000 francs.

(c) *United States*—The general policy of the United States has been to convert its debt in relatively small portions through a succession of operations covering several years rather than to convert large amounts in one operation. Important amounts were converted in the years 1870-81, 1900-03, and 1921-30.

The 4½% Fourth Liberty Loan, of which \$6,268,000,000 were outstanding in Oct. 1933, was converted in four separate operations between Oct. 1933 and Sept. 1935. Conversion was at par into four different issues of bonds and two issues of treasury notes. The bonds varied in term from 12 to 25 years and were callable only for short periods immediately preceding maturity. Each successive issue bore a lower rate of interest than the preceding one as follows: 4½%-3½%, 3½%, 2½%, and 2½%. The treasury notes ran for four years and bore interest rates, respectively, of 2½% and 1½%. If holders of the old bonds took no positive action they did not receive new bonds but their old bonds became payable in cash at the proper time. Approximately 85% of the old bonds were exchanged for the new issues at an annual interest saving of about \$74,000,000, additional interest savings were realized on the financing connected with the cash repayments. During World War II the United States maintained its policy of continuous conversion, calling issues bearing high interest rates and replacing them with issues bearing lower rates. (See also NATIONAL DEBT.)

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DEBT INSURANCE see CREDIT, INSOLVENCY OR BAD DEBT INSURANCE.

DEBTS, INTER-ALLIED see INTER-ALLIED DEBTS.
DEBUSSY, CLAUDE ACHILLE (1862-1918), French composer, was born at St. Germain-en-Laye on Aug. 22, 1862, and died in Paris on March 26, 1918. His musical training he received at the Paris Conservatoire under Marmoniel, Lavignac, Massenet and Guiraud. There, between 1874 and 1884, he gained many prizes for solfège, pianoforte playing, accompanying, counterpoint and fugue, and, in the last-named year, the coveted Grand Prix de Rome by means of his cantata *L'Enfant prodigue*. In this composition germs of unusual and "new" talent were already latent, though, in the light of later developments, it is not very easy to discern them, for then Debussy had not come under the influence which ultimately turned his mind to the system which he afterwards used in so remarkable a manner.

Early Tendencies—It was not long, however, before these highly-individual tendencies revealed themselves. For, in order to fulfil that condition of the Prix de Rome which entails the submitting periodically of compositions to the judges, Debussy sent to them his symphonic suite, *Printemps*, to which exception was immediately taken by the judges on the grounds of its formlessness and other unacademic qualities. Following in the wake of *Printemps* came *La damoiselle élue* for female voices (solo and chorus) and orchestra—a setting of a French version of Rossetti's "The Blessed Damosel"—which, in the eyes of the judges, was even more unorthodox than its predecessor, though, he it said fault was found almost as much with the libretto as with the music. So poor was the impression produced by these works, indeed, that

both were denied the customary public performance

The Rome period over, Debussy returned to Paris, where shortly he went to Russia, where he came directly under the influence already referred to. That is to say, he absorbed here the native music, especially that of Moussorgsky who, recently deceased, had left behind him the reputation of a musical nihilist, and on his return to Paris the results became speedily apparent. At the same time the effect of this Russian visit should not be overrated, and there is no reason to suppose that it did more than confirm and strengthen tendencies which were already deeply implanted, and would have quite certainly revealed themselves in due course in any event.

Recognition Tardy—Public recognition was rather slow in coming to Debussy, but in 1893 the Société Nationale de Musique performed his *La damoiselle élue*, in 1894 the Ysaye quartet introduced the string quartet (one of his greatest achievements), while in the same year was heard another of his most remarkable and individual creations, the now world famous prelude *L'Après-midi d'un faune*, which could no longer leave room for doubt as to the originality of its composer. Concurrently also, his piano forte pieces were being performed more and more. The works named were followed in due course by his only opera, *Pelléas et Mélisande*, first heard at the Opéra Comique on April 30, 1902. Then it was little understood, but understanding came in due course, and it was recognized as one of the most notable contributions to the repertory of the lyric stage since Wagner.

In an Apologia which he subsequently published, Debussy declared that in composing *Pelléas* he had wanted to dispense with "parasitic musical phrases." "Melody," he observed, "is, if I may say so, almost anti lyric and powerless to express the constant change of emotion and life. Melody is suitable only for the chanson, which confirms a fixed sentiment. I have never been willing that my music should hinder, through technical exigencies, the change of sentiment and passion felt by my characters. It is effaced as soon as it is necessary that these should have perfect liberty in their gestures or in their cries, in their joy and in their sorrow." And these principles found exquisite expression in the work as carried out, of which Dr Ernest Walker has happily observed—"It is one of the great landmarks in the history of opera, it is the summit of musical impressionism, catching every faint nuance of the words, always suggesting rather than saying, but always tense and direct and full of throbbing beauty."

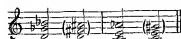
Works for Piano and Orchestra—But, outstanding as is *Pelléas et Mélisande*, it is surpassed even in importance by Debussy's contributions to piano literature, in which by the novelty of his methods he was responsible for the greatest development which had been effected in the technique since Chopin. In such things as *La Sorcière dans Grenade*, *Jardins sous la pluie*, *L'Isle joyeuse*, *Reflets dans l'eau*, *Bruyères* and *La Cathédrale engloutie*, he revealed possibilities which had previously been entirely unsuspected in the best known and most exhaustively studied of all instruments. Such music might not be of the highest order, in deed it made no pretensions to bigness or grandeur, but in its delicacy, subtlety and refinement, in its exquisite adaptation of the most novel means to the purposes of the most sensitive musical impressionism, it possessed a fascination all its own, and may be said to have opened a new chapter in the history of the art.

Debussy's work for the orchestra was, as a whole, of less significance in the technical sense, he did many fine things also, besides the consummate *L'Après-Midi*, in this field. Such are the exquisite nocturnes *Nuages*, *Fêtes* and *Sirènes*, one and all the last word in delicate impressionism. Neither should mention be omitted of his songs, all characterized by the same individuality of style and perfection of workmanship distinguishing his music as a whole, and including such examples as "Mandoline," "Recueillement," "Fantômes," "La Flûte de Pan" and "La Chevelure," things which have long since won universal favour.

Musical System—As to the theories, so much debated, of this remarkable musician, probably in the whole range of musical history there has not appeared a more difficult theorist to "place." Unquestionably Debussy introduced a new system of colour into music, which has begun already to exert widespread influence

Roughly, Debussy's system may be summarized thus

First, a scale basis is of six whole tones (enharmonic), as middle C, D, E, G \sharp , A \flat , B \flat , which are of excellent sound when super imposed in the form of two augmented unrelated triads,



used frequently incomplete (i.e., by the omission of one note) by Debussy.

Now, upon the basis of an augmented triad a tune may be played above it provided that it be based upon the six tone scale, and a fugue may be written, the re-entry of the subject of which may be made upon any note of the scale, and the harmony will be complete.

Secondly, a free use of the chord of the 7th, 9th, 11th and 13th upon every degree of the scale instead of (as in the conventional theory) only upon the tonic, super tonic and dominant, in conjunction with melodies constructed upon the ordinary diatonic scale. These two methods have an interesting connection which can be shown, i.e., let a major 9th be taken



one may conventionally flatten or sharpen the fifth of this (A becoming G \flat or B as desired) if both the flattened and sharpened fifths be taken in the one chord this chord is arrived at,



which is composed of the notes of the aforesaid scale whole tone. It will be noticed that chords of the 9th in sequence and in all forms occur in Debussy's music as well as the augmented triad harmonies, where the melodic line is based on the total scale. Thus, in all likelihood, is the outcome of Debussy's instinctive feeling for the association of his so called discovery with the ordinary scale.

But the appearance of a whole tone scale as a by product of two ordinary chords a tritone apart (as in a Neapolitan cadence) decorated by passing notes

$$\left\{ \begin{array}{l} CDE F\sharp G\sharp A\sharp \\ C F\sharp \end{array} \right\}$$

must not be confused with the conscientious avoidance of classical key relation which Debussy intends. As is shown in the article HARMONY, even Debussy's whole tone scale really falls into the classical scheme, with much more various results. Debussy himself becomes eclectic in his later works, though he would never have allowed the whole-tone chord to resolve in a classical polyphony. (R. H. L. X)

DECAEN, CHARLES MATHIEU ISIDORE, Count (1769-1832), French soldier, was born at Caen on April 13, 1769. He made his name during the wars of the French Revolution under Kleber, Marceau and Jourdan, in the Rhenish campaigns. In 1799 he became general of division, and fought at Hohenlinden (Dec 1800). Selected by Napoleon early in the year 1802 for the command of the French possessions in the East Indies, he set sail with Admiral Linois early in March 1803 with a small expeditionary force, touched at the Cape of Good Hope (then in Dutch hands), and noted the condition of the fortifications there. On arriving at Pondicherry he found matters in a very critical condition. Though the renewal of war in Europe had not yet been heard of, the hostile preparations adopted by the Marquis Wellesley caused Decaen to withdraw promptly to the Isle of France (Mauritius), where, for eight years, he sought to harass British trade and prepare for plans of alliance with the Mahratta princes of India. They all came to naught. Linois was captured by a British squadron, and ultimately, in 1811, Mauritius itself fell to the British. Decaen then received the command of the French troops in Catalonia. He died of the cholera in 1832.

DECALIN, a chemical substance obtained by hydrogenation of naphthalene ($q.v.$), it is decahydronaphthalene, $C_{10}H_{16}$. It exists in two stereoisomeric forms (*see* СТЪЛКОСНЕМІСТВЪ), which are known as *cis* and *trans* decalin, respectively.

DECALOGUE, another name for the biblical *Ten Commandments*, in Hebrew the *Ten Words* (Deut iv 13, x 4, Exod xxiv 28), written by God on the two tables of stone (Exod xxiv 12, xxxii 16), the so called *Tablets of the Revelation* (EV "tables of testimony," Exod xxxiv 29), or *Tables of the Covenant* (Deut ix 9, 11, 15) (in patristic $\Gamma\iota$ ἡ δεκάλογος *se* βιβλος or νομοθεσία). These tables were broken by Moses (Exod xxxii 19), and two new ones were hewn (xxiv 1), and upon them were written the words of the covenant by Moses (xxiv 27, *sqq.*) or, according to another view, by God himself (Deut iv 13, ix 10). They were deposited in the Ark (Exod xxv 21, i Ki viii 9). In Deuteronomy the inscription on these tables, which is briefly called the covenant (iv 13), is expressly identified with the words spoken by Jehovah (Yahweh) out of the midst of the fire at Mt. Sinai or Horeb (according to the Deuteronomic tradition), in the ears of the whole people on the "day of the assembly," and rehearsed in vi 6-21. The order of the commandments varies in some ancient texts (Vatican ms of the LXX, Nash Papyrus), and there are differences in detail between the form in which the Decalogue appears in Exodus and in Deuteronomy. Further, the term "Ten Words" does not occur in Exod. x, but is found in Exod. xxxiv 28, in a context which seems to imply that the words mentioned had immediately preceded this passage. Accordingly some scholars would find another Decalogue embedded in Exod. xxxiv 10-26.

The Decalogue of Exod. xx, Deut. v—Comparison between the two texts, especially in the law of the Sabbath, strongly suggests that neither form is original, both having been expanded from a rather shorter common source. It seems that in the earlier commandments even this common source has been extended from a much more concise primitive form, and that the commands first took the form of simple injunctions and prohibitions of the same type as "Thou shalt not steal."

Different views have been held as to the actual divisions of the Decalogue. Thus Philo regarded Exod. xx 2-3 as the first commandment, while the Talmud made v 2 the first and vv 3-6 the second, thus identifying the sins of apostasy and idolatry. In Christian circles the Roman and Lutheran Churches make the first commandment extend from v 2 to v 6, and distinguish the coveting of a wife from the coveting of property (This last is only possible on the basis of the text in Deuteronomy). The arrangement of the Orthodox Eastern, Calvinistic and Anglican Churches takes Exod. xx 2 as an introduction, separates the prohibition of apostasy from that of the making of images, and unites the clauses prohibiting covetousness into a single commandment. Different opinions obtain as to the date of the Decalogue. The general tendency is to place it late rather than early, though the view that the whole is Mosaic has been revived by some modern scholars (*e.g.*, McFadyen and Volz).

people in the wilderness and to a settled agricultural community, others could only have applied to the conditions of the latter. It is worth noting that most of the precepts are found also in the 'Book of the Covenant' (Exod. xx-xxiii E), where they occur unconnected with one another. This fact, together with the very simple type of ritual enjoined, has suggested a Judaean rather than an Ephraimite origin for Exod. xxxiv 12-26.

The Decalogue in Christian Theology—Following the New Testament, in which the "commandments" summed up in the law of love are identified with the precepts of the Decalogue (Mark x 19, Rom. xiii 9, cf. Mark xii 28 ff.), the ancient Church emphasized the permanent obligation of the ten commandments as a summary of *natural* in contradistinction to *ceremonial* precepts, though the observance of the Sabbath was to be taken in a spiritual sense (Augustine, *De spiritu et littera*, xiv, Jerome, *De celebratione Paschae*). The mediaeval theologians followed in the same line, recognizing all the precepts of the Decalogue as moral precepts of *lege naturae*, though the law of the Sabbath is not of the law of nature, in so far as it prescribes a determinate day of rest (Thomas, *summa*, I^{na} II^{ae} qu. c. art. 3, Duns, *Super sententias*, lib. iii dist. 37). The most important mediaeval exposition of the Decalogue is that of Nicolaus de Lyra, and the 15th century, in which the Decalogue acquired special importance in the confessional, was prolific in treatises on the subject (Antoninus of Florence, Gerson, etc.).

Important theological controversies on the Decalogue began with the Reformation. The question between the Lutheran (Augustinian) and Reformed (Philonic) division of the ten commandments was mixed up with controversy as to the legitimacy of sacred images not designed to be worshipped. The Reformed theologians took the stricter view. The identity of the Decalogue with the eternal law of nature was maintained in both churches, but it was an open question whether the Decalogue, as such (that is, as a law given by Moses to the Israelites), is of perpetual obligation. The Socinians, on the other hand, regarded the Decalogue as abrogated by the more perfect law of Christ, and this view, especially in the shape that the Decalogue is a civil and not a moral law (J. D. Michaels), was the current one in the period of the 18th century rationalism. The distinction of a permanent and a transitory element in the law of the Sabbath is found, not only in Luther and Melancthon, but in Calvin and other theologians of the Reformed church. The main controversy which arose on the basis of this distinction was whether the prescription of one day in seven is of permanent obligation. It was admitted that such obligation must be not natural but positive, but it was argued by the stricter Calvinistic divines that the proportion of one in seven is agreeable to nature, based on the order of creation in six days, and in no way specially connected with anything Jewish. Hence it was regarded as a *universal positive* law of God. But those who maintained the opposite view were not excluded from the number of the orthodox. The laxer conception found a place in the Cocceian school.

tures, chiefly of scenes from French and Algerine domestic life. Probably the best known of all his works is "The Monkey Connoisseurs," a clever satire of the jury of the French Academy of Painting, which had rejected several of his earlier works on account of their divergence from any known standard.

See Moreau's *Decamps et son oeuvre* (1896).

DE CANDOLLE, ALPHONSE, *see* CANDOLLE, AUGUSTIN PRYAME DE

DECAPOLIS, a league of ten cities situated with one exception on the eastern side of the upper Jordan and the sea of Tiberias. The names of the ten cities are Damascus, Philadelphia, Raphana, Scythopolis (= Beth Shan, now *Basjan*, W. of Jordan), Gadara, Hippos, Dion, Pella, Gerasa and Kanatha. Of these Damascus alone retains its importance. Scythopolis (as represented by the village of Beisan) is still inhabited, the ruins of Pella, Gerasa and Kanatha survive. Scythopolis in command of the communications with the sea and the Greek cities on the coast, was a very important member of the league. The purpose of the league was mutual defence against the marauding Bedouin tribes that surrounded them.

It was soon after Pompey's campaign in 64-63 B.C. that the Decapolis league took shape. The cities comprising it were united by the main roads on which they lay, their respective spheres of influence touching one another. A constant communication was maintained with the Mediterranean ports and with Greece. The cities were subject to the governor of Syria and tried for imperial purposes.

The best account is in G. A. Smith's *Historical Geography of the Holy Land*, chap. xxviii.

DECASTYLE, the architectural term given to a portico that has ten columns, as in the temple of Apollo Didymaeus at Miletus, also applied to a building with such a portico (see *TEMPLE*).

DECATUR, STEPHEN (1779-1850), American naval commander, was born at Sennepuxent (Md.) on Jan. 5, 1779, and entered the U.S. Navy as a midshipman in 1798. He was promoted lieutenant and saw service in the short naval war with France (1798-1800). In 1803 he commanded the "Enterprise," a part of Commodore Preble's squadron in the Mediterranean, and in Feb. 1804 led an expedition into the harbour of Tripoli to burn the U.S. frigate "Philadelphia," which had fallen into Tripolitan hands. He succeeded and made his escape under battery fire with only one man wounded. This exploit earned him his captain's commission and a sword of honour from Congress. He was engaged in all the attacks on Tripoli during 1804 and 1805.

In the War of 1812 his ship the "United States" captured H.M.S. "Macedonian." In 1813 he was appointed commodore to command a squadron in New York harbour, soon blockaded by the British. In an attempt to break out in Jan. 1815 his flagship the "President" was forced to surrender to a superior force. Subsequently he commanded in the Mediterranean against the corsairs of Algiers, Tunis and Tripoli with great success. He was made a Navy commissioner (Nov. 1815), an office which he held until killed in a duel with Commodore James Barron at Bladensburg (Md.) on March 22, 1820. A toast of his has become famous—"Our country! In her intercourse with foreign nations may she always be in the right, but our country, right or wrong!"

See A. S. Mackenzie, *Life of Decatur* (Boston, 1846).

DECATUR, a city of northern Alabama, U.S., on the Tennessee river, 75 mi. N. of Birmingham, served by the Louisville and Nashville and the Southern railways, the county seat of Morgan county. It was formed in 1927 by the consolidation of Albany, formerly called New Decatur (pop. 7,552 in 1920) and Decatur (pop. 4,752 in 1920), and its population was 19,879 in 1950 by the federal census. Manufactures include hosiery, tire fabric, cotton seed oil, copper tubing, steel nuts, sand and gravel, fertilizers, brick, tile, synthetic fibres, packing house products, steel barges and boats, sheet metal products, dairy products, iron grillwork, aluminum wares, concrete products, asphalt, flour and food products.

DECATUR, a town of Georgia, on the Georgia railroad, adjoining the city limits of Atlanta to the east, at an altitude of 1,050 ft., the county seat of Dekalb county. The population was 21,626

in 1950 and was 16,561 in 1940 by the federal census. It is a residential suburb the seat of Columbus Theological seminary (Presbyterian) and of Agnes Scott college for women (Presbyterian), founded in 1889 as a "female seminary" and named after the mother of a benefactor, Col. George W. Scott. Decatur was incorporated in 1835.

DECATUR, a city in central Illinois, U.S., on Lake Decatur, the county seat of Macon county. It is on federal highways 36 and 51 and state highways 47, 48 and 121, and is served by the Baltimore and Ohio, the Illinois Central, the Illinois Terminal (electric), the Pennsylvania and the Wabash railways. The land area is 10 sq. mi. The population was 67,801 in 1950 and 59,395 in 1940 by the federal census. Decatur is a pleasant city, of diversified manufacturing industries in a rich agricultural region underlaid with coal. It has a commission form of government.

The assessed valuation in 1948 was \$148,500,711. Bank debts in 1919 amounted to \$815,312,000.

There are parks in and near the city covering 1,230 ac., in one of which the original county courthouse (of logs) is preserved. Lake Decatur (11 mi. long), constructed in 1922-23 to assure an ample and dependable supply of water, provides fishing, boating and bathing.

Corn products and soybean products are among the most important manufactures. Others of importance are plastics, brass plumbing goods, malleable and gray iron, structural and sheet steel. Decatur is the trading centre for a ten-county area.

The Wabash has its principal repair shops there, also its hospital for employees.

The James Millikin university (opened 1903) had an enrolment of 1,331 in 1950. Decatur was founded in 1829 and was named after Stephen Decatur.

Decatur was the first Illinois home of Abraham Lincoln, and the Grand Army of the Republic was organized there on April 6, 1866.

DECATUR, a city of eastern Indiana, U.S., on St. Mary's river, 100 mi. N.E. of Indianapolis, the county seat of Adams county. It is on federal highway 27, and is served by the Erie, the Nickel Plate and the Pennsylvania railroads. The population was 7,272 in 1950 and was 5,861 in 1940 by the federal census. It is surrounded by a farming and lumbering region, and has various factories. Decatur was settled about 1835 and incorporated in 1882.

DECAZES, ÉLIE, Duc (1780-1860), French statesman, was born at Saint Martin de Laye (Gironde) on Sept. 28, 1780. He studied law, became a judge in the tribunal of the Seine in 1806, was attached to the cabinet of Louis Bonaparte in 1807, and was counsel to the court of appeal at Paris in 1811. Immediately upon the fall of the empire he declared himself a royalist, and remained faithful to the Bourbons through the Hundred Days. He made the personal acquaintance of Louis XVIII, who appointed him prefect of police at Paris in July 1815. His marked success in that difficult position won for him the ministry of police, in succession to Fouché, on Sept. 24. In the interval he had been elected deputy for the Seine (Aug. 1815) and both as deputy and as minister he led the moderate royalists. His formula was "to royalize France and to nationalize the monarchy." The Moderates were in a minority in the chamber of 1815, but Decazes persuaded Louis XVIII to dissolve the house, and the elections of Oct. 1816 gave them a majority. As minister of police he had to suppress the insurrections provoked by the ultra-royalists (the White Terror), then, after the resignation of the duc de Richelieu, he took the actual direction of the ministry, although the nominal president was General J. J. P. A. Desolles (1767-1838). He held at the same time the portfolio of the interior. The cabinet, in



BY COURTESY OF C. B. WILLIS, DECATUR, ILL.
COURTHOUSE IN MACON COUNTY ILL. ERECTED 1829 WHERE ABRAHAM LINCOLN PRACTISED LAW WHILE ON THE 8TH JUDICIAL CIRCUIT

which Byron Louis was minister of finance and Marshal Gouvion Saint Cyr remained minister of war, was entirely Liberal, and its first act was to suppress the ministry of police since Decazes held that it was incompatible with the regime of liberty. His reforms met with the strong hostility of the chamber of peers, where the ultraroyalists were in a majority, and to overcome it he got the king to create 60 new Liberal peers. He then passed the laws on the press, suppressing the censorship. By reorganization of the finances, the protection of industry and the carrying out of great public works, France regained its economic prosperity, and the ministry became popular. But the powers of the Grand Alliance had been watching the growth of liberalism in France with an anxiety that was increased by the election of the celebrated Abbe Grégoire. A threat of foreign intervention, rather than the clamour of the "Ultrar," forced Louis XVIII to urge a change in the electoral law that should render such a "scandal" as Grégoire's election impossible for the future. Dessolle and Louis, refusing to embark on this policy, now resigned, and Decazes became head of the new ministry, as president of the council (Nov 1819). But the exclusion of Grégoire from the chamber and the changes in the "Ultrar" The news of the revolution in Spain in Jan 1820 added fuel to their fury, and when, on Feb 13 the duke of Berry was murdered, clamorous tongues loudly accused Decazes of being an accomplice in the crime. Decazes, foreseeing the storm, at once placed his resignation in the king's hands. Louis at first refused. But in the end he was forced to yield to the importunity of his family (Feb 17), and Decazes, raised to the rank of duke, passed into honourable exile as ambassador to Great Britain. In Dec 1821 he returned to sit in the house of peers, where he continued to maintain his Liberal opinions. After 1830 he adhered to the monarchy of July, but after 1848 he remained in retirement. He had organized in 1826 a society to develop the coal and iron of the Aveyron, and the name of Decazeville was given in 1829 to the principal centre of the industry. He died on Oct 24, 1860.

His son, LOUIS CHARLES ÉLIE DECAZES, duc de Glucksberg (1819–1886), was born at Paris, and became minister plenipotentiary at Madrid and at Lisbon. In 1871 he was elected deputy to the national assembly by the Gironde, and was chosen by the duc de Broglie as minister of foreign affairs in Nov 1873. He voted with the Orleanists the "constitutional laws" of 1875, and approved of Comte de MacMahon's parliamentary coup d'état on May 16, 1877. He died on Sept 16, 1886.

On the duc Decazes see E. Daudet, *Louis XVIII et le duc Decazes* (1899), and his "L'Ambassade du duc Decazes" in the *Revue des deux mondes* for 1899.

DECAZEVILLE, a town of south central France, in the department of Aveyron, 34 mi. NW of Rodez by the Orleans railway. Pop. (1946) 12,138. It possesses iron mines and is the industrial centre of the coal and iron fields of the Aveyron, which supply the ironworks established by the duc Decazes, minister of Louis XVIII. A statue commemorates the founder.

DECCAN (Sansk. *Dakṣiṇa*, "the South"), a name applied, according to Hindu geographers, to the whole of India situated south of the river Narbada. It is sometimes understood as the country between that river and the Kistna, the latter having long formed the southern boundary of the Moslem sultanates of the Deccan. In the more extended meaning it includes the whole Indian peninsula, and in this view the Eastern and Western Ghats constitute the most striking feature. These two ranges unite in the north with the Vindhya mountains and thus form a vast triangle enclosing the high tableland from Cape Comorin to the valley of the Narbada. The surface of this tableland slopes from west to east—the great rivers, the Cauvery, Godavari, Kistna and Pennar, though deriving their sources from the base of the Western Ghats, all finding their way into the Bay of Bengal through fissures in the Eastern Ghats.

History—For the early history of the Deccan under Asoka and the Andhras, Vakatakas, Chalukyas, Rashtrakutas, Yadavas and Kakatiyas see the article *INDIA History*, and also *BOMBAY PRESENTDAY History*.

In 1294 Ala ud Din Khilji, nephew of the Delhi emperor, invaded the Deccan, stormed Dargir (Daulatabad, *qv*) and reduced the Yadava rajyas of Multashira to the position of tributary princes. In 1307, after Ala ud Din's accession to the throne, a fresh series of Moslem incursions began, under Malik Kafur, ending in the final ruin of the Yadava power, and by 1333 the reduction of the Deccan had been completed by Mohammed ben Tughlak. The imperial sway was, however, of brief duration. Telingana and Carnata speedily reverted to their former masters, and this defection on the part of the Hindu states was followed by a general revolt of the Moslem governors, resulting in the establishment in 1347 of the independent Mohammedan dynasty of Bahmani and the consequent withdrawal of the power of Delhi from the territory south of the Narbada. On the dissolution of the Bahmani empire between 1482 and 1518, its dominions were distributed into the five Mohammedan states of Golconda, Bijapur, Ahmednagar, Bidar and Berar. To the south of these the great Hindu state of Vijayanagar (*qv*) still survived, but this, too, was destroyed, at the battle of Talikota (1565), by a league of the Mohammedan powers, who also in their turn soon disappeared before the victories of the Delhi emperors. Their rule was of short duration. In 1706 the Marhattas acquired the right of levying tribute in southern India, and their principal chief, the peshwa of Poona, became a practically independent sovereign. A few years later Nizam ul Mulk, the Mogul viceroy of the Deccan, threw off his allegiance and established the seat of an independent government at Hyderabad (1724). The remainder of the imperial possessions in the peninsula were held by chieftains acknowledging the supremacy of one or the other of these two potentates. In the sequel Mysore became the prize of the Mohammedan usurper Hyder Ali. Mysore formed one of the earliest British conquests in the Deccan. Tanjore and the Carnatic were shortly after annexed. In 1818 the forfeited possessions of the peshwa added to their extent, and these acquisitions, with others which later fell to the paramount power by cession, conquest or failure of heirs, formed a continuous territory stretching from the Narbada to Cape Comorin.

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DECELEIA (Gr. *Δεκελία*), an Attic deme, on the pass which led over the east end of Mt. Parnassos toward Oropus and Chalcis (Khalkis), commanding the Athenian plain. Its eponymous hero, Decelus, was said to have indicated to the Tyndaridae, Castor and Pollux, the place where Theseus had hidden their sister Helen at Aphidnae, and hence there was a traditional friendship between the Decelians and the Spartans (Herodotus, ix, 73). This tradition, together with the advice of Alcibiades, led the Spartans to fortify Decelcia as a basis for permanent occupation in Attica during the later years of the Peloponnesian War, from 413–404 B.C. Its position enabled them to harass the Athenians frequently and to form a centre for fugitive slaves and other deserters. The royal palace of Tatol was built on the site.

See *PELOPONNESIAN WAR*, THE, also Judeich in Pauly-Wissowa, *Real-encyclopädie*.

DE CELLES, ALFRED DUCLOS (1843–1925), Canadian writer, was born at St. Laurent, Que., and educated at Quebec seminary and Laval university. He edited successively the newspapers *Le Journal de Québec*, *La Minerve* and *L'Opinion Publique* before becoming librarian of the dominion parliament in 1880. Thenceforth he devoted himself to history, producing *La Crise du régime parlementaire* (1888), *La conquête de la liberté en France et au Canada* (1891), *Les Constitutions du Canada* (1900), *Les États Unis* (1896), *Papeau, Carlier* (1904), *Carlier et son temps* (1907), *The "Patriotes" of 1837* (1916).

DECEMBER (Lat. *decem*, "ten"), the last month of the year. In the earliest Roman calendar, the year was divided into ten months, the last of which was called December, or the 10th month, and this name was retained for the last, or 12th, month

of the year as now divided Julius Caesar gave the month its present length. The *Saturnalia* occurred in December, which explains the phrase of Horace "hibernate Decembri utere." Martial applies to the month the epithet *canus* (hoary), and Ovid styles it *gelidus* (hoisty) and *fumosus* (smoky). The Saxons called it *winter monath*, winter month, and *heligth monath*, holy month, from the fact that Christmas fell within it. Thus the modern Germans call it *Christmonat*. In December is the date of the winter solstice, when the sun reaches the tropic of Capricorn.

DECEMVIRI, "the ten men," the name applied by the Romans to any official commission of ten, followed by a statement of the purpose for which the commission was appointed, e.g., *Viri stitibus iudicandis, sacris facundis*, etc.

I Usually, it signified the temporary commission which superseded all the ordinary magistrates from 451 to 449 B.C., for the purpose of drawing up a code of laws. In 462 B.C. a tribune proposed the appointment of a commission to draw up a code to secure for the *plebs* a defence against magisterial caprice. In 452 B.C. decemvirs were appointed to draw up a code, during their tenure of office all other magistracies were in abeyance, but they were bound to maintain the rights of the *plebs*. The first board of decemvirs (wholly patrician) held office during 451 B.C., the chief man among them was Appius Claudius (see CLAUDIUS). The decemvirs ruled with singular moderation, and submitted to the *Comitia Centuriata* a code of laws in ten headings. So popular were the decemvirs that another board of ten was appointed for the following year, some of whom, if the extant list of names is correct, were plebeians. These added two more to the ten laws of their predecessors, thus completing the Laws of the Twelve Tables (see ROMAN LAW). But their rule then became violent and tyrannical. They were forced to abdicate (449 B.C.).

II The judicial board of decemvirs (*stitibus iudicandis*) formed a civil court concerned mainly with the status of individuals. They were originally a body of jurors under the presidency of the praetor (*q.v.*), but eventually became minor magistrates of the republic, elected by the *Comitia Tributa*.

III The priestly board of decemvirs (*sacris facundis*) was half patrician and half plebeian. They were first appointed in 367 B.C., instead of the patrician *disumviri* who had hitherto performed religious duties. Their chief function was the care of the Sibylline books, and the celebration of the games of Apollo and the Secular Games.

IV Decemvirs were also appointed from time to time to control the distribution of the public land (*agris dandis assignandis*, see AGRARIAN LAWS).

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DECEPTION TEST, a name given to the measurement of certain bodily changes caused by the effort of lying, or by fear due to a sense of guilt. Working at Graz, Austria, in 1914, Vittorio Benussi devised a test based on the idea that the rate of breathing is affected by the effort of telling a lie, and that this change could be accurately measured. Three years later Harold Burt further developed this method in the Harvard Psychological Laboratory. In 1915 W. M. Marston, working in the same laboratory, had tested the relation of blood pressure to the effort of lying, but found that all persons examined showed blood pressure higher than normal whether they lied or told the truth.

A psychological deception test, based on association of words, was devised in Austria by Wertheimer and Klein in 1904, and developed by Carl Jung in Switzerland in 1905. Jung read a list of words to three nurses suspected of stealing a purse. Some of these words referred to objects which would have been seen when the theft was committed, and the suspects were asked to give associated words. In Jung's view the guilty nurse gave words which would not have been in the mind of an innocent person and further revealed guilt by delay in answering.

The vegetable alkaloid scopolamin was used by a Texas physician, R. E. House, with the idea that it produced a garrulous

semi-intoxication in which the truth was likely to be blurted out. Another test depends on the variation in electrical conductivity of the skin caused by the secretion of sweat under pressure of emotion. The objection to these forms of trial by ordeal is that they are considered too uncertain to be used with assurance in criminal trials.

See C. T. McCormick, "Deception Test and the Law of Evidence," *California Law Review* (Sept. 1917).

DECEBERATE RIGIDITY see EQUILIBRIUM, ANIMAL.

DE CESARE, CARLO (1824-1882), Italian political economist and legislator, was born at Spinazzola. He studied at Naples and was successively inspector general of the banks of issue, secretary general of agriculture, industry and commerce in 1868, and counsellor of the "cour des comptes." In his chief work, *Manuale di Economia pubblica* (2 vols., 1862), he advocated the doctrines of Ricardo. Of his numerous other works the most important are *Il mondo civile e industriale nel secolo XIX* (1857), *Del potere temporale del Papa* (2nd ed., 1861), *Il primo unitario italiano* (2nd ed., 1861), *La Politica, l'Economia e la Morale dei moderni Italiani* (1869), and *La Germania Moderna* (2nd ed., 1874). De Cesare died at Rome in 1882.

DECHAMPS, ADOLPHE (1807-1875), Belgian statesman, born on June 17, 1807, at Melle, in 1842 became governor of Luxembourg, in 1843 minister of public works, during his office working for the opening up of railways, and in 1845 minister of foreign affairs. His intimate knowledge of contemporary politics is exhibited in his *La Second Empire* (1859), *L'Empire et l'Angleterre* (1860), *La France et l'Allemagne* (1865), and *Le Prince de Bismarck et l'entrevue des trois empereurs* (1873). He died on July 19, 1875.

See E. de Moreau, *A. Dechamps* (Brussels, 1911).

DECHEN, HEINRICH VON (1800-1889), German geologist, was born in Berlin on March 25, 1800, and was educated in the university in that city. He was in the service of the mining department of the Prussian State for 44 years in all, being its director from 1841 to 1864. He paid special attention to the coalformation of Westphalia and northern Europe generally and wrote some important works on the mineralogy of the Rhineland, but his main work was a geological map of Rhenish Prussia and Westphalia in 35 sheets on the scale of 1:80,000, issued with two volumes of explanatory text (1855-82). He published also a small geological map of Germany (1869). He died at Bonn on Feb. 15, 1889.

DECIDUOUS, a botanical and zoological term for "falling in season," as of petals after flowering, leaves in autumn, the teeth or horns of animals, or the wings of insects.

DECIMAL see ARITHMETIC, FRACTION, NUMERICAL SYSTEMS. **DECIMAL COINAGE**, any currency in which the various denominations of coin are arranged in multiples or submultiples of ten (Lat. *decem*) with reference to a standard unit. Thus if the standard unit be 1 the higher coins will be 10, 100, 1,000, etc., the lower 1, 0.1, 0.01, etc. In a perfect system there would be no breaks or interpolations, but the actual currencies described as "decimal" do not show this rigid symmetry. In France the standard unit—the franc—has the 10 franc and the 100 franc pieces above it, the 10 centime below it, there are also, however, 50 franc, 20 franc, 5 franc, 2 franc pieces as well as 50 and 20 centime and other denominations. Similar irregularities occur in the German and United States coinages.

Subject to these practical modifications the leading countries of the world (Great Britain and India are the chief exceptions) have adopted decimal coinage. The United States led the way (1786 and 1792, see MORRIS, GOUVERNEUR), and France soon followed (1799 and 1803), her system being extended to the countries of the Latin Union (1865). Germany (1873), the Scandinavian States (1875), Austria-Hungary (1870, developed in 1892) and Russia (1839 and 1897) are further adherents to the decimal system. The Latin-American countries and Japan (1871) have also adopted it.

In Great Britain proposals for decimalizing the coinage have often been discussed. Besides the inconvenience of altering the

established currency, the difficulty of choosing between the different schemes propounded has been a considerable obstacle. One plan took the farthing as a base then 10 farthings = 1 dot (24d), 10 dots = 1 florin (2s 1d), 10 florins = 1 pound (20s 10d). The advantages claimed for this scheme were the preservation of the smaller coins and the avoidance of interference with the smaller retail prices. Its great disadvantage was the destruction of the existing unit of value. Another proposal would retain the pound as unit and the florin, but would subdivide the latter into 100 "units" (or farthings reduced 4%) and introduce a new coin = 10 units (24d). By it the unit of account would remain as at present, and the shilling (as 50 units) would continue in use. The alteration of the bronze and several silver coins, and the need of readjusting all values and prices expressed in pence, formed the principal difficulties.

A third scheme, which was connected with the assimilation of English to French and American money, proposed the establishment of an 8s gold coin as unit, with the penny and franc and the penny (reduced by 4%) as subdivisions. The new coin would be equivalent to 10 francs or (by an anticipated reduction of the dollar) 2 dollars.

A fourth scheme was put forward by the Decimal association to meet the objections raised by the royal commission on coinage of 1918-20 to the proposed 6-mill system (= £ divided into 1,000 parts). This scheme left all the silver coins unchanged but proposed to increase the value of the copper coins by 20%, so that the shilling would consist of ten instead of 12 pence.

For the general question of monetary scales see MONEY, and for the decimal system in reference to weights and measures see MEASURES AND WEIGHTS.

DÉCIN or **TETSCHEN**, a town on the right bank of the Elbe in Bohemia, Czechoslovakia, it owes its chief importance to the fact that it shares with the sister town of Podmokly (qv) the guardianship of the entrance to Bohemia from Saxony. It has a varied development of industry, its products comprising chemicals, confectionery, dyes, plaster of Paris, cotton goods, cellulose, flour and beer. The town is dominated by a rocky height crowned by an old 17th century chateau and the frontier position is evident in the fact that its control alternated between Saxony and Bohemia and in the composition of the population (1930), 13,034, of whom about 10,000 are German. The town has road and rail connection with Bodenbach. With the Sudetenland the town was occupied in 1938 by the Germans.

DECIVS, GAIUS MESSIVS QUINTVS TRAIANVS (A.D. 201-251), Roman emperor, was born at Budala near Sirmium in lower Pannonia in 201. About 245 the emperor Philip the Arabian entrusted him with a command on the Danube, and in 249 (or end of 248), having been sent to put down a military rising in Moesia and Pannonia, he was proclaimed emperor, against his will. Philip advanced against him and was slain near Verona. Decius had to take the field at once against the Goths, who crossed the Danube and overran Moesia and Thrace. The details of the campaign are obscure. The Goths were surprised by the emperor while besieging Nicopolis on the Danube, at his approach, they crossed the Balkans and attacked Philippopolis. Decius followed but was defeated near Beroe. Philippopolis fell and its commander, Priscus, declared himself emperor under Gothic protection. The siege had so exhausted the Goths that they offered to surrender their booty and prisoners on condition of being allowed to retire unmolested. But Decius, who had succeeded in surrounding them, refused their offer. The final engagement took place on swampy ground in the Dobruja near Abritum (Abrittus) or Forum Treboni and ended in the defeat and death of Decius and his son. Decius was a capable soldier and administrator. The chief blot on his reign was the systematic and authorized persecution of the Christians, which had for its object the restoration of the religion and institutions of ancient Rome. Decius tried to revive the separate office and authority of the censor. The choice was left to the senate, who unanimously selected Valerian (afterwards emperor) who declined the responsibility. The invasion of the Goths and the death of Decius put an end to the abortive attempt.

See Aurelius Victor, *De Caesaribus*, 29, *Epit.* 29, Jordanes, *De rebus Geticis*, 18, fragments of Dexippus, in C. W. Müller, *Frag. Hist. Graec.* 18 (1849), Edward Gibbon, *Decline and Fall*, chap. 10, H. Schiller, *Geschichte der römischen Kaiserzeit*, 1 (pt. 2), 1883.

DECIVS MUS, PUBLIVS see MUS

DECIZE, a town of central France, in the department of Nièvre, on an island in the Loire, 24 mi S.E. of Nevers by the Paris-Lyon railway. Pop. (1936) 3,357. Julius Caesar mentions it as Decetia, stronghold of the Aedui, and in 52 B.C. held there a meeting of the senate to settle the leadership of the tribe and to reply to his demand for aid against Verucingetorix. Later the counts of Nevers owned it, and granted it a charter of franchise in 1236. The church of Saint Aré dates in part from the 11th and 12th centuries, there are also ruins of a castle of the counts of Nevers. Decize is the starting point of the Nivernais canal. The coal mine of La Machine, which belongs to the Schneider company of Le Creusot, lies 4 mi to the north. The industries of Decize and its suburbs on both banks of the Loire include the working of gypsum and lime, and the manufacture of ceramic products and glass. Trade is in horses from the Morvan, cattle, coal, iron, wood and stone.

DECKEN, KARL KLAUS VON DER (1833-1865), German explorer, was born on Aug. 8, 1833, at Kotzen. He left the military service of Hanover in 1860 to explore East Africa. He reached the volcanic mountain, Kilimanjaro, which he ascended to the height of 15,000 ft., and then explored the East African coast. In 1865 he attempted to navigate the Juba river, but with three others was murdered in Bardera by the Somali, the rest of the party escaping to Zanzibar.

See O. Kersten, *KK v. der Deckens Reisen in Ostafrika* (4 vols., 1869-79).

DECKER, SIR MATTHEW, BART (1679-1749), British merchant and writer on trade, born in Amsterdam in 1679 went to London in 1702 and established himself there as a merchant. He was a director of the East India company, sat in parliament for four years as member for Bishop's Castle, and was high sheriff of Surrey in 1729. He was created a baronet by George I. in 1716. Decker's fame as a writer on trade rests on two tracts. The first, *Serious considerations on the several high duties which the Nation in general, as well as Trade in particular, labours under, with a proposal for preventing the removal of goods, discharging the trader from any search, and raising all the Publick Supplies by one single Tax* (1723, name affixed to 7th ed., 1756), proposed to do away with customs duties and substitute a tax upon houses. He also suggested taking the duty off tea and putting instead a licence duty on households wishing to consume it. The second, an *Essay on the Causes of the Decline of the Foreign Trade, consequently of the value of the lands in Britain, and on the means to restore both* (1744), has been attributed to W. Richardson, but internal evidence is strongly in favour of Decker's authorship. He advocates the licence plan in an extended form, urges the repeal of import duties and the abolition of bounties, and, in general, shows himself such a strong supporter of the doctrine of free trade as to rank as one of the most important forerunners of Adam Smith. Decker died on March 18, 1749.

See the exhaustive article by Prof. E. C. K. Gonner in Palgrave's *Dict. Pol. Econ.*

DECLARATION, formerly, in an action at English law, a precise statement of the cause of action. Under the system of pleading established by the Judicature act 1875, the declaration has been superseded by a statement of claim setting forth the facts on which the plaintiff relies. Declarations are now in use only in certain local courts of record, and in those of the United States and some British colonies in which the common law system of pleading survives. In the United States a declaration is termed a "complaint," which is the first pleading in an action. It is divided into parts—the title of the court and term, the venue or county in which the facts are alleged to have occurred, the commencement, which contains a statement of the names of the parties and the character in which they appear, the statement of the cause of action, and the conclusion or claim for relief. (See PRACTICE AND PROCEDURE.)

The term is also used in other English legal connections, e.g.,

the Declaration of Insolvency (see *BANKRUPTCY*), the Declaration of Title, for which, when a person apprehends an invasion of his title to land, he may, by the Declaration of Title act 1862, petition the Court of Chancery (see *LAND TITLES*), or the Declaration of Trust (see *TRUST AND TRUSTEES*). By the Statutory Declarations act 1835 a solemn declaration may be substituted for an affidavit. In nearly all civilized countries an affirmation is now permitted to those who object to take an oath or upon whose conscience an oath is not binding (see *AFFIDAVIT, OATH*). An exceptional position in law is accorded to a Dying or Deathbed Declaration. Where the charge is one of homicide it is the practice to admit dying declarations of the deceased with respect to the cause of his death. Unsworn declarations as to family matters, e.g., as to pedigree, may also be admitted as evidence, as well as declarations made by deceased persons in the course of their duty (see *EVIDENCE*).

In the United States the declaration survives in such States as still follow common law pleading. It is a statement of all material facts constituting the plaintiff's cause of action in a methodical and legal form filed appropriately. Where code pleading has been adopted, the complaint supersedes the old declaration.

In the United States, the declaration of intention is that statement of an alien that he intends to renounce his or her citizenship and acquire that of the United States. Popularly it is known as "first papers." It may be filed at any time in a court competent in naturalization matters, even though the alien may not be naturalized until he has been a resident for five years. A declaration expires if the alien fails to file his application for naturalization or "second papers" within a period of seven years thereafter. If subsequently he desires to take out naturalization papers, he must file a new declaration of intention. Two years must elapse between the filing of the declaration of intention and the application for naturalization.

DECLARATION OF INDEPENDENCE in United States history, the act (or document) by which the 13 original States of the Union broke their colonial allegiance to Great Britain in 1776. The controversy preceding the war (see *AMERICAN REVOLUTION*) gradually shifted from one primarily upon economic policy to one upon issues of pure politics and sovereignty, and the acts of Congress, as viewed to day, seem to have been carrying it, from the beginning, inevitably into revolution, but there was apparently no general and conscious drift toward independence until near the close of 1775. The first colony to give official countenance to separation as a solution of colonial grievances was North Carolina, which, on April 12, 1776, authorized its delegates in Congress to join with others in a declaration to that end. The first Colony to instruct its delegates to take the actual initiative was Virginia, in accordance with whose instructions—voted on May 15—Richard Henry Lee, on June 7, moved a resolution "that these United Colonies are, and of right ought to be, free and independent States." John Adams of Massachusetts seconded the motion. The conservatives could only plead the unpreparedness of public opinion, and the radicals conceded delay on condition that a committee be meanwhile at work on a declaration "to the effect of the said resolution," to serve as a preamble thereto when adopted. This committee consisted of Thomas Jefferson, John Adams, Benjamin Franklin, Roger Sherman and Robert R. Livingston. To Jefferson the committee entrusted the actual preparation of the paper. On July 2, by a vote of 12 States—10 voting unanimously, New York not voting, and Pennsylvania and Delaware casting dividing ballots (3 votes in the negative)—Congress adopted the resolution of independence, and on the 4th, Jefferson's "Declaration." The 4th has always been the day celebrated, the decisive act of the 2nd being quite forgotten in the memory of the day on which that act was published to the world. "Independence Day" is a holiday in all the States and Territories of the United States. It should also be noted that as Congress had already, on Dec. 6, 1775, formally disavowed allegiance to parliament, the Declaration recites its array of grievances against the crown, and breaks allegiance to the crown. Moreover, on May 10, 1776, Congress had recommended to the people of the Colonies that they form such new governments as their representatives

should deem desirable, and in the accompanying statement of causes, formulated on May 15, had declared it to be "absolutely irreconcilable to reason and good conscience for the people of these colonies now to take the oaths and affirmations necessary for the support of any government under the crown of Great Britain," whose authority ought to be "totally suppressed" and taken over by the people—a determination which, as John Adams said, inevitably involved a struggle for absolute independence, involving as it did the extinguishment of all authority, whether of crown, parliament or nation.

Though the Declaration reads as "In Congress, July 4, 1776" The unanimous Declaration of the thirteen united States of America," New York's adhesion was in fact not voted until the 9th, nor announced to Congress until the 15th—the Declaration being unanimous, however, when it was ordered, on the 19th, to be engrossed and signed under the above title. As read before the army meanwhile, it was headed "In Congress, July 4, 1776. A Declaration by the representatives of the United States of America in General Congress assembled." Contrary to the inference naturally to be drawn from the form of the document no signatures were attached on the 4th. As adopted by Congress, the Declaration differs only in details from the draft prepared by Jefferson, censures of the British people and a noble denunciation of slavery were omitted, appeals to Providence were inserted, and verbal improvements made for the sake of terseness and measured statement. The document is full of Jefferson's fervent spirit and personality, and its ideals were those to which his life was consecrated. It is the best known and the noblest of American State papers. Though open to controversy on some issues of historical fact, not flawless in logic, necessarily partisan in tone and purpose, it is a justificatory preamble, a party manifesto and appeal, reasoned enough to carry conviction, fervent enough to inspire enthusiasm. It mingles—as in all the controversy of the time, but with a literary skill and political address elsewhere unrivalled—state disputation with philosophy. The rights of man lend dignity to the rights of Englishmen, and the broad outlook of a worldwide appeal, and the elevation of noble principles, relieve minute criticisms of an administrative system.

Jefferson's political theory was that of Locke, whose words the Declaration echoes. Both Locke and Jefferson wrote simply of political equality, political freedom. Even within this limitation, the idealistic formulae of both were at variance with the actual conditions of their time. The variance would have been greater had their phrases been applied as humanitarian formulae to industrial and social conditions. The Lockian theory fitted beautifully the question of colonial dependence, and was applied to that by America with inexorable logic, it fitted the question of individual political rights, and was applied to them in 1776, but not in 1690, it did not apply to non-political conditions of individual liberty, a fact realized by many at the time—and it is true that such an application would have been more inconsistent in America in 1776 as regards the negroes, than in England in 1690 as regarded freemen. The Declaration's influence upon American legal and constitutional development has been profound. Locke, says Leslie Stephen, popularized "a convenient formula for enforcing the responsibility of governors"—but his theories were those of an individual philosopher—while by the Declaration a State, for the first time in history, founded its life on democratic idealism, pronouncing governments to exist for securing the happiness of the people, and to derive their just powers from the consent of the governed. It was a democratic instrument, and the revolution a democratic movement, in South Carolina and the Middle Colonies particularly, the cause of independence was bound up with popular movements against aristocratic elements. Congress was fond of appealing to "the purest maxims of representation," it sedulously measured public opinion, took no great step without an explanatory address to the country, cast its influence with the people in local struggles as far as it could, appealed to them directly over the heads of conservative assemblies, and in general stirred up democracy. The Declaration gave the people recognition equivalent to promises, which, as fast as new governments were instituted, were converted by written constitutions into

IN CONGRESS, JULY 4, 1776

THE UNANIMOUS DECLARATION of the thirteen united STATES of AMERICA

WHEN in the Course of human events it becomes necessary for one people to dissolve the political bands which have connected them with another, and to assume among the powers of the earth, the separate and equal station to which the Laws of Nature and of Nature's God entitle them, a decent respect to the opinions of mankind requires that they should declare the causes which impel them to the separation.—We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.—That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed,—That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or to abolish it, and to institute new Government, laying its foundation on such principles and organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happiness. Prudence, indeed, will dictate that Governments long established should not be changed for light and transient causes, and accordingly all experience hath shewn that mankind are more disposed to suffer, while evils are sufferable, than to right themselves by abolishing the forms to which they are accustomed. But when a long train of abuses and usurpations, pursuing invariably the same Object evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government, and to provide new Guards for their future security.—Such has been the patient sufferance of these Colonies, and such is now the necessity which constrains them to alter their former Systems of Government. The history of the present King of Great Britain is a history of repeated injuries and usurpations, all having in direct object the establishment of an absolute Tyranny over these States. To prove this, let Facts be submitted to a candid world.—He has refused his Assent to Laws, the most wholesome and necessary for the public good.—He has forbidden his Governors to pass Laws of immediate and pressing importance, unless suspended in their operation till his Assent should be obtained, and when so suspended, he has utterly neglected to attend to them.—He has refused to pass other Laws for the accommodation of large districts of people, unless those people would relinquish the right of Representation in the Legislature, a right inestimable to them and formidable to tyrants only.—He has called together legislative bodies at places unusual, uncomfortable, and distant from the depository of their public Records, for the sole purpose of fatiguing them into compliance with his measures.—He has dissolved Representative Houses repeatedly, for opposing with manly firmness his invasions on the rights of the people.—He has refused for a long time, after such dissolutions, to cause others to be elected, whereby the Legislative powers, incapable of Annihilation, have returned to the People at large for their exercise, the State remaining in the mean time exposed to all the dangers of invasion from without, and convulsions within.—He has endeavoured to prevent the population of these States, for that purpose obstructing the Laws for Naturalization of Foreigners, refusing to pass others to encourage their migrations hither, and raising the conditions of new Appropriations of Lands.—He has obstructed the Administration of Justice, by refusing his Assent to Laws for

troops among us,—For protecting them by mock trial, from punishment for any Murders which they should commit on the Inhabitants of these States.—For cutting off our Trade with all parts of the world.—For imposing Taxes on us without our Consent.—For depriving us in many cases, of the benefits of Trial by Jury.—For transporting us beyond Seas to be tried

for pretended offences.—For abolishing the free System of English Laws in a neighbouring Province, establishing therein an Arbitrary government, and enlarging its Boundaries so as to render it at once an example and fit instrument for introducing the same absolute rule into these Colonies.—For taking away our Charters, abolishing our most valuable Laws and altering fundamentally the Forms of our Governments.—For suspending our own Legislatures, and declaring themselves invested with power to legislate for us in all cases whatsoever.—He has abdicated Government here, by declaring us out of his Protection and waging War against us.—He has plundered our seas, ravaged our Coasts, burnt our towns, and destroyed the lives of our people.—He is at this time transporting large Armies of foreign Mercenaries to complete the works of death, desolation and tyranny, already begun with circumstances of Cruelty & perfidy scarcely paralleled in the most barbarous ages, and totally unworthy the Head of a civilized nation.—He has constrained our fellow Citizens taken Captive on the high Seas to bear Arms against their Country, to become the executioners of their friends and Brethren, or to fall themselves by their hands.—He has excited domestic insurrections amongst us, and has endeavoured to bring on the inhabitants of our frontiers, the merciless Indian Savages, whose known rule of warfare, is an undistinguished destruction of all ages, sexes and conditions. In every stage of these Oppressions We have Petitioned for Redress in the most humble terms: Our repeated Petitions have been answered only by repeated injury. A Prince, whose character is thus marked by every act which may define a Tyrant, is unfit to be the ruler of a free people. Nor have We been wanting in attentions to our British brethren. We have warned them from time to time of attempts by their legislature to extend an unwarrantable jurisdiction over us. We have remonstrated to them of the circumstances of our emigration and settlement here. We have appealed to their native justice and magnanimity, and we have conjured them by the ties of our common kindred to disavow these usurpations, which would inevitably interrupt our connections and correspondence. They too have been deaf to the voice of justice and of consanguinity. We must, therefore, acquiesce in the necessity, which denounces our Separation, and hold them, as we hold the rest of mankind, Enemies in War, in Peace Friends.—

WE, THEREFORE, the Representatives of the UNITED STATES OF AMERICA, in General Congress, Assembled, appealing to the Supreme Judge of the world for the rectitude of our intentions, do, in the Name, and by Authority of the good People of these Colonies, solemnly publish and declare, That these United Colonies are, and of Right ought to be FREE and INDEPENDENT STATES, that they are Absolved from all Allegiance to the British Crown, and that all political connection between them and the State of Great Britain, is and ought to be totally dissolved, and that as Free and Independent States, they have full Power to levy War, conclude Peace, contract Alliances, establish Commerce, and to do all other Acts and Things which Independent States may of right do. And for the support of this Declaration, with a firm reliance on the protection of divine Providence, we mutually pledge to each other our Lives, our Fortunes and our sacred Honor.

| | | |
|--------------------|-------------------|------------------|
| John Hancock | Benj Harrison | Lewis Morris |
| Button Gwinnett | Thos Nelson, Jr | Richd Stockton |
| Lyman Hall | Francis Lightfoot | Jno Witherspoon |
| Geo Walton | Lee | Fras Hopkinson |
| Wm Hooper | Carter Braxton | John Hart |
| Joseph Hewes | Robt Morris | Abra Clark |
| John Penn | Benjamin Rush | Josiah Bartlett |
| Edward Rutledge | Benj Franklin | Wm Whipple |
| Thos Heyward, Jr | John Morton | Saml Adams |
| Thomas Lynch, Jr | Geo Clymer | John Adams |
| Arthur Middleton | Jas Smith | Robt Treat Paine |
| Samuel Chase | Geo Taylor | Elbridge Gerry |
| Wm Paca | James Wilson | Step Hopkins |
| Thos Stone | Geo Ross | William Ellery |
| Charles Carroll of | Cesar Rodney | Roger Sherman |
| Carrollton | Geo Read | Sam Huntington |
| George Wythe | Tho M Kean | Wm Williams |
| Richard Henry Lee | Wm Floyd | Olver Wolcott |
| Th Jefferson | Phil Livingston | Matthew Thornton |
| | Frans Lewis | |

THE DECLARATION OF INDEPENDENCE OF THE UNITED STATES

The text of the Declaration of Independence. The original document is shown in facsimile on the facing page.

rights, which have since then steadily extended

For 101 years after the Declaration was proclaimed it had no permanent home. During its wanderings, it found shelter in 10 cities and 5 states, twice narrowly escaped destruction by fire, and in both the Revolutionary War and the War of 1812 was nearly captured by the British. In 1894, when the text of the manuscript had been dimmed by more than 50 years' exposure to light and its signatures damaged by too frequent rolling of the parchment, the document was placed in a safe in the State Department library. Finally, in 1927, it was removed to the Library of Congress, where it is on permanent exhibition in a shrine specially constructed for its preservation and safekeeping.

The signers were: John Hancock (1737-92), of Massachusetts, president; Button Gwinnett (c. 1732-77), Lyman Hall (1725-90), George Walton (1740-1804), of Georgia, William Hooper (1742-90), Joseph Hewes (1730-79), John Penn (1741-88), of North Carolina, Edward Rutledge (1749-1800), Thomas Heyward, Jr. (1746-1809), Thomas Lynch, Jr. (1749-79), Arthur Middleton (1742-87), of South Carolina, Samuel Chase (1741-1811), William Paca (1740-99), Thomas Stone (1743-87), Charles Carroll (1737-1832) of Carrollton, Md., George Wythe (1726-1806), Richard Henry Lee (1732-94), Thomas Jefferson (1743-1826), Benjamin Harrison (1740-91), Thomas Nelson, Jr. (1738-80), Francis Lightfoot Lee (1734-97), Carter Braxton (1736-97), of Virginia, Robert Morris (1734-1806), Benjamin Rush (1745-1813), Benjamin Franklin (1706-90), John Morton (1724-77), George Clymer (1739-1813), James Smith (c. 1719-1806), George Taylor (1716-81), James Wilson (1742-98), George Ross (1730-79), of Pennsylvania, Caesar Rodney (1728-84), George Read (1733-98), Thomas McKean (1734-1817), of Delaware, William Floyd (1734-1821), Philip Livingston (1716-78), Francis Lewis (1732-1803), Lewis Morris (1726-98), of New York, Richard Stockton (1730-81), John Witherspoon (1722-94), Francis Hopkinson (1737-91), John Hart (1768-80), Abraham Clark (1726-94), of New Jersey, Josiah Bartlett (1729-95), William Whipple (1730-85), Matthew Thornton (1714-1803), of New Hampshire, Samuel Adams (1722-1803), John Adams (1735-1826), Robert Treat Paine (1731-1814), Elbridge Gerry (1744-1814), of Massachusetts, Stephen Hopkins (1707-85), William Ellery (1727-1820), of Rhode Island, Roger Sherman (1721-93), Samuel Huntington (1733-96), William Williams (1731-1811), Oliver Wolcott (1726-97), of Connecticut. Not all the men who rendered the greatest services to independence were in Congress in July 1776, not all who voted for the Declaration ever signed it, not all who signed it were members when it was adopted. The greater part of the signatures were certainly attached on Aug. 2, but at least six were attached later. With one exception—that of Thomas McKean, present on July 4, but not on Aug. 2, and permitted to sign in 1781—all were added before printed copies with names attached were first authorized by Congress for public circulation in Jan. 1777.

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DECLARATION OF LONDON see **CONTRA BAND, PRIZE, NEUTRALITY, VISIT AND SEARCH**

DECLARATION OF PARIS (1856) owes its origin to the diametrically opposing views of Great Britain and France on

the carriage of property at sea at the time of the Crimean War. In 1854 France allowed enemy goods in neutral vessels to go free, but confiscated neutral goods in enemy vessels, whilst Great Britain confiscated enemy goods in neutral vessels, but respected neutral goods in enemy vessels. The situation was an impossible one for neutrals. Accordingly each Power abandoned part of its doctrines and acceded to part of its ally's doctrines. This compromise finds expression in Articles 2 and 3 of the Declaration, which stated four principles of international law—

1. Privateering is and remains abolished. 2. The neutral flag covers enemy's goods, with the exception of contraband of war. 3. Neutral goods, with the exception of contraband of war, are not liable to capture under the enemy's flag. 4. Blockades in order to be binding must be effective, that is to say, maintained by a force sufficiently real to prevent access to the coast of the enemy. (See Hertslet, *Treaties*, x, p. 547.)

The Declaration was signed by Austria, France, Great Britain, Prussia, Russia, Sardinia and Turkey, and acceded to by all the Powers except Bolivia, Spain, United States, Uruguay and Venezuela. Spain acceded in 1908. The United States withheld formal adherence on the ground that, not possessing a large navy, she was obliged to rely upon privateers, and she would not agree to their abolition unless the principle of the immunity of private property at sea were generally accepted. At the commencement, however, of the Civil War and again in the Spanish American War, 1898, she declared her adherence to the Declaration for the duration of hostilities only. Spain in the latter war, whilst repudiating any obligation to the Declaration, announced that she would take a similar course.

During the World War it was declared in the British Prize Court that the court would regard the Declaration not only in the light of rules binding in the conduct of war, but as a recognized and acknowledged part of the law of nations, see *The Marie Glaeser*, 1 B. & C. P. 38 (141). But with the disappearance of the "Free List", by the extension of the term "contraband" to all commodities of use, directly or indirectly, to the enemy in the operations of war, by the presumption of hostile destination, by the application of the doctrine of continuous voyage, Article 4 became almost wholly nullified. Article 3 was also rendered almost wholly nugatory by the German submarine method of indiscriminate destruction. Whilst the neutral owner of goods on board an enemy vessel was entitled to their restitution or value when brought in for adjudication, he took the risk of all necessary acts of war. It was held by the French and German Prize Courts that in the case of lawful destruction of an enemy merchant vessel compensation for loss of neutral goods on board could not be claimed. Sinking at sight, without visit and search, was, however, illegal, and it has now been prohibited by the Treaty of Washington, 1922, *Parl. Pap.* 1922 [Cmd. 1627], ratified by the United States, the British Empire, Italy and Japan. Article 4 was reproduced in the Declaration of London and it was objected that the so-called blockade of the German coast on the Baltic was not effective, since neutral Baltic States still had access to German Baltic ports. The answer is that the British measures were taken under the law of contraband and not under those of blockade. (H. H. L. B.)

DECLARATOR, in Scots law, a form of action by which some right of property, or of servitude, or of status, or some inferior right or interest, is sought to be judicially declared.

DECLIFFORD, BARON see **CLIFFORD**

DECLINATION, in magnetism is the angle between true north and magnetic north, i.e., the variation between the true (geographic) meridian and the magnetic meridian. It is derived from *Lat. declinare*, to decline. In 1596 at London the angle of declination was 11° E. of N., in 1652 magnetic north was true north, in 1813 the magnetic needle pointed 24½° W. of N., in 1891 18° W., in 1896 17° 56' W. and in 1906 17° 45'. The angle is gradually diminishing and the declination will in time again be 0°, when it will slowly increase in an easterly direction, the north magnetic pole oscillating slowly around the North Pole. Regular daily changes of declination also occur. Magnetic storms cause irregular variations sometimes of one or two degrees. (See

TERRESTRIAL MAGNETISM)

In astronomy the declination is the angular distance, as seen from the earth, of a heavenly body from the celestial equator, thus corresponding with terrestrial latitude. (See ASTRONOMY)

DECOLORIZING, in practical chemistry and chemical technology, the removal of coloured impurities from a substance. Charcoal, sometimes made from blood, bones or sugar, but now most usually made from wood, is frequently used. So called "activated charcoal," which is especially effective as a decolorizing agent, is prepared by treating charcoal with super heated steam for several hours at 800-1,000° C, or with air at 350-400° C. When shaken with a coloured solution, charcoal often retains the coloured substances, leaving the solution colourless. Thus the red colour of wines may be removed by filtering the wine through charcoal, the removal of the dark coloured impurities of crude sugar may be similarly effected. Other "decolorizers" acting through purely chemical reactions are chlorine, sulphurous acid, permanganates and manganates, all of which have received application in the sugar industry. (See CHARCOAL and ADSORPTION)

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DECORAH, a city of northeastern Iowa, U.S.A., on the upper Iowa river, the county seat of Winnebago county. It is on federal highway 52, and is served by the Chicago, Milwaukee, St Paul and Pacific and the Rock Island railways. The population was 6,059 in 1950 and 5,303 in 1940. It is the seat of Luther college (1861). Decorah is supported by farming, and the main product is corn which is fed to hogs, and the hogs in turn are marketed. No corn is sold. A famous ice cave is near by. Decorah was founded about 1849, incorporated as a city in 1871.

DECORATED PERIOD, in architecture, the name of the second of the three periods into which the English Gothic was usually divided, generally embracing the first three quarters of the 14th century. It may itself be divided into two, the earlier half being known as the Geometric period, and the later as the Curvilinear, although no definite date separates these two parts. The Geometric Decorated style is characterized by window tracery based on the arch, the circle and the quatrefoil and trefoil, frequently much cusped. (See CURVE) Windows of great width and height were thus treated, with two, four, six or even eight lights, or main subdivisions. In the later, or curvilinear style, the ogee curve, or curve of double curvature, controls tracery design. Two main types thus developed, one, in which the tracery bars form a net, the other in which flame-like, or flowing forms predominate. (See TRACERY) In the entire decorated period moulding profiles are heavy and complex, carved ornament is intricate and of great naturalism. The most famous examples are the east end of Lincoln cathedral and the crossing and western part of the choir of Ely. During the decorated period, church vaulting became much complicated and subdivided by the addition, first of tiercerons, which are additional vaulting ribs springing from the capital, and rising to the ridge, toward the end of the period there also appeared liernes, which are smaller ribs of little structural value, connecting the more important ribs, and so forming star or network patterns. (T F H)

DECORATION DAY, a holiday, known also as Memorial day, observed in the northern states of the United States on May 30, originally in honour of soldiers killed in the U.S. Civil War, but subsequently also in honour of those who fell in later wars. Before the close of the Civil War May 30 was thus celebrated in several of the southern states, in the north there was no fixed celebration until 1868, when (on May 5) Commander-in-Chief John A. Logan, of the Grand Army of the Republic, issued a general order designating May 30, 1868, "for the purpose of strewing with flowers or otherwise decorating the graves of comrades who died in defense of their country during the late rebellion", Logan did this "with the hope that it will be kept up from year to year". In 1882 the Grand Army urged that the "proper designation of May 30 is Memorial Day"—not Decoration day. Rhode Island made it a legal holiday in 1874, Vermont in 1876 and New Hampshire in 1877, and by 1910 it was a legal

holiday in all the states and territories save Alabama, Alaska, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Texas. In Virginia May 30 is observed as a Confederate Memorial day. June 3 (the birthday of Jefferson Davis) is observed as Confederate Memorial day in Louisiana and Tennessee, April 26, in Alabama, Florida, Georgia and Mississippi, and May 10, in North Carolina and South Carolina.


DECORATIVE ART, that art which is concerned with the decoration of objects which in themselves are not necessarily beautiful, being practically the same meaning as applied art or the arts and crafts. Decorative art may concern itself with the treatment of architectural units, furniture, textiles or any other object which the human being feels should not only be useful but beautiful. If the object has no use other than that of its aesthetic appeal the art is no longer decorative but falls into what is known as fine art. Good decorative art is appropriate in its adaptation and seems to be a part of the object upon which it is executed, as though it had sprung from within, rather than as though it had been applied on the surface. (See PAINTING, DRAWING, SCULPTURE, ARTS AND CRAFTS, etc.)

DE CORT, FRANS (1834-1878), Flemish poet, was born June 21, 1834, at Antwerp, and died Jan 18, 1878, at Elsenre. He edited the *Schelde* from 1858, and from 1861 to his death was secretary to the general auditor of the Brussels military court. His *Leidenen* (2 vols., 1857), his *Zingzang* (1866) and his *Leidenen* of 1868 show great tenderness and feeling. His translation of poems from Burns appeared in 1862. He made many fine translations from Jasmijn, the Provencal poet, and from the German.

DECOY, a contrivance for the capture or enticing of duck and other wild fowl within range of a gun, hence any trap or enticement into a place or situation of danger. Decoys are usually made on the following plan: long tunnels leading from the sea, channel or estuary into a pool or pond are covered with an arched net, which gradually narrows in width, the ducks are enticed into this by a tame trained bird, also known as a "decoy" or "decoy-duck". In America the "decoy" is an artificial bird, placed in the water as if it were feeding, which attracts the wild fowl within range of the concealed sportsman. The word "decoy" has, etymologically, a complicated history. It appears in English first in the 17th century in these senses as "coy" and "coy duck," from the Dutch *kooi*, a word which is ultimately connected with Latin *cavea*, hollow place, "cage." The term is used in football in the case of deceptive plays, i.e., decoying tacklers in a wrong direction, and is a synonym for trickery of the sort in various sports.

It is also widely used in similar sense in police parlance—detection of crime, etc.

DECREE, in earlier form *Decreet*, an authoritative decision having in some places the force of law, also the judgment of a court of justice. In Roman law, a decree (*decretum*) was the decision of the emperor, as the supreme judicial officer, settling a case which had been referred to him. In ecclesiastical law the term was given to a decision of an ecclesiastical council settling a doubtful point of doctrine or discipline (cf. also DECRETALS). In English law decree was more particularly the judgment of a court of equity, but after the Judicature acts the expression "judgment" (see PRACTICE AND PROCEDURE) has been employed in reference to the decisions of all the divisions of the supreme court. A "decree nisi," now "order nisi," is the conditional order for a dissolution of marriage made by the divorce court (see DIVORCE). *Decreet arbitral* is a Scottish phrase for the award of an arbitrator. In some foreign countries, e.g. in Spain, royal decrees may amount to legislation, while in some the subsequent ratification by the legislature is required. In the United States, a decree is the judgment given in courts of admiralty and equity. In addition to the decree nisi, courts of equity sometimes issue decrees of nullity, for annulment of marriages.

DECRESCENDO (It, abbr *decresc.*, lit "decreasing," i.e., as used in the familiar musical direction, diminishing in loudness. The sign  conveys the same meaning.

DECRETALS (*Epistolae decretales*), the name (see DECREE above), which is given in canon law to those letters of the pope which formulate decisions in ecclesiastical law, they are generally

given in answer to consultations, but are sometimes due to the initiative of the popes. These furnish, with the canons of the councils, the chief source of the legislation of the church, and form the greater part of the *Corpus Iuris*. In this connection they are dealt with in the article on Canon Law.

The False Decretals.—A special interest, however, attaches to the celebrated collection known as the False Decretals. This collection, indeed, comprises at least as many canons of councils as decretals, and the decretals contained in it are not all forgeries. It is an amplification and interpolation, by means of spurious decretals, of the canonical collection in use in the church in Spain in the 8th century, all the documents in which are perfectly authentic. With these amplifications, the collection dates from the middle of the 9th century.

The author assumes the name of Isidore, evidently the archbishop of Seville, who was credited with a preponderating part in the compilation of the *Hispana* (see CANON LAW), he takes in addition the surname of Mercator, perhaps because he has made use of two passages of Marus Mercator. Hence the custom of alluding to the author of the collection under the name of the "pseudo Isidore."

The collection is divided into three parts. The first, which is entirely spurious, contains, after the preface and various introductory sections, 70 letters attributed to the popes of the first three centuries, up to the council of Nicaea, i.e., up to but not including St. Sylvester, all these are a fabrication of the pseudo-Isidore, except two spurious letters of Clement, which were already known. The second part is the collection of councils, classified according to their regions, as it figures in the *Hispana*, the few spurious pieces which are added, and notably the famous Donation of Constantine (qv), were already in existence. In the third part the author continues the series of decretals which he had interrupted at the council of Nicaea. But as the collection of authentic decretals does not begin till Siricius (385), the pseudo Isidore first forges a letter which he attributes to the pope from Sylvester to Siricius, and then continues the series of decretals. The collection is full of evidences of a discipline which actually existed, so it is by no means all invented.

Thus the authentic elements were calculated to serve as a passport for the forgeries, which were, moreover, skillfully composed, and the collection thus blended was passed from hand to hand without meeting with any opposition. At most all that was asked was whether those decretals which did not appear in the *Liber canonum* (the collection of Dionysius Exiguus, accepted in France) had the force of law, but Pope Nicholas having answered that all the pontifical letters had the same authority, they were henceforward accepted, and passed in turn into the later canonical collections. No doubts found expression until the 15th century, when Cardinal Nodding of Pisa (d. 1464) and Juan Torquemada (d. 1468) freely expressed their suspicions. More than one scholar at the 15th century, George Cressand, L'amus, and the two editors of the *Decretum* of Gratian, Du moulin (d. 1568) and Le Comte (d. 1577), decisively rejected the False Decretals. This contention was again upheld in the form of a violent polemic against the papacy, by the Centuriators of Magdeburg (*Ecclesastica historia*, Basle, 1559-74), the attempt at refutation by the Jesuit Porres (Adversus Centur Magdelurg libri quatuor, Florence, 1572) provoked a violent rejoinder from the Protestant minister David Blondel (*Pseudo Isidorus et Turrisianus rapulantes*, Geneva, 1620). Since then the conclusion has been accepted, and all researches have been of an almost exclusively historical character.

Date.—The author shows himself acquainted with the False Capitularies, three books of capitularies of the Frankish kings (mostly spurious) purporting to have been written by a certain Benedict, a deacon of Mainz. These are for civil legislation while the False Decretals are for ecclesiastical, and their date, 847, gives the earliest possible date for the latter, on the other hand, in a letter of Lupus, abbot of Ferrières, written in 858, and in the synodical letter of the council of Quercy in 857 are to be found quotations which are certainly from these false decretals, and further, an undoubted allusion occurs in the statutes of Hincmar to his diocese on Nov. 1, 857. The composition of the collection may then be dated approximately at 850.

Aim of the Forger.—This is clearly stated in his preface, the reform of the canon law, or rather its better application. But in what particular respects he wishes it to be reformed can be best deduced from certain preponderant ideas which make themselves felt in the apocryphal documents. He constantly harps upon accusations brought against bishops and the way they were judged, his wish is to prevent them from being unjustly accused, deposed or deprived of their sees, to this end he multiplies the safeguards of procedure, and secures the right of appeal to the pope and the possibility of restoring bishops to their sees. His object, too, was to protect the property, as well as the persons, of the clergy against the encroachments of the temporal power. In the second place, Isidore wishes to increase the strength and cohesion of the churches, he tries to give absolute stability to the diocese and the ecclesiastical province, he reinforces the rights of the bishop and his comprovincials, while he initiates a determined campaign against the *chorepiscopi*, finally, as the keystone of the arch he places the papacy. These aims are most laudable and in no way subversive.

Canonical Influence.—It is certain that in 864 Rothad of Soissons took with him to Rome, if not the collection, at least important extracts from the pseudo Isidore, M. Fournier has pointed out in the lifetime of the pope of that time, "L'empereur Louis le Pieux, qui se rendait à Rome, emporta avec lui le pseudo-Isidore."

The pseudo-Isidore was not, however, the only collection of decretals which was in vogue in the 11th century, only two or three insignificant citations of the pseudo-Isidore have been pointed out, the use of the pseudo-Isidoran forged documents did not become prevalent at Rome till about the middle of the 11th century, in consequence of the circulation of the canonical collections in which they figured, but nobody then thought of casting any doubts on their authenticity. One thing only is established, and this may be said to have been the real effect of the False Decretals, namely, they gave a powerful impulse in the Frankish territories to the movement towards centralization round the see of Rome, and opposed legal obstacles to unjust proceedings against the bishops.

BIBLIOGRAPHY.—The best edition is that of P. Hinschius, *Decretales pseudo Isidorus ac et capitula Angilramni* (Leipzig 1863). In it the authentic texts are printed in two columns, the forgeries across the whole width of the page, an important piece of scrupulous page-contains, besides, the classification of the material, a profound study of the sources and other questions bearing on the collection. The nationality and place of composition has been the subject of much discussion. The view that they originated at Rome has long been abandoned. Hinschius and others argue that they were composed in the province of Reims. For instance Hinschius, *Præface* p. xxvii. Tardif, *Histoire des sources du droit canonique* (1887), Schneider *Die Lehre der Kirchenrechtsquellen* (1892). The latter alternative is inclined to place them in the Province of Tours, and at Le Mans a conclusion defended by Simson *Die Entstehung der pseudo-Isidorischen Fälschungen* (1886) and by Fournier, *La Question des fausses decretales* in the *Nouvelle Revue historique de droit français et étranger* (1887-1888), and in the *Revue d'histoire ecclésiastique de Louvain* v. (1906, 1907).

There is a preliminary office for laying a foundation stone (Maskell, pp 191-94) On the day of consecration the bishop vests in a tent outside the church, proceeds thence to the church door, a single deacon being inside the church, and there blesses holy water, twelve lighted candles being placed outside and twelve inside the church He sprinkles the walls all round outside, and knocks at the door, these two actions are repeated twice and after the third knocking he enters the church with his attendant clerics, all laity being excluded He then fixes a cross in the centre of the church and the litany is said, including a special petition for the consecration of church and altar He next inscribes the Greek and Latin alphabets, in form of a St Andrew's cross, on the pavement cindered for the purpose, blesses water, mingled with salt, ashes and wine, and sprinkles thrice the walls inside the church, then the centre of the church longwise and crosswise on the pavement, and then goes round the outside of the church sprinkling it thrice Returning to the centre of the church he sprinkles holy water to the four points of the compass and toward the roof Next he anoints with chrism the twelve internal and twelve external wall crosses, afterwards perambulating the church thrice inside and outside, censuring it

Consecration of Altar—Then follows the consecration of the altar Holy water is mixed with chrism, and with the mixture the bishop makes seven crosses on the altar The altar is sprinkled seven times or thrice with water not mixed with chrism, and the altar-table is washed, censed and wiped A cross is made with oil of catechumens in the centre of the altar, the altar-stone is anointed with chrism, and the whole altar is rubbed with oil of catechumens and with chrism Incense is blessed and the altar censed, five grains of incense being placed crosswise in the centre and corners, and on the grains five slender candle-crosses, which are lit Afterwards the altar is scraped and cleansed, the altar-cloths and ornaments are sprinkled with holy water and placed on the altar, which is then censed The service ends with the celebration of mass The various collects, psalms, anthems, benedictions, etc, have been omitted for the sake of brevity

The Sarum rite described above is substantially identical with that of Rome, but the latter contains in addition one important feature, viz, the translation of relics, found also in the Gallican and other uses After the sprinkling of the church, the bishop prepares cement at the altar He then goes to the place (outside the church) where the relics have been placed overnight and carries them in solemn procession to the church door, where he addresses the people and the founder, and two decrees of the council of Trent are read, together with the deed of foundation Then the bishop, anointing the door with chrism, enters the church with the relics and deposits them in the cavity on the altar, censes and covers them, and anoints the cover The altar is then censed and wiped, as in the Sarum order

This use of relics goes back to the time of St Ambrose (see above), but was not universal The council of Chalcedon (Chelsea) in 816 ordered that part of the consecrated Host should be enclosed if relics were not obtainable The tracing of the Greek and Latin alphabets on the church floor can be traced back certainly to the beginning of the 10th century, and is doubtless earlier Its origin and precise meaning are unknown, but various explanations have been suggested by Rossi and others The annual commemoration of the dedication of a church is probably as old a custom as that of dedication itself In the Roman Catholic Church it is observed as a double feast, of the first class, with octave

The dedication service of the Eastern Church is long and elaborate (see J M Neale, *History of the Holy Eastern Church*, part II, 1850, pp 1042-45) Relics are prepared and guarded overnight in a neighbouring sacred church On the day, the bishop goes to the latter, vests and returns in procession with the relics to the new church and goes round it When he comes to the door the relics are laid on a table called the tetrapodium and the epistle and gospel are read A second and third procession follow, after which the bishop is admitted into the church, the relics are placed in the reliquary and set on the altar, and the bishop is wrapped in a roll of linen over his vestments He then

washes the altar with warm water and with wine and makes crosses on it with chrism The altar is vested and the service ends with the liturgy, which is repeated daily for seven days

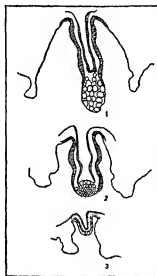
There is no authorized form for the dedication of a church in the reformed Church of England A form was approved by the convocation of Canterbury in 1712, and an almost identical form was submitted in 1715, but neither form ever received royal sanction Anglican bishops have, however, drawn up forms for use in their various dioceses In the diocese of London, for instance, the bishop, attended by clergy and churchwardens, receives outside the west door a petition for consecration, the procession then moves round the whole church outside, while certain psalms are chanted On again reaching the west door the bishop is admitted after knocking thrice and advances to the east end of the church He there lays the keys on the table "which is to be hallowed" The *Veni Creator* is sung, followed by the litany with special suffrages The bishop then blesses the font, chancel, lectern, pulpit, stalls and holy table The deed of consecration is read and signed and Holy Communion is celebrated The Church of Ireland and the episcopal Church of Scotland have no fully authorized form of dedication, but various forms have been issued on episcopal authority

DEDIFFERENTIATION, a biological term meaning the reverse of differentiation, i.e., for processes which lead to organisms or their parts reverting to greater simplicity, the term reduction has also been employed, but is unsatisfactory as it is in demand for chromosome-reduction (See CYTOLOGY) Dedifferentiation in its strict sense should not be applied to simple cases of degeneration, but in practice it is often impossible to draw the line

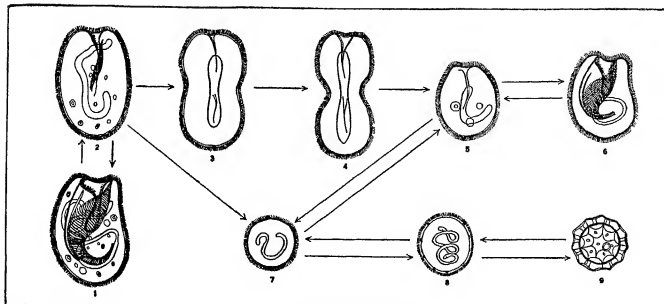
Dedifferentiation in many Protozoa (q.v.) may be a regular and physiological phenomenon When Protozoa with complicated structure, such as many Ciliates, reproduce by simple fission, many

of the old structures differentiate, the daughter-cells acquiring new organs of the same kind by new differentiation In *Bursaria*, Lund has shown that, in addition, damage or unfavourable conditions will cause the whole animal to revert to a sphere without any trace of normal differentiation Redifferentiation to the normal form may occur from this state or from any stage in the process Similar total dedifferentiation occurs in the encystment of *Bursaria* and many other unicellular forms

Starvation is a frequent cause of dedifferentiation The common *Hydra*, by this and other means, may be made to lose all its tentacles, and eventually revert to a mere spheroid with no mouth, and similar phenomena have been described in sea-anemones The common jelly-fish *Aurelia*, kept without food shrinks enormously in bulk, some parts, e.g., the gelatinous bell, being much more reduced than others like the mouth-tentacles, specialized tissues lose their histological differentiation, e.g., the genital organs and the special sense-organs, the tentaculocysts In the worm *Ophryotrocha*, remarkable dedifferentiation occurs if it is damaged or mutilated In starvation, there will clearly be a "struggle of the parts," the less resistant breaking down and serving as food for the rest Starvation itself is apparently favourable to dedifferentiation, but when this has once begun, the tissue can be more readily made to degenerate into mere food-materials This differential resistance of tissues has sometimes been turned to physiological ac-



FROM OF REER AN INTRODUCTION TO EXPERIMENTAL BIOLOGY (CLARENCE PIERCE)
FIG. 1.—STAGES IN THE DEDIFFERENTIATION OF THE TENTACULOCYST OF AURELIA BY STARVATION
(1) Normal tentaculocyst (2) Slightly dedifferentiated (3) Dedifferentiated to a small cell without the characteristic structure



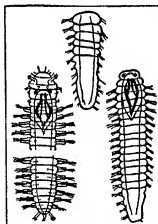
BY COURTESY OF WINTER INSTITUTE OF ANATOMY AND BIOLOGY FROM LINA REVERSIBILITY OF MORPHOGENETIC PROCESSES IN BURSARIA

FIG. 2.—DIAGRAM ILLUSTRATING REVERSIBILITY OF DEVELOPMENTAL PROCESSES IN BURSARIA

(1) Normal animal (2) to (4) Dedifferentiation preparatory to division (5) and (6) A product of division redifferentiating (1) (2) and (7) Dedifferentiation to a sphere as reaction to unfavourable conditions (8) and (9) Formation of resting-stage (oyst) The arrows indicate the direction in which the steps may be taken Many steps are reversible

count in higher forms, e.g., the salmon's sexual organs grow enormously while the fish is in fresh water, though it takes no or negligible food during this time. The necessary material is supplied by the dedifferentiation and later degeneration of the muscles. Similarly the wing-muscles of the queen ant are so constructed that when she breaks off her wings after the nuptial flight, they dedifferentiate, eventually becoming converted into food-material.

Dedifferentiation is often complicated by resorption. When the process has reached a certain stage, many kinds of cell migrate out of the tissues. In higher forms with massive tissues this is not possible, and resorption is usually effected by phagocytes devouring the dedifferentiating cells. This is so in the tail-resorption of metamorphosing tadpoles; the tissues begin to dedifferentiate, but are subsequently attacked by phagocytes.



FROM KORNBLUTH, REGENERATION AND TRANSPLANTATION (GUSTAV FISCHER)

FIG. 3.—DEDIFFERENTIATION OF OPHRYOTROCHA PUERILIS

On left, anterior and posterior ends of body, normal. Right and centre, partial and almost complete dedifferentiation after injury

In lower types, the fate of dedifferentiating organs is largely determined by the space available to the emigrating cells, e.g., in colonial Hydroids, such as *Obelia*, when exposed to unfavourable conditions, the polyps "part to dedifferentiate" or "regenerate".

On a particularly notable example, the regeneration of the final tentacle. If the animal is cut, the tentacle is replaced by a new one. If the animal is cut, the tentacle is replaced by a new one. If the animal is cut, the tentacle is replaced by a new one.

that had occurred

The Ascidians are the most highly organized animals in which total dedifferentiation is possible. This has been best worked out in *Clavelina*. Halved animals may, in the midst of normal regeneration, dedifferentiate to a small opaque spheroid, from which later a whole organism may arise. Intact whole animals, if small, may also dedifferentiate thus. Dedifferentiation may be induced by leaving in unchanged water, redifferentiation by change of water. Two successive dedifferentiations, each followed by redifferentiation, have been obtained in a single animal, though deprived of food throughout.

The internal organs become greatly simplified, and different parts are affected at a very different rate, the cells revert to an embryonic type. Recovery is not possible from the most extreme stages, but at all earlier stages the process is reversible.

Schultz has attempted to show that dedifferentiation is a true reversal of normal development, but later work shows that this view is untenable. The structural changes seen are mainly due to the cells reverting to the "embryonic" type, roughly cubical when in epithelia, spherical when isolated. This, however, is not due to any mysterious force compelling return to the embryonic type because it is embryonic, but because this type has the least amount of surface relative to volume, to maintain any

FROM HIZLEY AND DE BEER IN "THE QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE"

FIG. 4.—DEDIFFERENTIATION AND RESORPTION IN OBELIA

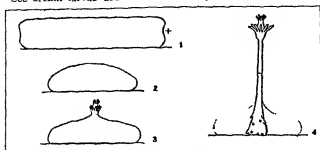
(1) to (5) When a section of stem is left attached to the polyp (1) Normal polyp (2) Dedifferentiation begins, and cells start migrating into the digestive cavity (3) Mouth closed tentacles retracted (4) and (5) Tentacles retracted (6) Tentacles retracted (7) Tentacles retracted (8) Tentacles retracted (9) Tentacles retracted

the same time, a continual performance of work against the forces of entropy is beyond the powers of cells exposed to unfavourable conditions. The picture is complicated by the fact that, the facility with which different tissues dedifferentiate; secondly, the different resistance of cells, leading to the least resistant breaking down and becoming food-material for the others.

Behaviour which may perhaps be included under dedifferentiation is that of (e.g.) certain Planarian flatworms when starved.

These do not revert to a morphologically simpler state, but become smaller, living upon their own capital. As Child showed, these reduced specimens not only acquire the proportions of normal young animals, but are in most respects physiologically young, they have undergone rejuvenation (*qv*). Here the destruction of reserves and the altered surface volume relations probably effect the change automatically.

Sea-urchin larvae dedifferentiate readily in unfavourable con-



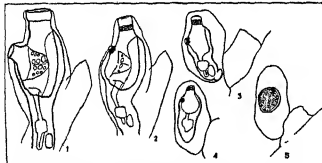
FROM CHILD PHYSIOLOGICAL FOUNDATIONS OF BIOLOGY

FIG 5—DEDIFFERENTIATION IN CORYMORPHA FOLLOWED BY REDIFFERENTIATION WITH NEW POLARITY

(1) A piece of cut stem + is the end nearest to the polyp. (2) The same after dedifferentiation in dilute alcohol in sea water. (3) and (4) When replaced in pure sea water redifferentiation occurs but the new stem axis is at right angles to the old (the polyp being formed where oxygen is most abundant).

ditions, resorbing arms and skeleton, and eventually becoming mouthless lumps. This tendency has been taken advantage of in nature, and dedifferentiation of larval tissues, followed by their resorption into the adult rudiment, is the method of normal metamorphosis (*qv*).

A striking type of dedifferentiation is that of tumour tissue malignant and otherwise. When a tumour is formed, the cells of the tissue from which it arises lose some of their differentiation. Roughly speaking, the greater the malignancy, the more complete the dedifferentiation (See CANCER). This type of dedifferentiation apparently differs importantly from that hitherto discussed, for tumour cells are characterized by undue activity and multiplicative power, whereas in the other type activity is reduced, and multiplication, if present, stopped. Possibly the existence of histological differentiation is only possible at a not too high level of metabolic activity, and relatively such stable scaffolds as connective tissue fibrils, muscle-fibres, nerve-



FROM BUTLER, STRUCTURE IN DEDIFFERENTIATION

FIG 6—REDUCTION PHENOMENA IN THE ASCIDIAN CLAVELINA
(1) Upper part of normal specimen showing heart (below to right) gut, stomach, and rectum (below to left) with above large pharynx opening by upper aperture of atrium (opening by aperture to left). The small circles are all slits leading from pharynx to atrium. (2) to (5) Stages in dedifferentiation of the same specimen to isolate.

fibrils etc. are only constructed and maintained when the cell activities are keyed at a certain pitch, and are broken down when they are higher, just as to use a rough analogy sandbanks are only laid down in a river when its rate of flow is suitable and are destroyed if its speed increases. On the principle of the struggle of the parts, it would be expected further that if cell-metabolism were altered so as to encourage cell reproduction less food-material would be available for maintaining structural differentiation or for activities such as secretion. However, these views, though interesting, are admittedly speculative. They do

not in any case cover all the facts, since differentiation can be shown to be sometimes caused by presumably chemical stimuli from another kind of tissue, e.g., when kidney tubule tissue is cultivated alone in artificial media (see TISSUE CULTURE) its cells dedifferentiate entirely, but when connective tissue is added, the tubule-cells differentiate to form regular tubules.

In any event, it is a well established fact that active cell multiplication is incompatible with the maintenance of differentiation, we may accordingly correlate the dedifferentiation of cancer cells with this fact, and conclude that its origin is different from the dedifferentiation correlated with lowered activity.

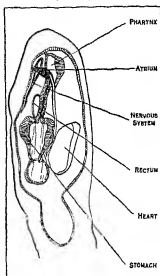
Dedifferentiation associated with increased cell multiplication is also seen in regeneration. In many cases, the first process observed at the cut surface after wound-healing is rapid multiplication of cells to form a so called regeneration blastema, consisting of cells dedifferentiated as far as visible characteristics go. That they are also dedifferentiated in other respects is shown by the interesting results obtained in newts, where grafting of a young regeneration blastema, e.g., of a limb, to some other region, e.g., the newly cut stump of the tail, will cause the blastema to complete the organ on to which it is grafted, instead of that by which it was first regenerated (See REGENERATION IN ANIMALS, EXPERIMENTAL EMBRYOLOGY).

It will be seen that several diverse processes are at present lumped together under the head of dedifferentiation. Not only is the dedifferentiation correlated with increased multiplicative activity to be sharply distinguished from that correlated with depression of activity, but among depressant agencies starvation, at least in moderate degree, probably has a different, less pathological effect than exposure to chemically unfavourable conditions. Distinction should also be made between reversible dedifferentiation and that which is irreversible and therefore leads to degeneration (though reversible dedifferentiation, if long continued, often passes over into irreversible). In reversible cases, investigation is needed as to whether the dedifferentiated cells themselves redifferentiate (as in Protozoa, and undoubtedly in some Metazoa cases, e.g., in early stages of *Clavelina's dedifferentiation*), or whether they degenerate, and redifferentiation occurs from undifferentiated "reserve" cells. Investigation is also needed with reference to "metaplasia"—the capacity for tissues to transform from one differentiated type into another. While this undoubtedly occurs, it is probably confined to the power of a tissue to pass from lower to higher grade of differentiation, as when non cornified epidermis becomes converted into cornified under abnormal stimuli, and to redifferentiation in a new direction after passing through a de-differentiated phase in which cell multiplication has taken place, as in the above-cited example from regeneration. The study of tissue culture may solve several of these problems.

See also REGENERATION IN ANIMALS, EXPERIMENTAL EMBRYOLOGY, CANCER, TISSUE CULTURE.
BIBLIOGRAPHY—L. Scholtz, "Über den embryonalen Entwicklungsprozess, 'Rück-Entwicklung' und 'Abwärts-Entwicklung' im Tierreich" (1908). C. M. Child, "Senescence and Rejuvenation" (1915). B. Dürken, "Fortschritte der Experimentellen Zoologie" (1919), 15. H. H. Oskar, "Zur Vererbung", Morph., Robert, "Metamorphose und Evolution" (1926).

DE DONIS CONDITIONALIBUS see LATITUD.

DEDUCTION, a term used in common parlance for the process of taking away from, or subtracting (as in mathematics),



BY COURTESY OF THE BIOLOGICAL STATION JARVIS

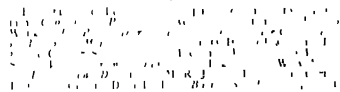
FIG 7—DEDIFFERENTIATION IN CLAVELINA

Internal anatomy of a specimen, showing the way in which certain organs dedifferentiate more rapidly than others.

and specially for the argumentative process of arriving at a conclusion from evidence, *i.e.*, for any kind of inference (from Lat *deducere*, to take or lead from or out of, derive). Two forms of the verb are used, "deduce" and "deduct", originally synonymous, they are now distinguished, "deduce" being confined to arguments, "deduct" to quantities. In this sense it includes both arguments from particular facts and those from general laws to particular cases. In logic it is generally used in contradiction to "induction" for a kind of mediate inference in which a conclusion (often itself called the deduction) is regarded as following necessarily under certain fixed laws from premises. This, the most common form of deduction, is the syllogism (*q.v.*, see also *Logic*), which consists in taking a general principle and deriving from it facts which are necessarily involved in it. This use of deduction is of comparatively modern origin, it was originally used as the equivalent of Aristotle's *ἀναγωγή* (see *Præf. Analyt.*, B. xiv). The modern use of deduction is practically identical with the Aristotelian *ἀναγωγή*. Logical usage is some what inconsistent. On the one hand, Deduction is said to be from a universal premise, on the other hand, even syllogisms consisting of singular propositions only are described as deductive. To secure consistent usage it is best to apply the term *deduction* to all inferences from a universal proposition (even to immediate inferences of a singular or particular proposition from a universal) and to no other inference (such as singular syllogisms). Another source of confusion lies in the fact that in Mathematics the term deduction is sometimes used as synonymous with *Analysis*. Descartes' "deductive method" is often misunderstood for this reason as it covers both deduction proper and this analytic method.

DEE, JOHN (1527–1608), English mathematician and astrologer, was born in London, and educated at St John's college, Cambridge, becoming a fellow of Trinity. He spent two years at Louvain and at Rheims in study and lecturing, returning to England in 1551, when he received a pension from Edward VI, which he exchanged for the living of Upton-on-Severn. Soon after Mary's accession he was imprisoned on a charge of using enchantments against the queen's life, but was released in 1555. Dee enjoyed the favour of Queen Elizabeth. He was asked to name a propitious day for the coronation, gave lessons to the queen in the mystical interpretation of his writings, was sent abroad in 1578 to consult with German physicians and astrologers on the nature of her illness, and was employed by her in establishing the claim of the Crown to the overseas countries discovered by British subjects. In 1581 began his collaboration with Edward Kelly, who professed to have discovered the philosopher's stone and to be able to raise spirits. The two spent the years 1583–89 in Poland and Bohemia under the patronage of Albert Laski, palatine of Siradez. Dee returned to England in 1589. He was helped over his financial difficulties by the queen and his friends. In May 1595 he became warden of Manchester college. In Nov. 1604 he returned to Mortlake, where he died in Dec. 1608, at the age of 81, in the greatest poverty. Dee's *Speculum* or mirror, a piece of solid pink-tinted glass about the size of an orange, is preserved in the British Museum.

His principal works are *Propædeumata ophoristica* (1558), *Monas hieroglyphica* (Antwerp, 1564), *Epistola ad Fredericum Commandinum* (Pesaro, 1570), *Preface Mathematical to the English Euclid* (1570), *Drivers Annotations and Inventions added after the tenth book of English Euclid* (1570), *Epistola præfata* (1570), *De Arte et Magia* (1570), *De Arte et Magia* (1570).



DEE, river, south Aberdeenshire, Scotland, flowing generally eastwards from its source in the west of the county till it reaches the North Sea at the city of Aberdeen. It rises in the Wells of

Dee, a spring on Ben Braernach, one of the Curngorms, at a height of 4,061 ft. With its tributaries the river drains an area of 1,500 sq m. Rapid and turbulent during the first half of its course of 90 m, it broadens below Aboyne and the rate of flow is diminished. The channel towards its mouth was artificially altered in order to provide increased dock accommodation at Aberdeen, but, above, the stream is navigable only for barges and small craft for a few miles. It runs through beautiful scenery especially in Braemar. About two miles above Inverey it enters a narrow rocky gorge, 300 yd long and only a few feet wide at one part, and forms the rapids and cascades of the famous Linn of Dee. One of the finest of Scottish salmon streams, it retains its purity almost throughout. The principal places on the Dee are Castleton of Braemar, Balla ter, Aboyne, Kincardine O'Neil, Banchoory, Culter and Culs.

DEE, a river of Wales and England. It rises in Bala Lake, Merionethshire. Leaving the lake near Bala, it flows north east to Corwen and turns east past Llangollen to near Overton, and then bends nearly north to Chester, and thereafter north west through a great estuary into the Irish Sea. In the Llangollen district the Dee crosses Denbighshire, and thereafter forms the boundary of that county with Shropshire, a detached part of Flint, and Cheshire. From Bala to Overton (35 m), the river falls about 330 ft., and its course lies through a narrow, beautiful valley, enclosed on the south by the steep slopes of the Berwyn Mountains and on the north by a succession of lesser ranges. The Vale of Llangollen is especially famous. Here an aqueduct of the Shropshire Union canal bestrides the valley, it is a remarkable engineering work completed by Thomas Telford in 1805. The Dee has a total length of about 70 m and a fall of 530 ft. Below Overton it debouches upon its plain track. Below Chester it follows a straight artificial channel to the estuary, and this is the only navigable portion. The estuary, which is 14 m long, and 5½ m wide at its mouth, between Hülbre Point and Point of Air, is not a commercial highway like the Mersey, for at low tide it becomes a vast expanse of sand, through which the river meanders in a narrow channel. The tide rushes in with great speed over the sands, and their danger is illustrated in the well-known ballad "The Sands of Dee" by Charles Kingsley. The Dee drains an area of 813 sq m.

DEED, in law, a contract in writing, sealed and delivered by the party bound to the party intended to benefit. Contracts or obligations under seal are called in English law *specialties*, and down to 1869 they took precedence in payment over *simple contracts*, whether written or not. Writing, sealing and delivery are all essential to a deed. The signature of the party charged is not material, and the deed is not void for want of a date. Delivery, it is held, may be complete without the actual handing over of the deed, it is sufficient if the act of sealing were accompanied by words or acts signifying that the deed was intended to be presently binding, and delivery to a third person for the use of the party benefited will be sufficient. On the other hand, the deed may be handed over conditionally as an *escrow*, in which case it will not take effect as a deed until the conditions are performed. A deed indented, or indenture (so called because written in counterparts on the same sheet of parchment, separated by cutting a wavy line between them so as to be identified by fitting the parts together), is between two or more parties who contract mutually. The actual indentation is not now necessary to an indenture. The *deed-poll* (with a polled or smooth cut edge, not indented) is a deed in which one party binds himself without expression of any obligations undertaken by another party. (See *CONTRACT*.)

Statutes have been enacted in many of the United States, as in Great Britain and her colonies, setting forth certain short and convenient forms for deeds, thus giving effect to statutory provisions and forms. In the United States a deed has the effect of feoffment with livery of seisin or as a deed under the statute of uses or of any species of conveyance necessary to effect the intent of the parties and not repugnant to the legal requirements.

DEED REGISTRATION see *LAND TITLES*

DEEMSTER or **DOOMSTER**, the former title of an officer attached to the High Court of Justice in Scotland who pronounced the doom or sentence on condemned persons. Mention of this

office is made in the Domesday Book. Deemster is the title proper to each of the two justices of the Isle of Man.

DEER, originally the name of one of two British species, the red deer or the fallow deer, but now extended to all the family Cervidae (see ARTIODACTYLA, PECORA, UNGULATA). Briefly, deer may be defined as Pecora in which antlers are usually present in the male, when no antlers are developed, the upper canine teeth are elongated and sabrelike. The antlers arise from pedicles or bony projections of the frontal bone, when a new antler is to be formed the summits of these pedicles become highly vascular and from the blood thus supplied a bony secretion is deposited. During its growth the antler is covered with soft, hairy skin, through which run a number of blood vessels, this skin is known as the velvet. Toward the completion of the antler's growth a more or less prominent ring of bone, the burr or coronet, is deposited at its base just above the junction with the pedicle, this tends to constrict the blood vessels, and thus cut off the supply of blood from the antlers. When the antlers are freed from the velvet—a process usually assisted by the animal rubbing them against trees—they have a more or less rugose surface, owing to the grooves formed in them by the nutrient blood vessels. In the antlers of the red deer group, which form the type of the whole series, the following names have been applied to their different component parts and branches. The main shaft is termed the beam, the first or lowest tine the brow antler, the second the bez antler, the third the tree antler, or royal, and the branched summit the crown, or surroysals.

The Cervidae are distributed all over Europe, Asia, northern Africa and America, but are unknown in Africa south of the Sahara. They are essentially woodland animals and where forced to dwell in open country, as in the highlands of Scotland, become stunted. Thus the prehistoric remains found in the Scottish peat bogs indicate that a moderate sized old-time red deer (*Cervus elaphus*), which was a forest dweller, was a third larger than well grown modern forms. That this is not due to deterioration of the stock, but primarily to the conditions of the environment, is shown by the fact that the descendants of Scottish deer introduced into New Zealand are among the largest specimens known. The existing members of the family are arranged in two subfamilies, the Moschinae containing only a single species, the musk deer, and the Cervinae, including not only the true deer but the muntjaks, roe deer, mule deer, etc.

The subfamily Moschinae is distinguished by the presence of a gall bladder and, in the males, a large caudal gland, and by the absence of antlers, face glands and foot glands. The hemispheres of the brain are comparatively smooth, with few convolutions. The species are distributed over a large part of central and northeastern Asia, from Gilgit southward to Cochinchina, and eastward to Korea. The musk deer or kastura (*Moschus moschiferus*) stands about 20 in. at the shoulder, with the hindquarters elevated, but the Korean subspecies is smaller and more slenderly built. The hair is thick and brittle, resembling pith, the general colour is brownish speckled with gray. The ears are large and the upper canine teeth of the males greatly enlarged, projecting well beyond the lip margin. The tail is very short, and the naked area of the muzzle is extensive. Musk deer are forest-dwelling animals, usually found at considerable elevations, the males secrete the "musk," from which the animal derives its name, in an abdominal gland. The record specimen carries canine teeth which project out beyond the jawbone for a distance of $3\frac{1}{2}$ in. These weapons appear to be chiefly used for fighting, the bucks engaging in severe combats during the pairing season.

The Cervinae have no gall bladder or caudal gland but these are foot glands at least in the hind limbs (absent in *Pudu*), antlers are, as a rule developed and are characteristic of all true deer. The cerebral hemispheres present numerous convolutions. It is an interesting point that the ratio between body weight and antler weight increases with the absolute size of the animal. Thus in the red deer (*Cervus elaphus*) it was found that in stags of mean weight 74.4 kg. the antler weight was 2.2% of the total in stags of mean weight 120.6 kg. it was 3.03% and in those of 211.8 kg. 4.21%, a point of great evolutionary

significance. The growth of the antlers depends also upon a number of other circumstances which are favourable or unfavourable to the production of large, heavy antlers. Lime in the soil is very important, and the amount of food available, depending on the weather, is also influential. The successive antlers of a stag increase rapidly in weight during the first few years, but after the 11th year, and sometimes before, decrease again ("go back"). The percentage increments for the red deer from Warrnambool park are: second year, 230.6%, third, 72.2%, fourth, 38.6%, fifth, 18.1%, sixth, 8.5%, seventh, 5.2%. The antlers are used in fighting other stags and only exceptionally, or as a last resort, for defense, deer trusting rather to their fleetness to escape from an enemy. It is a remarkable fact, however, that antlerless stags, which fight with their fore hooves, seem often to be able to vanquish their antlered rivals. Most deer (but not the roe) are polygamous, the males fighting fiercely for possession of the females.

The subfamily contains 19 genera which vary in size from the pudu, standing only about 13 in. in height, to the gigantic moose and elk.

Muntiacus.—The members of this genus agree with all the other Cervinae, excepting the reindeer and caribou (*Rangifer*), in the absence of antlers in the females and the presence of a small, bare muzzle. They are known popularly as muntjaks or barking deer and are characterized by the tuskslike development of the upper canine teeth in the males, a feature in which these animals approach the condition found in the musk deer and resembling in this respect the tufted deer (*Elaphodus*) and the Chinese water deer (*Hydropotes*). Six species and numerous subspecies have been described, all are small animals, with small and simple antlers consisting of a small brow antler and a beam, arising from long, bony pedicles which are continued downward to form prominent ridges on the frontal region of the skull. In the females these pedicles are represented by small, bony prominences surmounted by tufts of hair. The ears are small and the tail long and thin. The various species are distributed over the Indo-Malayan region eastward as far as Sumatra and Borneo, a number of forms occur in China and one in Formosa, muntjaks do not extend into Japan. The record length of the antlers, taken from the burr to the tip, is 20 in. The males stand about 20 to 22 in. in height at the shoulder and weigh about 38 lb.

Elaphodus contains but a single species, *E. cephalophus* or Chinese tufted deer, distinguished from the muntjaks by the small size of the antlers and by the supporting pedicles diverging inferiorly. Further, the pedicular ridges on the frontal region are absent. Four races are known, all confined to China. In size these deer about equal the larger species of muntjak.

Dama.—Two species of *Dama* are now recognized, *D. dama* and *D. mesopotamica* from Iran, they are popularly known as fallow deer. In this genus, as in all the remaining genera except *Hydropotes*, the male canine teeth, when present, are not tuskslike. The antlers are large and are supported on short pedicles which do not form frontal ridges as in the muntjaks, the bez antler is normally absent, and the beam is palmated and bears numerous snags on the under edge. The coat is usually spotted with white in summer, and the height at the shoulder is about 3 ft. Originally the species were restricted to the Mediterranean countries and Iran, the typical species has, however, been introduced into many parts of Europe. The extinct Irish elk (*Megaceros*) is an allied genus.

Axis.—Some authors regard the genera *Axis*, *Hyelaphus*, *Rusa*, *Rucervus* and *Sika* as subgenera of *Cervus*, but it seems more convenient to regard them as distinct. The chital or spotted deer (*Axis axis*) resembles *Dama* in the coat being spotted with white, the antlers are, however, very different, being long, slender and not palmated. They are three-tined, the brow antler forming a right angle with the beam. These Indian deer are of medium size, standing about 36 in. at the shoulder, five antlers measure as much as 39 in. along the outer curve.

Hyelaphus.—Closely allied to the chital, the hog deer of the genus *Hyelaphus* are more stocky in build and the horn pedicles longer. The auditory bullae are very large and the coat is either spotted in summer or uniformly coloured throughout the year. The two species are confined to the oriental region. *H. porcus* is the best known.

Rusa.—This genus includes large, medium-sized and small deer, normally carrying three-tined antlers in which the brow antler forms an acute angle with the beam. The coat is long and shaggy and uniformly coloured in the adults. The species are widely distributed over most of the oriental region, extending northward as far as Szechuen. Five species are recognized, of which the sambar (*R. ussurorum*) is the best known. This species is typically a very massive animal standing as much as 51 in. at the shoulder, some stags carry exceptionally large antlers (45 to 50 in. in length).

Rucervus.—In this genus the species of which are large, the second (bez) and third (tree) antlers are wanting and the beam divides into four or more branches, the brow antler forms either a right angle or continuous curve with the beam. The range include a large part of southern Asia, extending to the island of Hainan. *R. du-ruceli*, the barasingha

or swamp deer (confined to peninsular India), *R. schomburgkii*, Schomburgk's deer (remarkable for its many-tined antlers), and *R. thomasi*, the thamin (with cylindrical and rugose antlers, which have a long brow antler forming a continuation of the curve of the beam), are the best known.

Sika—The sika or Japanese deer of Japan and Manchuria are medium-sized deer related to the true deer but with smaller and simpler antlers, the latter are flattened and usually four-tined. The coat is spotted with yellowish white in summer, there is a white area bordered with black in the caudal region.

Cervus—In this genus which includes the true deer, the antlers are more complex, usually having at least five times. The tail is considerably shorter than in *Sika*, and the coat color uniform in the adult. The following species are here regarded as belonging to the typical genus the red deer (*C. elaphus*), wapiti (*C. canadensis*), Yarkand stag (*C. yarkandensis*), shou (*C. wallichii*), Macneil's deer (*C. macneilli*), hangul (*C. cashmiriensis*) and Thorold's deer (*C. albirostris*). The typical species (*C. elaphus*) is widely distributed, ranging over the greater part of Europe (excluding the Italian peninsula) and extending eastward to the Caucasus and Caspian provinces of Iran. The largest of these red deer is the maral (*C. e. maral*) from Iran, the height at the shoulder reaching as much as 43 in. The wapiti (mis-called elk in America) is typically from east Canada, but in addition to the new world forms, several local races have been described from central and north-east Asia. The wapiti may stand as much as 5 ft 4 in. at the shoulder and carries very massive antlers. Both red deer and wapiti have been successfully introduced into New Zealand. The shou and the hangul occur in the Himalayan region. Some authorities prefer to consider the genera *Axis*, *Hyelaphus*, *Rusa*, *Rucervus* and *Sika* as subgenera of the genus *Cervus*.

Elaphurus is apparently most nearly related to the true deer. The antlers divide a short distance above the butt, the front branch curving forward and again dividing, and the single hind branch projecting backward. Only one species is known, *E. davidsoni*, the mu-tu, or Père David's deer, the distributional range is uncertain, as this deer is known only from a herd formerly kept in the gardens of the Summer palace, Peking, and their descendants notably at Woburn abbey, England.

Odocoileus includes the white-tailed deer (*O. virginianus*), mule deer (*O. hemionus*) and black-tailed deer (*O. columbianus*). In this genus and those following, unlike *Dama*, *Cervus*, etc., the lateral metacarpals are represented by their lower, and not their upper, extremities. The antlers are large and the beam dichotomously forked, a subbasal snag is developed. The deer included in this group are exclusively American, the range extending from Alaska to Peru, Bolivia and northern Brazil. A large number of local races of the white-tailed deer have been described, from both North and South America. The mule deer and black-tailed deer are found only in North America.

Blastocercus—This genus is closely allied to the foregoing, but without metatarsal glands. The antlers are large, complex and lack the subbasal snag of *Odocoileus*. Two species are known, *B. dolomieu*, the marsh deer, and the smaller *B. besaarticus*, the Pampas deer, both South American. The former species is the largest South American deer, nearly equaling the red deer. *B. besaarticus* is a little larger than a roe deer.

Hippocamelus is distinguished by the small, simple, dichotomously forked antlers, of which the front prong is the shorter, and absence of metatarsal glands. Two species occur, both in South America.

Mazama—The deer of this genus are all small species, allied to *Hippocamelus* but distinguished by their antlers being unbranched spikes. A large number of species and subspecies have been named, distributed throughout central and tropical South America, but the distinguishing characters are, in many instances, only very slight. The typical brocket (*M. americana*) is about 27 in. in height at the shoulder and the coat is bright rufous in colour. Some species are considerably smaller, notably *M. nana* from the Matto Grosso.

Pudu—This group contains two very small species, standing only 13 to 15 in. at the shoulder, with very small spike-like horns, both from South America.

Capreolus—The reindeer or caribou (*C. reindeer*) is the largest of the deer, standing 6 to 7 ft at the shoulder, with very small spike-like horns, both from North America. The European elk (*A. alces alces*) at one time extended throughout the greater part of northern Europe and part of northern Asia, but is now extinct in most parts of Europe, the American moose (*A. alces americanus*) from eastern North America is the typical moose. During the winter a herd of moose will often trample down a space in the soft snow ("moose yard") to give them firm footing. The gait of these animals is a curiously stiff-legged run, but they nevertheless possess a considerable amount of

speed notwithstanding their ungainly appearance.

Rangifer—The reindeer and caribou differ from all the preceding genera in that the female bears antlers and the muzzle is completely hairy. They are medium or large in size, in some subspecies the antlers are massive and broadly palmated (*R. terraenovae*), in others long and slender (*R. s. arcticus*). The various races range over the northern parts of Europe and North America as far south as northern Columbia and New Brunswick. In many parts of its range *Rangifer* is migratory and is indispensable as a domestic animal to the Lapps of northern Europe.

Hydropotes—In this genus antlers are entirely wanting, and the upper canines form long, curved tusks. The Chinese water deer (*H. merms*) is the sole species, it stands only 20 in. at the shoulder. The general colour is rufous, much as in the brockets, and the range is confined to China and Korea.

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(J. G. D., X.)

DEERE, JOHN (1804–1886), U.S. manufacturer and inventor of the steel plow, was born at Rutland, Vt., on Feb. 7, 1804. He attended Middlebury college for a short time, but left at the age of 17 to become an apprentice to a blacksmith in Middlebury. He established his own smithy in 1825. Eleven years later he moved to Grand Detour, Ill., where he opened a shop in partnership with Maj. Leonard Andrus. There he began experimenting with the use of steel, instead of wood, for plowshares, and in 1837 he manufactured the first steel plow, moulded over a log. By 1846 the output of his small establishment was about 1,000 plows annually. The next year he went to Moline, Ill., where he founded his own firm, incorporated in 1868 as Deere & Company. He continued as president of the company until his death at Moline.

DEERFIELD, a town of Franklin county, Mass., U.S., on the Connecticut and the Deerfield rivers, 33 mi. N. of Springfield, served by the Boston and Maine railroad. The population in 1950 was 3,082, in 1940 it was 3,684 by the federal census. The greater part of the population is centred about the village of South Deerfield. The oldest of the several villages, Old Deerfield, sometimes called "The Street," extends along one broad thoroughfare lined with elms, through a beautiful valley, bordered by hills on the east and the west. Many of the houses date from the 18th century, and the ground is dotted with tablets marking the home lots of early settlers and places where historic incidents occurred. In Memorial hall, built in 1798 for the Deerfield academy, the Pocumtuck Valley Memorial association has assembled a collection of colonial and Indian relics. In 1896 many of the old household arts and crafts were revived and placed on a business basis by the formation of a society for the marketing of the products. For many years Deerfield (settled in 1669 and incorporated in 1673) was the frontier post of New England on the northwest. It suffered severely from the Indians in 1675 and 1677, and again, on Feb. 29, 1704, the village was surprised in the early morning by a force of French and Indians who killed 49, captured 111 (including the Rev. John Williams, who lived to publish an account of his experiences), burned the town and on the way back to Canada killed 20 of the captives.

DEER FLY, any of the species of the genus *Chrysops* of the family Tabanidae, order Diptera (*qv*). They are important because, in western North America, *C. discalis* transmits tularemia to humans. In Africa *C. discalis* and *C. silacea* are vectors of loa loa (see ENTOMOLOGY, Medical Entomology).

Also a name applied to the deer botfly, *Cephenemyia prairii* or *velutina*, of western North America, claimed to be the speediest animal on earth. (See BOTFLY.) (C. H. CN.)

DEER PARK, an enclosure of pastureland for deer. The largest existing deer park in England is at Savernake (4,000 ac).

DE FALLA, MANUEL (1876–1946), Spanish composer, was born at Cadix on Nov. 23, 1876. He studied piano with José Tragó and composition with Felipe Pedrell in Madrid. In 1905 he won the prize offered by the Academia de Bellas Artes with his opera *La Vida breve*. Two years later he went to live in Paris where he met with much help and encouragement from Debussy, Ravel, Dukas and others, who recognized the sincerity of his aims. *La Vida breve* was produced at Nice in 1913 and in Paris

the year following. When at last it reached Spain it was received with great enthusiasm, but in view of the tardy recognition of the composer in his own country overtures were made to him to become a naturalized Frenchman and so improve his chances of being heard in Paris. This he declined to do, and on the outbreak of World War I in 1914 he went back to Spain where he made an exhaustive study of Spanish folk music—in particular of the *cante* of Andalusia—before settling in his new home in Granada in the precincts of the Alhambra. The traditional music of Spain provides an unusually rich source of inspiration, containing as it does melodic elements from the church modes introduced by early Christians and eastern rhythms brought by the Moors. De Falla's researches in this field made him a national composer in the profoundest sense of the word. He made comparatively little use of traditional melodies as they stood, for although he believed that the modality of folk tunes should, and does, form the basis of all great music, his belief implied not only a complete absorption of the spirit of that modality but a thorough testing of the material in the light of the composer's aesthetic and ethical principles. Acting upon this, he submitted his own work to the most searching revision before it was given to the public, though fortunately without destroying its effect of spontaneity. He was a firm believer in tonality and in consonant chords, having had no love of dissonance for its own sake. His best-known work is the brilliant second ballet, *The Three-cornered Hat*, first played at the Alhambra, London, in 1919. His first ballet, *Love the Magician*, was performed in Madrid in 1915. Another dramatic work is *Master Peter's Puppet-Show*, a scenic version of a chapter from *Don Quixote*. He also wrote *Nights in the Gardens of Spain* for piano and orchestra, *Concerto for harpsichord (or piano)*, flute, oboe, clarinet, violin and violoncello, *Pieces espagnoles* for piano, and *Seven Spanish Folk-Songs*. He died on Nov. 11, 1946.

See Manuel de Falla, *Immature Essays* (J. & W. Chester, Ltd., London), A. E. Hull (ed.), *Dictionary of Modern Music and Musicians* (London, 1924).

DEFENDER OF THE FAITH (Lat. *Fides Defensor*), a title belonging to the sovereign of England in the same way as *Christianissimus* (Most Christian) belonged to the king of France, and *Catholicus* (Catholic) belongs to the ruler of Spain. It seems to have been suggested in 1516, and although certain charters were appealed to in proof of an earlier use of the title, it was first conferred by Pope Leo X on Henry VIII. The bull granting the title is dated Oct. 11, 1521, and was a reward for the king's treatise against Luther. When Henry broke with the papacy Pope Paul III deprived him of his designation, but in 1544 the title of "Defender of the Faith" was confirmed to Henry by parliament, and was used by his successors on the English throne.

DEFENSE see PRACTICE AND PROCEDURE

DEFENSE MECHANISMS By defense mechanisms, in psychology, is meant a group of acquired adjustive techniques which are developed and used by human beings in overcoming, circumventing, avoiding, escaping from or ignoring frustration and threat. By means of these techniques the individual manipulates situations and reduces the neuromuscular tensions of need or anxiety, of conflict, of thwarting and suspense. As in the case of other learned behaviour, a person need not recognize or identify this procedure to be able to use it effectively. This is implied in popular terminology by the statement that defense mechanisms are as a rule "unconscious".

Defense mechanisms, as products of learning, show a remarkable degree of similarity in their patterns from person to person, at least within our culture. When this similarity was recognized by students of behaviour pathology early in the 20th century, considerable speculation arose concerning the possibility that we might all inherit a "racial unconscious" which in some unknown way determined our patterns of defense. With the development by psychologists of a more adequate understanding of social learning, however, the hypothesis of a "racial unconscious" was discarded in favour of more fruitful explanations in terms of acquired habits. The relative uniformity is actually not difficult to account for when we reflect that human beings are all very much alike in structure, and that in a given culture they are all faced by

certain fundamental problems of adjustment, common to the social environment which they share.

The individual differences that have been found in habitual reliance upon one or another defense mechanism have turned out to be of greater significance for abnormal psychology than the similarities. These differences arise principally from variations in the degree to which each mechanism, or adjustive technique, is used and developed by a given person, particularly during childhood and adolescence. Long before full biosocial maturity has been reached, most persons show well marked preference for certain techniques, and neglect of others, although they themselves seldom recognize their preference or neglect. In many of the behaviour disorders it is possible to trace the inadequacies and distortions of personality organization to the overdevelopment, underdevelopment or maldevelopment of the various defense mechanisms.

Aggressive Defense Mechanisms—Direct aggression is one of the simplest of human reactions to frustration and threat, but under the conditions of adult social organization there are comparatively few circumstances in which it is sanctioned. Most children learn early in life that the nonspecific aggressive temper tantrum and the specific direct aggression are alike relatively unsuccessful in dealing with complex situations, or with individuals who are larger, stronger and more skilled than they themselves are. It is in the process of such learning that children arrive at substitute techniques of indirect, disguised aggression which are tolerated or encouraged by their elders. The most prominent representatives of this group are (1) attention getting, (2) identification, (3) compensation, (4) rationalization and (5) projection.

Attention getting—This technique reduces the tensions of need or anxiety by making the reacting individual the focus of other persons' behaviour. In the form of crying, it develops so early in life that it illustrates clearly the fact that, to be effective, a mechanism need not be planned, recognized or understood by the person using it. The infant's crying is at first merely one component of a vigorous general response to internal or external stimulation, and not a call for help. Its success in bringing relief and comfort, however, makes it the most likely component to persist as the habitual response to any need or anxiety. If crying is consistently rewarded with attention throughout infancy and childhood, it will continue to be a preferred mechanism of defense against all frustration and threat. Similar conditions of learning account in part for persistent breath-holding, thumb sucking, enuresis, slow eating and rejection of food. In older children, adolescents and adults the attention-getting techniques show increased variety and complexity, but the general principles of their development are much the same. Among the commonest patterns are grimacing, asking questions endlessly, boasting, showing off, complaining, nagging, talking roughly, obscenely or oddly, lying, stealing and extravagant giving.

Identification—The mechanism of identification reduces tensions by enabling an individual to react to the characteristics, status, possessions and achievements of other individuals, or groups, as though these were also his own, and to react to objects and symbols as if he shared in the qualities attributed to them. Young children, for example, may gain security and prestige by identifying with a parent, a sibling or a prominent relative or acquaintance. Older children, adolescents and adults identify with the gang, school, clubs, minority and majority groups, and civic or regional aggregations.

Compensation—This technique reduces tensions by substituting some other need-satisfaction sequence for the one that is frustrated or induces anxiety. When a taboo or socially discredited need-satisfaction sequence is directly replaced by a socially approved one, the compensatory substitution is often called sublimation. Like the other mechanisms, compensation plays an important part in the development and maintenance of social institutions, and like them also its consequences may be harmful as well as beneficial to the individual developing it.

Rationalization—The rationalizing person reduces tensions by attributing to his behaviour socially approved motives which

cannot be substantiated by an impartial analysis. Rationalization has constructive value in protecting a person from the over-scrupulous investigation of all his motives, and in this respect acts as a buffer against guilt reactions. It may have detrimental effects, however, when it leads to self-deception in relation to socially or personally significant behaviour.

Projection—In projection, a person reduces tensions by attributing his own motives, intentions, characteristics or attitudes to someone else. If he merely assumes that others must be as he is, we speak of *assimilative projection*, but if he disclaims what he attributes to another, we speak of *disowning projection*. Both varieties are found in all normal persons, and both are important in delusional and hallucinatory developments.

Passive Defense Mechanisms—Direct withdrawal or flight in the face of threat and frustration, like direct aggression, has limited usefulness as an adaptive technique under the conditions of adult social organization. The young child finds flight a relatively inadequate reaction to the aggressions and encroachments of older persons, who are superior to him in strength, agility and skill. This leads him to develop and use more indirect, substitute procedures for avoidance and escape. The most prominent representatives of the passive defense mechanisms are (1) *seclusiveness or insulation*, (2) *negativism*, (3) *regression*, (4) *repression* and (5) *phantasy*.

Seclusiveness or Insulation.—This technique reduces tensions by rendering the individual or his behaviour relatively inaccessible to the reactions of others. It is often no more than an extension of the hiding or shrinking responses which frightened animals and young children show when they cannot flee. Common examples of seclusiveness or insulation are seen in children who prefer to play alone, in adolescents who remain haughty and aloof in the presence of the opposite sex and in adults who choose vocations and avocations that minimize the necessity for human relationships.

Negativism—Negativism reduces tensions by providing reactions opposed to those which a situation demands, thus making participation impossible. Its clearest examples appear in the "age of resistance," held by 10 per cent of the children in the second and fourth grades.

ferred assets are advertising paid in advance, development expense, moving expense and organization expense. With such items as insurance and advertising, the problem of prorating costs is relatively simple, with such items as development, moving and organization expenses, the problem becomes more involved.

DEFFAND DE LA LANDE, MARIE ANNE DE VICHY-CHAMROND, MARQUISE DU (1697-1780), a celebrated Frenchwoman, was born at the chateau of Chamronde of a noble family on Dec 25, 1697. Educated at a convent in Paris, she showed a sceptical and cynical turn of mind which led the abbot to arrange that Massillon should reason with her, but he accomplished nothing. She was married at 21 to her kinsman, Jean Baptiste de La Lande, marquis du Deffand but they were separated as early as 1722. Mme du Deffand, young and beautiful, is said by Horace Walpole to have been for a short time the mistress of the regent, the duke of Orleans (Walpole to Gray, Jan 25, 1766). In 1721 began her friendship with Voltaire, but their regular correspondence dates only from 1736. She spent much time at Sceaux at the court of the duchesse du Maine, where she formed a close friendship with the president Charles Henault (*qv*). In Paris she was in a sense the rival of Mme Geoffrin, but the members of her salon were drawn from aristocratic society more than from literary circles, though Voltaire, Montesquieu, Fontenelle and Mme de Staël Delaunay were among the habitués. When Henault introduced D'Alembert, Mme du Deffand was at once captivated by him. With the other early *clapadists* she was never in sympathy, and appears to have tolerated them only for his sake. When she lost her sight in 1754 she engaged Mlle de Lespinaise to help her in entertaining. This lady's wit and charm made some of the guests, D'Alembert among others, prefer her society to that of Mme du Deffand, and she arranged to receive her friends for an hour before the appearance of her patron. When this state of things was discovered Mlle de Lespinaise was dismissed (1764), but the salon was broken up, for she took with her D'Alembert, Turgot and the literary clique generally. From this time Mme du Deffand rarely received any literary men. The principal friendships of her later years were with the duchesse de Choiseul and with Horace Walpole. Her affection for the latter, which dated from 1765, was the most durable of all her attachments. Under the stress of this tardy passion she developed qualities of style and eloquence of which her earlier writings had given little promise. In the opinion of Sainte-Beuve the prose of her letters ranks with that of Voltaire as the best of that classical epoch. Walpole refused at first to acknowledge the closeness of their intimacy from fear of the ridicule attaching to her age, but he paid several visits to Paris expressly for the purpose of enjoying her society, and maintained a close and most interesting correspondence with her for 15

She died on Sept. 23, 1780, leaving her dog Tonton to the care of Walpole, who was also entrusted with her papers. Of her innumerable witty sayings the best known is her remark on the cardinal de Polignac's account of St. Denis's miraculous walk of two miles with his head in his hands—*Il n'y a que le premier pas qui coûte* (It is only the first step which costs).

The *Correspondance inédite* of Mme du Defland with D'Alembert, Hénault, Montesquieu, and others was published in 2 vol. (1809). In 1820 Mary Berry edited *Letters of the Marquise du Defland to the Hon. Horace Walpole, afterwards earl of Orford, from 1766 to 1789* (4 vol.), and gave numerous extracts from Walpole's letters to Mme du Defland, since destroyed. In 1912 Mrs Paget Toynbee published in 3 vol. *Lettres de Mme du Defland a Horace Walpole*, with 78 of the supposedly lost letters from Walpole. Her letters were also edited by J. de Maistre in 1855, and by the marquis de St. Aulaire in *Correspondance inédite*, etc. (1859 and 1866). See also Sainte-Beuve, *Causeries du Lundi*, vol. 1 and 4iv (1852-64), L. Percy, *Le président Hénault et Mme du Defland*, xth ed. (1893), P. de Ségur, *Esquisses et recits* Mme du Defland et sa famille (1908), Claude Ferval (Marguerite Aimery de Pierrebourg), *Madame du Defland* (Paris, 1933), Gaston Rageot, *Madame du Defland* (Paris, 1937) (Farenthine Henthorn), *Madame du Defland: Letters to and from the Deflands and Julie de Lespaulx* (1938), and W S Lewis and W H Smith edited *Horace Walpole's correspondence with Madame du Defland and Wiart*, 3 vol. (1939).

DEFERRED ANNUITY

DEFERRED ASSETS, '

are not properly chargeable to the current accounting period. The charging of such items to current operating costs is deferred until the period arrives to which they are applicable. The premium, for example, on an insurance policy may be paid one year in advance. In addition to unexpired insurance, the other common de-

DEFIANCE, a city of northwestern Ohio, U.S., at confluence of Auglaize and Tiffin rivers with the Maumee, county seat of Defiance county, on federal highway 24 and five state highways, and is served by Baltimore and Ohio and Wabash railways, bus and truck freight lines. Pop. (1950) 11,270 (federal census). It is the central market of the Maumee valley, a rich dairy and farming region. Manufactures include machine tools, radio condensers, metal stampings, screw machine products, commercial refrigeration, dairy products, luncheon meats, beer, gray iron castings, glass fibre items, service station equipment and mechanics' tools. It is the seat of Defiance college (Christian), established as a normal school in 1884. The confluence of the rivers was a favourite meeting place of the Indians. In 1794 Gen. Anthony Wayne built a fort (which he named Defiance) on a spot now included in a public park. Fort Winchester was built by Gen. Harrison there during the War of 1812. The town was incorporated as a village in 1836. It developed commercially after the opening of the Miami and Erie canal (1845), was made the county seat in that year, and became a city in 1887.

DE FILIPPI, FILIPPO (1869–1938), Italian scientist and explorer, was born in Turin April 6, 1869. After graduating in medicine at the Turin University, he became assistant in the surgical clinic and lecturer in operative surgery in the University of Bologna. He published a number of important papers on physiological and biological chemistry. In 1897 he went with the Duke of the Abruzzi to Alaska as scientific observer and ascended Mount St. Elias. Although he did not accompany the Duke to the Ruwenzori in Central Africa in 1906, De Filippi wrote the report of the expedition. In 1909 De Filippi joined the Duke's expedition to the Western Himalaya and Karakoram Mts., where a point 24,600 ft. high was reached on a ridge of the Bride Peak close to K2, which established a record of altitude unsurpassed until the exploits on Mount Everest (1922 and 1924). He later (1913–14) organized and led an important scientific expedition to the Karakoram range in Central Asia, under the auspices of the Indian and Italian Governments. He died Sept. 23, 1938.

He published *The Ascent of Mount St. Elias* (1900), *Ruwenzori* (1909), *Karakoram and Western Himalaya* (2 vol. 1912), *Storia della spedizione scientifica italiana nel Himalaya, Karakoram e Turchestan cinese, 1913–1914* (1924), and *Ippolito Desideri di Pistoia, S.J. His Travels and Account of Tibet, 1712–27* (1932 and 1937).

DEFINITION, a logical term used popularly for the process of explaining, or giving the meaning of, a word, and also in the concrete for the proposition or statement in which that explanation is expressed (Lat. *definitio*, from *de finire*, to set limits to, describe). In logic, definition consists in determining the qualities which belong to given concepts or universals, it is not concerned with individuals, which are marked by an infinity of peculiarities, any one or all of which might be predicated of another individual. Individuals can be defined only in so far as they belong to a single kind. According to Aristotle, definition is the statement of the essence of a concept, that is, it consists of the genus and the differentia. In other words, "man" is defined as "animal" and "rational," or "rational animal," i.e., the concept is (1) referred to the next higher genus, and (2) distinguished from other modes in which that genus exists, i.e. from other species. "Rational animal" is thus the predicate or the statement constituting the definition. Sometimes the word 'definition' is used to signify merely the predicate. It is sometimes argued that, there being no definition of individuals as such, definition is of names (see J. S. Mill, *Logic* I viii §5), not of things, it is generally however, maintained that definition is of things, regarded as, or in so far as they are, of a kind. Definition of words can be nothing more than the explanation of terms such as is given in a dictionary.

The following rules are generally given as governing accurate definition: (1) *The definition must be equivalent or commensurate with that which is defined*, it must be applicable to all the individuals included in the concept and to nothing else. Every man, and nothing else, is a rational animal. 'Man is mortal' is not a definition, for mortality is predicable of irrational animals. (2) *The definition must state the essential attributes*, a concept cannot be defined by its accidental attributes, those attributes must be given which are essential and primary. (3) *The definition must*

be per genus et differentiam, as we have already seen. These are the important rules. Three minor rules are: (4) *The definition must not contain the name of the concept to be defined*, if it does, no information is given. Such a proposition as "an archdeacon is one who performs archidiaconal functions" is not a definition. Concepts cannot be defined by their correlatives. Such a definition is known as a *circulus in definiendo*. (5) *Obscure and figurative language must be avoided*, and (6) *Definitions must not be in the negative when they can be in the affirmative*.

Definition per genus et differentiam is a concise description of what a certain kind of thing is. There is another kind of definition, known as *genetic definition*, which describes how the kind of thing in question can be produced. Some terms can be defined in both ways, e.g., the term *circle* may be defined as "a plane curve every point of which is equidistant from a certain point called the centre," or as "a plane curve produced by moving a point at a constant distance from another point." Many chemical formulae are really genetic definitions.

DEFLATION. A diminution of the volume of currency, causing a rise in the value of money per unit and a fall in prices. Its effect varies with the degree of inflation which preceded it and which it is concerned to reduce. For a full discussion see *INFLATION AND DEFLATION, MONEY*.

DEFOE, DANIEL (c. 1659–1731), English author, was born in the parish of St. Giles, Cripplegate, London, in the latter part of 1659 or early in 1660, of a Nonconformist family. His father James Foe, was a butcher and a citizen of London. Until late in life Daniel signed Defoe or Foe indifferently.

Daniel was educated at a famous dissenting academy, Mr. Charles Morton's of Stoke Newington, where many of the best-known Nonconformists of the time were his schoolfellows. He joined Nonmouth's rebellion in 1685, and is supposed to have owed his lucky escape from the law to his being a Londoner, and therefore a stranger in the west country. Before his western escapade he had taken up the business of hosiery factor, and had married Mary Tuffey, by whom he had seven children. At the entry of William and Mary into London he is said to have served as a volunteer trooper "gallantly mounted and richly accoutred." At this period he seems to have been a sort of commission merchant, especially in Spanish and Portuguese goods, and at some time to have visited Spain on business. In 1692 he failed for £17,000. Although his creditors accepted a composition, he afterwards honourably paid them almost in full, a fact attested by not very friendly witnesses. He then became secretary and afterwards manager and chief owner of some tile works at Tilbury, but here also he was unfortunate, and his imprisonment in 1703 brought the works to a standstill, and he lost £3,000. About the middle of the reign of William III he was introduced to the King, and in 1695 he was appointed accountant to the commissioners of the glass duty, an office which he held for four years. At this time he produced his *Essay on Projects* (1698), containing remarkable suggestions, much in advance of his time, on banks, road management, friendly and insurance societies of various kinds, debt asylums, bankruptcy, academies, military colleges, high schools for women, etc. In the same year he wrote the first of a long series of ingenious pamphlets on the then burning question of occasional conformity. He argued that the conscience of the Dissenters should not permit them to conform, yet he denounced the imprudence of requiring tests as a bill in support of the government he published in 1698. In *An attempt to a Standing Army*, followed in 1700 by a defence of William's war policy called *The Two Great Questions considered*, and a series of pamphlets on the partition treaty. *The True Born Englishman* (1701) is a satire in rough but extremely vigorous verse on the nation's objection to William as a foreigner, and on the claim of purity of blood for a nation of mixed origin. He also took part in the proceedings which followed the Scottish petition, and was the author, some say the presenter, of the *Leijon's Memorial*, which asserted the supremacy of the electors or the elected. The theory of the indefeasible supremacy of the monarchs of England was one of Defoe's favourite political topics, and he returned to it in a powerfully written tract entitled *The Original Power of the Collectors*

Body of the People of England examined and asserted (1701)

In an evil hour for himself Defoe wrote the anonymous *Shortest Way with the Dissenters* (1702), a statement in the most forcible terms of the extreme "high-flying" position, which some high churchmen were unwary enough to endorse, without any suspicion of the writer's ironical intention. The author was soon discovered, and the advertisement offering a reward for his apprehension gives the only personal description we possess of him, as "a middle-sized spare man about forty years old, of a brown complexion and dark brown-coloured hair, but wears a wig, a hooked nose, a sharp chin, grey eyes, and a large mole near his mouth." In this conjuncture Defoe had really no friends, for the Dissenters had already been annoyed by his rather caustical tracts on the question of occasional conformity, and were as much alarmed at his book as the high-flyers were irritated. He was fined (Feb. 24, 1703) 200 marks, and condemned to be pilloried three times, to be imprisoned indefinitely, and to find sureties for his good behaviour during seven years. It was in reference to this incident that Pope, whose Catholic rearing made him detest the abettor of the Revolution and the champion of William of Orange, wrote in the *Dunciad*—

Earless on high stands unabash'd Defoe

—though he knew that the sentence to the pillory had long ceased to entail the loss of ears. Defoe's exposure in the pillory (July 20, 30, 31) was, however, rather a triumph than a punishment, for the populace took his side, and his *Hymn to the Pillory* is one of the best of his writings in verse. Unluckily for him his condemnation had the indirect effect of destroying his business at Tilbury.

He remained in prison until Nov. 1, 1704, and then owed his release to the intercession of Robert Harley, who represented his case to the queen, and obtained for him not only liberty but pecuniary relief and employment, which, of one kind or another, lasted until the termination of Anne's reign. There is no doubt that Harley, who understood the influence wielded by Defoe, made some conditions. Defoe says he received no pension, but his services were certainly rewarded, and he was a secret agent of the government in 1706 and 1707 in Scotland, working in favour of the Union. In this case he was employed by Godolphin, to whom Harley had recommended him. He wrote in prison many short pamphlets, chiefly controversial, published a curious work on the famous storm of the 26th November, 1703, and started in February 1704 *The Review*. This was a paper which was issued during the greater part of its life three times a week. It was entirely written by Defoe, and extends to eight complete volumes and some few score numbers of a second issue. He did not confine himself to news, but wrote something very like finished essays on questions of policy, trade and domestic concerns; he also introduced a "Scandal Club," in which minor questions of manners and morals were treated in a way which undoubtedly suggested the *Tatlers* and *Spectators* which followed. Only one complete copy of the work is known to exist, and that is in the British Museum. After his release Defoe went to bury St. Edmunds, though he did not interrupt either his *Review* or his occasional pamphlets. One of these, *Giving Alms no Charity, and Employing the Poor a Greivance to the Nation* (1704), is extraordinarily far-sighted. It denounces both indiscriminate alms giving and the national work shops proposed by Sir Humphrey Mackworth.

In 1705 appeared *The Consolidator, or Memoirs of Sundry Transactions from the World in Moon*, a political satire which is supposed to have given some hints for Swift's *Gulliver's Travels*, and at the end of the year Defoe performed a secret mission, the first of several of the kind, for Harley. In 1706 appeared the *True Relation of the Apparition of one Mrs. Veal*, an excellent example of Defoe's skill as a special reporter. In the course of his service in Scotland he wrote his *History of the Union*, which appeared in 1709. In this year Henry Sacheverell delivered his famous sermons, and Defoe wrote several tracts about them and attacked the preacher in his *Review*.

In 1710 Harley returned to power, and Defoe was placed in a somewhat awkward position. He seems, in fact, to have agreed

with the foreign policy of the Tories and with the home policy of the Whigs, and naturally incurred the reproach of time serving and the hearty abuse of both parties. At the end of 1710 he again visited Scotland. In the negotiations concerning the Peace of Utrecht, Defoe strongly supported the ministerial side, to the intense wrath of the Whigs, displayed in an attempted prosecution against some pamphlets of his on the all important question of the succession. Again the influence of Harley saved him. He continued, however, to take the side of the Dissenters in the question affecting religious liberty. He naturally shared Harley's downfall, and, though the loss of his salary might seem a poor reward for his constant support of the Hanoverian claim, it was little more than his ambiguous, not to say trimming, position must have led him to expect.

Defoe declared that Lord Annesley was preparing the army in Ireland to join a Jacobite rebellion, and was indicted for libel, and prior to his trial (1715) he published an apologia entitled *An Appeal to Honour and Justice* which is one of the chief sources for the facts of his life. He was convicted, but was liberated later in the year under circumstances that only became clear in 1864, when six letters were discovered in the Record Office from Defoe to a government official, Charles Delafaye, which, according to William Lee, established the fact that in 1718 at least Defoe was doing political work of an equivocal kind—that he was sub-editing the Jacobite *Mist's Journal* under a secret agreement with the government that he should tone down the sentiments and omit objectionable items. He had, in fact, been released on condition of becoming a government agent. He seems to have fulfilled similar functions in *Dormer's Letter* and the *Mercurius Politicus*.

The first volume of Defoe's most famous work, the immortal story—partly adventure, partly moralizing—of *The Life and Strange Surprising Adventures of Robinson Crusoe*, was published on April 25, 1719. It ran through four editions in as many months, and then in August appeared the second volume. Twelve months afterwards the sequel *Serious Reflections*, now hardly ever reprinted, appeared. The first two parts were reprinted as a *feuilleton* in *Heathcote's Intelligencer*, perhaps the earliest instance of the appearance of such a work in such a form. The story was founded on Dampier's *Voyage round the World* (1697), and still more on Alexander Selkirk's adventures, as communicated by Selkirk himself at a meeting with Defoe at the house of Mrs. Damaris Daniel at Bristol. Selkirk afterwards told Mrs. Daniel that he had handed over his papers to Defoe. *Robinson Crusoe* is one of the world's classics in fiction. Crusoe's shipwreck and adventures, his finding the footprint in the sand, his man "Friday," are all immitably told, but it is the conception of civilized man alone face to face with nature which has made Defoe's great work an imperishable part of world literature. In the same year appeared *The Dumb Philosopher, or Dickory Cronke*, who gains the power of speech at the end of his life and uses it to predict the course of European affairs.

In 1720 came *The Life and Adventures of Mr. Duncan Campbell*. This was not entirely a work of imagination, its hero, the fortune-teller, being a real person. There are amusing passages in the story, but it is too desultory to rank with Defoe's best. In the same year appeared two wholly or partially fictitious histories, each of which might have made a reputation for any man. The first was the *Memoirs of a Cavalier*, which Lord Chatham believed to be true history. *Captain Singleton*, the last work of the year, has been unjustly depreciated by most of the commentators. The record of the journey across Africa, with its surprising anticipations of subsequent discoveries, yields in interest to no work of the kind.

In 1721 nothing of importance was produced, but in the next year three works of capital importance appeared. These were *The Fortunes and Misfortunes of Moll Flanders*, *The Journal of the Plague Year*, and *The History of Colonel Jack*. *Moll Flanders* still ranks among the great English novels, and deserves far more notice than it has usually received.

The Journal of the Plague Year, more usually called, from the title of the second edition, *A History of the Plague*, reads like a

contemporary record. No one had the imaginative power necessary to create circumstantial detail in a greater measure than Defoe, and there is no more reason to presuppose a documentary basis than in the case of *Moll Flanders*. Defoe was able to make all his narratives appear true stories, and he was gifted in a high degree with historical imagination. *The History of Colonel Jack* is an unequal book, and the end of the story is less good than the beginning.

To this period belong his stories of famous criminals, of Jack Sheppard (1724) of Jonathan Wild (1725) of the Highland Rogue, &c., Rob Roy (1733). The pamphlet on the first of these Defoe maintained to be a transcript of a paper which he persuaded Sheppard to give to a friend at his execution.

In 1724 appeared also the first volume of that admirable guide, *A Tour through the whole Island of Great Britain*, which was completed in the two following years. In 1725 appeared *A New Voyage round the World*, apparently entirely due to the author's own fertile imagination and extensive reading. It has all the interest of Anson's or Dampier's voyages.

Towards the end of 1726 appeared *The Complete English Tradesman*, which called forth the scorn of Charles Lamb. To 1726 also belongs *The Political History of the Devil*. This he longs to a series of demonological works, of which the chief others are *A System of Magic* (1726), and *An Essay on the History of Apparitions* (1728), issued the year before under another title. *A Plan of English Commerce*, containing very enlightened views on export trade, appeared in 1728.

During the years 1715-28 Defoe had issued a formidable array of pamphlets and minor works which cannot be enumerated here. No man can ever have written more continuously. He must in some way or other have obtained a considerable income. In 1724 he had built himself a large house at Stoke Newington, and he had obtained on lease in 1722 a considerable estate from the corporation of Colchester, which was settled on his unmarried daughter at his death. He died in Ropermaker's Alley, Moorfields, on April 26, 1731, and was buried in Bunhill Fields. He left no will, all his property having been previously assigned, and letters of administration were taken out by a creditor. How his affairs fell into this condition, why he did not die in his own house, and why in the previous summer he had been in hiding, as we know he was from a letter still extant, are points not clearly explained. In 1724 he was, however, attacked by Mist, who was disarmed and wounded (May 18) imprisoned. It is more likely that Mist had found out that Defoe was a government agent and quite probable that he thus informed other editors, for Defoe's journalistic employment almost ceased about this time, and he began to write anonymously, or as "Andrew Moreton." Mist had escaped to France, and may have designed revenge on Defoe. It is possible that he had to go into hiding to avoid the danger of being accused as a real Jacobite, when those with whom he had contracted to assume the character were dead.

Colonel Jack, *The Cavalier*, *Duncan Campbell*, *The Plague*, *Everybody's Business*, *Mrs. Veal*, *The Shortest Way with Dissenters* giving *Alms no Charity*, *The True-Born Englishman*, *Hymn to the Pillory*, and very copious extracts from *The Complete English Tradesman*. An edition of Defoe's *Romances and Narratives* in sixteen volumes by G. A. Aitken came out in 1895. *The Selected Writings of Daniel Defoe* (14 vols.), were published by Blackwell, 1907.

The reprints and editions of *Crusoe* have been innumerable, it has been often translated, and the eulogy pronounced on it by Rousseau gave it special currency in France, where imitations (or rather adaptations) have also been common.

See also John Forster, *Historical and Biographical Essays* (1856), G. Saintsbury, "Introduction" to Defoe's *Minor Novels*, and valuable notes by G. A. Aitken in *The Contemporary Review* (February 1890) and *The Athenaeum* (April 30, 1889, August 31, 1890). Dr. Karl I. Baumbach edited two unpublished works of Defoe, *The Complete English Gentleman* (1890), and *Of Royal Education* (1905), from British Museum Add. MS. 35,555. Further light was thrown on Defoe's work as a political agent by the discovery (1906) of an unpublished paper of his in the British Museum by G. F. Warner. This was printed in the *English Historical Review*, and afterwards separately.

See further P. Dutton, *Daniel Defoe et ses romans* (1924). W. E. Mann, *Robinson Crusoe en France* (1916), W. Nicholson, *The Historical sources of Defoe's Journal of the Plague Year* (Boston, 1919). William P. Trent, *Defoe: How to Know Him* (1916).

DE FOREST, LEE (1873—), U.S. inventor, was born at Council Bluffs, Ia., Aug. 26, 1873, graduated from Yale Sheffield Scientific school in 1896 and received his Ph.D. in 1899. Almost immediately he started his career of invention and the promotion of radio communication or wireless as it was then called.

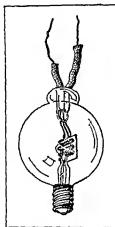
Soon the De Forest Wireless Telegraph company was organized but after several years it failed. Primarily an individualistic experimenter and inventor, De Forest next spent several years on the important problem of devising a sensitive detector for the reception of radio waves. This work culminated in 1906 in the invention of the audion, the elementary form of the modern radio tube. Slowly the usefulness of these tubes as generators, amplifiers, and detectors of radio waves was established. However, it was not until the radio communication needs of World War I arose that the audion, by then improved by the work of others, became an invaluable engineering device and was manufactured in large quantities.

In 1910 De Forest transmitted the singing voice of Enrico Caruso and thus was one of the pioneers of radio broadcasting. His many patents included the phonofilm, an early development in the field of talking motion pictures. He was honoured by medals and awards from several learned societies and served as president of the Institute of Radio Engineers.

(W. C. Wix)

DEFREGER, FRANZ VON (1835-1921), Austrian genre painter, was born in Dolsach, in Tyrol, on April 30, 1835, in the old farm house Ederhof zu Stronach. He spent his youth amid the mountains as a farm labourer, and on the death of his father took over the farm, at the age of 23. Two years later he sold his farm, meaning to go to America, but eventually went to Innsbruck to study drawing and carving, to which he was devoted from his boyhood. His teacher, Franz Stolz, took him to Munich in 1861. In 1863 he went to Paris, and returning to Munich, studied under Piloty for five years. His pictures, representing the rustic life of the Tyrolese, and the struggle of Tyrol, under Andreas Hofer, for freedom from foreign yoke, met with success from the first. They made their appeal by the subject-matter. Among his best known works are the "Speckbacher" (1866) at the Ferdinandeum, Innsbruck, the "Wrestlers" (1870), the "Dancers" (1871), the "Return of the Victors" (1876). He is represented in most German museums and also in the Metropolitan Museum of Art, New York.

DEGAS, HILAIRE GERMAIN EDGAR (1849-1917), French painter, was born in Paris on July 19, 1849 and died there



THE ORIGINAL AUDION INVENTED BY DE FOREST
The audion by regulating the amount of current that passes and magnifying feeble currents is of vital importance to long distance telephony and radio

on Sept. 27, 1917. He studied under Lamoignon and Ingres at the École des Beaux Arts, and first exhibited in the Salon of 1865, contributing a "War in the middle ages," a work executed in pastel. To this medium he was ever faithful, using it for some of his best work. But he soon turned to subjects from contemporary life. He exhibited "Steeplechase" (1866), "Family Portraits" (1867), and a portrait of a dancer in the "Ballet of La Source" (1868). In 1869 and 1870 he restricted himself to portraits, but thenceforward he abandoned the salons and attached himself to the Impressionists. With Manet and Monet he took the lead of the new school at its first exhibition in 1874, and repeatedly contributed to these exhibitions (in 1876, 1878, 1879 and 1880). In 1868 he had shown his first study of a dancer, and in numerous pastels he proclaimed himself the painter of the ballet. He painted innumerable studies of dancers, showing an amazing mastery of drawing and of light. Several of his works may be seen at the Luxembourg Gallery, to which they were bequeathed among a collection of impressionist pictures by M. Caillebotte. In 1880 Degas showed his powers of observation in a set of "Portraits of Criminals," and he attempted modelling in a "Dancer," in wax. He afterwards returned to his studies of the sporting world, exhibiting in Dec. 1884 at the Petit Gallery two views of "Races" which had a great success, proving the increasing vogue of the artist among collectors. At the eighth Impressionist Exhibition, in 1886, Degas continued his realistic studies of modern life, showing drawings of the nude, of workwomen, and of jockeys. Besides his pastels and his paintings of genre and portraits—among these, several likenesses of Manet—Degas also handled his favourite subjects in etching and in aquatint, and executed several lithographs of "Singers at Cafés-concerts," of "Ballet-girls," and indeed of every possible subject of night-life and incidents behind the scenes. His work is to be seen not only at the Luxembourg but in many of the great private collections in Paris, in England and America. In the Centenary Exhibition of 1900 he exhibited "The Interior of a Cotton-Broker's Office at New Orleans" and "The Rehearsal."

See also G. Moore, "Degas, the Painter of Modern Life," *Magazine of Art* (1890), J. K. Huysmans, *Certains* (1899), G. Gellroy, *La Vie Artistique* (3^e Série, 1894), J. B. Manson, *The Life and Work of Degas* (1927), Ambrose Vollard, *Degas* (trans. R. T. Weaver, 1928).

DE GEER, JONKHEER DIEK JAN (1870–), Dutch statesman, was born on Dec. 14, 1870, and graduated doctor at Groningen. He was a barrister and a journalist by profession. Entering the second chamber in 1907, he became one of the leaders of the Christian Historical Union. He was burgomaster of Arnhem (1920–22), finance minister (1921–23), and in March 1926 became prime minister, retaining for himself the portfolio of finance. The new Government put forward a moderate program of retrenchment, disarmament, and the promotion of native participation in the government of the East Indies. In August 1939 de Geer again became premier.

DE GEER, LOUIS GERHARD, BARON (1818–1896), Swedish statesman and writer, was born on July 18, 1818, at Finspång castle. In 1855 he became president of the Göta Hofret, or lord justice of one of the Swedish supreme courts. From 1858–70 he was minister of justice. His greatest achievement was the reform of the Swedish representative system, whereby he substituted a bi-cameral elective parliament, on modern lines, for the existing cumbersome representation by estates, a survival from the later middle ages. This great measure was accepted by the *Riksdag* in Dec. 1865, and received the royal sanction on June 22, 1866. He retired from the ministry in 1870, but took office again, as minister of justice, in 1875. From 1876–80 he was minister of State, and from 1881–88 chancellor of the universities of Uppsala and Lund.

Besides several novels and aesthetic essays, De Geer wrote political memoirs of supreme merit both as to style and matter, the most notable of which are *Minnesteckning öfver A. J. v. Hopken* (1881), *Minnesteckning öfver Hans Järta* (1874), *Minnesteckning öfver B. B. von Platen* (1886), and his own *Minnen* (1892), an autobiography, invaluable as a historical document. See *Sveriges historia* (1881, etc.), vi, Carl Gustaf Malmström, *Historiska Studier* (1897), C. Arcadius, *Löns de Geer* (1906).

DEGENERATION This term is loosely used in diverse ways in biology. It was applied by Sir Edwin Ray Lankester to an evolutionary change in the direction of simplification. Degenerative or, better, retrogressive evolution may be said to have taken place in those plants or animals in which a presumed ancestral organ or part is greatly reduced or even lacking. In a modern bird, to use a familiar example, whose beak performs the office of the teeth in other animals, no vestige of a tooth occurs. Yet it was otherwise in many ancient birds, such as *Hesperornis* and *Ichthyornis* (qq v.), known to us only from their fossilized skeletons, their jaws were well provided with abundant conical teeth. The weight of evidence leads us to conclude that the reduction of birds has been lost in the course of their evolution. The fossil record tells a similar story about other toothless forms, e.g., the sturgeon among fishes, toads, turtles, egg-laying mammals, anteaters and whalebone whales. So is it also with fins and limbs which were primitively present as two pairs, fore and hind (pectoral and pelvic), in ancestral vertebrates. Most of the modern forms have retained both pairs of appendages but others in supposed adaptation to specialized habits have lost one or both sets of limbs as in the eels, the limbless coelocans (burrowing amphibians), numerous lizards and the entire group of snakes. In all of the above there has been a considerable elongation of the body and, necessarily, changes in the mode of locomotion. In whales (see CETACEA), the most highly modified of the secondarily aquatic animals, the forelimbs have been retained as flippers, while the hind pair is represented by small paired remnants of the hip bone deeply buried in the flesh. An analogous but less extensive degeneration is exemplified in flightless birds (ostrich, cassowary, kiwi, etc.) in which the wing, although typically formed, is reduced to such an extent that it does not suffice for flight.

Among the best examples of degeneration correlated with environment are cave animals. Independently and in widely scattered regions such diverse inhabitants of caves as crayfish, spiders, beetles, grasshoppers (cave crickets), fish and salamanders are blind as a result of the reduction or loss of the eyes and colourless owing to the reduction of pigment.

Although the examples above have been chosen from more familiar forms, it should be pointed out here that degeneration in evolution is a very general process. Most highly developed organisms have lost some organs, modified and elaborated others and developed some entirely unrepresented in the ancestral stocks (see EVOLUTION, ORGANIC and article by Emerson cited below).

If we grant that such retrogression has taken place, we are faced with the question of the means by which it was effected. Charles Darwin thought that the initial reduction in an organ might be brought about by disuse (a view which has received no recent support), but he realized the logical difficulty of calling on disuse to produce any further changes "after the organ had once been rendered functionless." The current concepts of selection (qq v.) suggest that in the absence of selection pressure favouring the maintenance of an organ (e.g., an eye in a cave animal) gene mutations which degrade the structure may proceed unchecked, particularly if the effect of the mutations be favourable in respect to other organs.

The process of degenerative evolution has gone furthest in parasites, such as tapeworms and the remarkable parasitic crustacean, *Saccalinia*, among others (see PARASITOLOGY).

ment is well-illustrated in the metamorphosis of insects (Diptera, Hymenoptera, etc.), where there is extensive destruction of the larval cells followed by the reconstruction of the adult on a new plan. Analogous processes occur in other kinds of metamorphosis, as in the tadpole larva of nemertines and the planula larva of sea urchins. The dissolution of the tail in the tadpole is a more localized change. During fetal life in higher vertebrates, the notochord is largely lost, the cartilage of the provisional skeleton is in large part dissolved to make way for the deposition of bone, the paired embryonic kidneys (mesonephros) rapidly waste away, the duct system of each being salvaged in males to serve as *ductus deferens* and epididymis, but withering to functionless rudiments in the female. The Mullerian ducts

(oviducts), well developed in the embryos of both sexes, continue to grow in females, but become vestigial in the male. These developmental alternatives have provided an ideal object for the investigation of causal relationships in degeneration by means of hormone ($q.v.$) treatment or transplantation of organs fated to degenerate. The mesonephros of a chick, for example, has been shown to degenerate at the proper time when transplanted quite regardless of the age of the host. It seems to carry within itself the seeds of its own dissolution (Vera Danchakoff).

Perhaps to be placed in the same category is the cyclical or continuous regression of the various cells or organs in adults—skin, blood cells, *corpora lutea* in the ovary, the uterine epithelium, etc., in which the parts are regenerated either continuously or periodically as the case may be.

In the third place, particular attention has been directed to senile degeneration, the disappearance of sensory, nerve, muscle and other cells in aging. This is possibly better treated as a phenomenon of pathology ($q.v.$) which studies the degenerative changes following disease or accident.

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DEGGENDORF or **DECKENDORF**, town of Bavaria, Germany, 25 mi N W of Passau, on the left bank of the Danube, which is there crossed by two iron bridges. Pop. (1939) 11,767. It is at the lower end of the beautiful valley of the Perlach. The old town hall dates from 1566. The church of the Holy Sepulchre, built in 1337, attracts thousands of pilgrims to its *Porta Caeli* or *Gnadenporte* (Gate of Mercy) opened annually on Michaelmas eve and closed again on Oct. 7. The town is a depot for the timber trade of the Bavarian forest, a station for Danube steamboats and the seat of several mills, breweries, etc. On the bank of the Danube outside the town are the remains of the castle of Fündelstein, and on the Geiersberg (1243 ft.), in the immediate vicinity, stands another old pilgrimage church. About 6 mi N is the village of Metten, with a Benedictine monastery founded by Charlemagne in 801, restored as an abbey in 1840 by Louis I of Bavaria, and well known as an educational institution. The first mention of Deggenndorf occurs in 868, and it appears as a town in 1212. Henry (d. 1290) of the Landschut branch of the ruling family of Bavaria made it the seat of a custom-house, and in 1331 it became the residence of Henry III of Natterberg (d. 1333). In 1337 a wholesale massacre of the Jews, who were accused of having thrown the sacred host of the church of the Holy Sepulchre into a well, took place in the town, and it is probably from about this date that the pilgrimage above mentioned came into vogue. The town was captured by the Swedish forces in 1633, and in the war of the Austrian Succession it was more than once laid in ashes.

DE GOEJE, MICHAEL JAN. *see* GOEJE, MICHAEL JAN DE

DEGREE, a step or stage. In academic usage, a degree is a title conferred by a university as a mark of proficiency in scholarship. The word was first applied to the preliminary steps to the mastership or doctorate, viz., the baccalaureate and baccalaureate. "The use of academic degrees, as old as the 13th century, is visibly borrowed from the mechanic corporations, in which an apprentice, after serving his time, obtains a testimonial of his skill and a license to practise his trade and mystery" (Gibbon, *Autobiography*, 29). Originally, as the words "master" and "doctor" imply, the degree was a certificate of fitness to teach at a university. Degrees in law, medicine and theology still carry with them a license to practise the corresponding professions, but degrees in arts are no more than certificates of a certain measure of acquaintance with the subject. In modern times the practice has arisen of conferring honorary degrees as a recognition of distinction with out regard to academic qualifications. (X)

In general two practices are followed in the award of degrees. The European and South American countries have as a rule retained the degrees of the five traditional faculties—law, medicine, theology, arts and philosophy, and in granting academic recognition for work in newer fields of study have granted the degree of the faculty to which they most nearly approximate. Except in France and Spain all intermediate degrees, such as those of

bachelor and master, have been abolished. In Germany the doctorate of the various faculties is the only one granted, but there is a tendency to add new signatures such as *Dr Phil Nat* or *Dr Rer Nat* in mathematics and sciences and *Dr Ing* or *Dr Rer Techn* in engineering. Except in the faculty of law, where the *baccalaureat* is granted, the usual French degrees are the *licence* and *doctorat* according to the faculties, these are State degrees, to which a *doctorat d'université* has been added recently, carrying with it the recognition of a university but none from the State.

In the British universities Oxford and Cambridge have remained conservative and grant the B.A. as the first degree in most faculties, the B.Sc. and B.Litt. at Oxford are awarded for special research and examination. In 1926 Dublin introduced the B.Sc. for students who do not present a classical language in their examinations. The local universities have been more liberal in adding to the list of degrees although the B.A. and B.Sc., the latter in a great variety of special branches of science and technology, are the first degrees (M.A. in Scotland). The B.Com. in commerce, B.Arch. in architecture and B.Ed. in education are the more recent additions. The second degree is the M.A. or M.Sc., obtained everywhere by examinations except at Oxford and Cambridge where it is granted after a period of residence and payment of the prescribed dues. The doctorate (D.Sc., D.Litt., LL.D., etc.) is available in most branches, but in arts and science is usually awarded on the basis of contributions to knowledge and distinction in some special field. Since World War I an attempt has been made, but without much success, to establish the Ph.D. by examination. The usual degrees are available in medicine, law and theology. In all the universities the first degrees in arts or science may be obtained as an ordinary degree or with honours.

The greatest multiplication of degrees has taken place in the United States. Not only has there been a rapid expansion of specialization in the universities and colleges, but graduation in each specialty is recognized by a distinctive degree. The commonest degrees are still the B.A. and B.S. to which the signature of the special field is added, as B.A. in Ed., or B.S. in Arch. No attempt seems to be made at standardization, thus in business are B.B.A. and B.B.S. (business administration and banking) and B.B.A. (business administration). As soon as a new grouping of subjects takes place, it is designated by its own degree, as B.J. (journalism) or B.S. in AeE (aeronautical engineering). These special fields have their corresponding designations at the more advanced levels, especially the master's degree, and although there is a tendency to retain the Ph.D. as the most advanced degree in arts and science special signatures are found, as Ed.D. (education). An attempt has been made for several years to grant certain degrees, such as L.H.D., D.D., LL.D., Litt.D., and D.C.L., *honoris causa* only. (I. L. K.)

In the science of measurement, degrees are small equal subdivisions of an interval, e.g., the interval between the freezing and boiling points of water are divided into equal increments of temperature, the size of these depending on the arbitrary temperature scale chosen (*see* THERMOMETRY). The angle ($q.v.$) through which the radius of a circle turns in completing one revolution is divided into 360 degrees. The subdivisions of density scales are also termed degrees (*see* HYDROMETERS). The universal symbol for degree is a small circle at the top right-hand side of the figure denoting the number of degrees, e.g., fifteen degrees centigrade is written thus 15°C . The degree as an angular measure is further divided into 60 minutes of arc ($1^{\circ}=60'$).

In mathematics, the degree of an expression is determined by the highest dimensions of its terms, thus $2x^2y+3y$ is an expression of the third degree, the first term, being the product of three variables, x , x and y , has three dimensions and is of higher dimensions than the second which is the product of only two variables (*see* EQUATIONS, THEORY OF). In dynamics ($q.v.$) the expression "degrees of freedom" refers to the number of unique possible directions or modes of motion of a body (*see* also QUANTUM MECHANICS and GYROSCOPE).

DEHMEL, RICHARD (1863-1920), German poet, was born in Wendisch Hermsdorf, Brandenburg, on Nov. 18, 1863. He was educated in Kremen, Berlin and Danzig, and in 1882 began

to study philosophy, natural sciences and social economy, and also became editor of a provincial newspaper. From 1887-95 he was secretary of the Union of German Fire Insurance Companies. In 1891 he published his first volume of poetry, *Erlosungen*. This was followed by *Aber die Liebe* (1893), and *Weib und Welt* (1896). From 1899 until 1902 he travelled in Italy, Greece, Switzerland, Holland and England, and afterwards lived in Blankensee, near Hamburg. In collaboration with his first wife, Paula Dehmel, he published some books for children, including *Fitzbutze* (1907). He wrote a novel in lyrical form, *Zwei Menschen* in 1903, the epic composition *Die Verwandlungen der Venus* in 1904 and also dramas and pantomimes. He took part as a volunteer in World War I, and in 1919 published his diary, *Zwischen Krieg und Menschheit*. Among his dramas, *Die Menschenfreunde* (1917) was successful. His *Collected Works*, 10 vol., began publication in 1906. Dehmel's work is characterized by most unusual emotional power. His theme, whether it be erotic or social, awakens in him an intensity of feeling which seeks expression with almost explosive force. Sometimes taste and even sense are swept away in this torrent, on the other hand, Dehmel had a very strong feeling for form and music, and his best pieces, where form and thought have been most successfully welded together, are among the masterpieces of the German lyric. He died at Blankensee, Feb. 8, 1920. See *Selected Letters*, 2 vol. (1922-23), E. Ludwig, *Richard Dehmel* (1913).

DEHRA DUN, a district of British India, in the Meerut division of the United Provinces, with an area of 1,202 sq mi. The Dun proper is a beautiful valley lying between the Siwalik range and the foothills of the Himalayas. The administrative district runs up into the latter and embraces the sanatorium of Mussoorie. The mountains in its northern section attain a height between 7,000 and 8,000 ft., one peak reaching an elevation of 8,565 ft., the highest point of the Siwalik range is 3,041 ft. above sea level. The principal passes through the Siwalik hills are the Timli pass, leading to the military station of Chakrata, and the Mohand pass leading to the sanatoriums of Mussoorie and Landaur. The Ganges bounds the Dehra Dun valley on the east, the Jumna bounds it on the west. It is well wooded, undulating and relatively temperate in climate. To the east the valley is characterized by swamps and forests, but to the west the natural depressions freely carry off the surface drainage. In 1941 the population was 266,244. A railway to Dehra Dun from Hardwar, on the Oudh and Rohilkhand line (32 mi.), was completed in 1900. The district is served by the Dun canals. Tea gardens cover a considerable area, and the valley contains a colony of European tea planters.

Dehra Dun only emerges from the mists of legend into authentic history in the 17th century A.D., when it formed part of the Garhwal kingdom. Toward the end of the century the heretical Sikh Guru, Ram Rai, expelled from the Punjab, sought refuge in the Dun and gathered a crowd of devotees. Fateh Sah, rajah of Garhwal, endowed the temple which he built, round which grew up the town of Gurudwara or Dehra Dun (q.v.). In the 18th century the fertility of the valley attracted the attention of Najib-ud-daula, governor of Saharanpur, who invaded it with an army of Rohillas in 1757 and annexed it to his dominion. His rule, which lasted till 1770, brought great prosperity to the Dun, but on his death it became a prey to the surrounding tribes, its desolation being completed after its conquest by the Gurkhas in 1803. In 1814 it was taken possession of by the British.

DEHRA DUN, a town of British India, headquarters of the Dehra Dun (q.v.) district in the United Provinces. It lies at an elevation of 2,300 ft., at the terminus of the Hardwar Dehra Dun railway. Dehra Dun is the headquarters of the Trigonometrical survey and of the forest department, besides being a cantonment for a Gurkha force. The Indian Forest college, which trains forest officials for all parts of India, is a fine building. Attached to it is a research institute for the scientific study of silviculture and the exploitation and administration of forests. The Prince of Wales Royal Indian Military college was founded in 1922 to train Indian boys for the Royal Military college at Sandhurst, England, and for the Indian Military academy after the establishment

of that institution at Dehra Dun in 1932.

The town of Dehra Dun grew up round the temple built in 1699 by the heretical Sikh Guru, Ram Rai, the founder of the Udasi sect of Ascetics. This temple is a remarkable building in Mohammedian style. The central block, in imitation of the emperor Jahangir's tomb, contains the bed on which the Guru, after dying at will and coming back to life several times, ultimately died outright, it is an object of great veneration. At the corners of the central block are smaller monuments commemorating the Guru's wives. Pop. of town (1941) 57,183.

DEHYDRATION, in chemistry, the removal of molecules of water from a chemical compound. The water may be present in the form of water of hydration (see **HYDRATE**) in which case it is removed by heating the crystals, or by placing them in an evacuated desiccator in the presence of a drying agent such as phosphorus pentoxide. It may be removed from the molecules of oxyacids and basic hydroxides by similar procedures. Alternatively, water may form part of a molecule of an organic compound, in which case it is frequently removed by heating the compound in the presence of a metallic oxide, which acts as catalyst (see **CATALYSIS**), e.g., depending on the conditions, alcohols may yield either aldehydes or ethers (see **ALCOHOLS**, **ETHERS**, **OLEFINES**).

DEHYDROGENATION, the removal of hydrogen from the molecule of a chemical compound, which may be effected in the case of an organic compound by heating it in the presence of a metal, which acts as a catalyst (see **CATALYSIS**). e.g., the alcohols (q.v.) lose hydrogen and yield aldehydes (q.v.), see also **HYDROGENATION**.

DEINARCHUS, last of the "ten" Attic orators, son of Sostratus (or, according to Suidas, Socrates), born at Corinth about 361 B.C. He settled at Athens early in life, and when not more than twenty-five was already active as a writer of speeches for the law courts. In 324 the Areopagus, after inquiry, reported that nine men had taken bribes from Harpalus, the fugitive treasurer of Alexander. Deinarchus wrote, for the prosecution, the three speeches which are still extant—*Against Demosthenes*, *Against Aristogiton*, *Against Philochus*. The sympathies of Deinarchus were in favour of an Athenian oligarchy under Macedonian control, but it should be remembered that he was not an Athenian citizen. In the Harpalus affair Demosthenes was doubtless innocent, and so, probably, were others of the accused. Yet Hyperides, the most fiery of the patriots, was on the same side as Deinarchus. Under the regency of his old master, Demetrius Phalereus, Deinarchus exercised much political influence. On the restoration of the democracy by Demetrius Poliorcetes, Deinarchus was condemned to death and withdrew into exile at Chalcis in Euboea. About 292 B.C., thanks to his friend Theophrastus, he was able to return to Attica. Deinarchus died at Athens about 291.

According to Suidas, Deinarchus wrote 160 speeches, and Dionysius held that, out of 85 extant speeches bearing his name, 58 were genuine—28 relating to public, 30 to private cases. Although the authenticity of the three speeches mentioned above is generally admitted, Demetrius of Magnesia doubted that of the speech *Against Demosthenes*, while A. Westermann rejected all three. Deinarchus had little individual style and imitated by turns Lysias, Hyperides and Demosthenes. He is called by Hermogenes *ὁ κρηδὸς Δημοκρίτης*, a Demosthenes whose strength is rough, without flavour or sparkle.

Editions (text and exhaustive commentary) E. Matzner (1842), (text) T. Thalheim (1887), F. Blass (1888), see L. L. Forman, *Index Antiochensis*, *Lycargensis*, *Deinarchus* (1897), and, in general, F. Blass, *Attische Reden*, in which, there is a valuable treatise on the life and speeches of Deinarchus by Dionysius of Halicarnassus.

DEINOCRATES, a famous and original Greek architect of the time of Alexander the Great. He tried to create the ambitious fancy of that king with a design for carving Mount Athos into a gigantic seated statue. This plan was not carried out, but Deinocrates designed for Alexander the plan of the new city of Alexandria, and constructed the vast funeral pyre of Ptolemy. Alexandria was, like Petraea and Rhodes (see **HIPPODAMUS**), built on a regular plan, the streets of most earlier towns being narrow and confused.

DEIOCES (Διοκῆς) according to Herodotus (i 96 ff.) the first king of the Medes. He narrates that, when the Medes had rebelled against the Assyrians about 710 B.C., according to his chronology (cf. Diodor., ii 32), they lived in villages without any political organization. Then Deioces, son of Phraortes, was chosen judge in his village, and the justice of his decisions induced the inhabitants of the other villages to throng to him. At last the Medes resolved to set up a kingdom, and chose Deioces king. He now caused them to build a great capital, Ecbatana, with a royal palace, and introduced the ceremonial of oriental courts. He united all the Median tribes, and ruled 53 years (c. 690–647 B.C.), though perhaps, as G. Rawlinson supposed, the 53 years of his reign are exaggerated by mistake with the 22 years of his son Phraortes.

The narration of Herodotus is only a popular tradition. We know from the Assyrian inscriptions that just at the time which Herodotus assigns to Deioces the Medes were divided into numerous small principalities and subjected to the great Assyrian conquerors. Among these petty chieftains, Sargon in 715 mentions Dayyaku, "lieutenant of Man" (the probably was, therefore, a vassal of the neighbouring king of Man in the mountains of south-eastern Armenia), who joined the Urartians and other enemies of Assyria, but was by Sargon transported to Hamath in Syria "with his clan." His district is called "bt Dayyauku," "house of Deioces," also in 713, when Sargon invaded these regions again. So it seems that the dynasty, which more than half a century later founded the Median empire, was derived from this Dayyaku, and that his name was thus introduced into the Median traditions, which contrary to history considered him as founder of the kingdom.

DEIOTARUS, a tetrarch of Galatia in Asia Minor, and a faithful ally of the Romans. At the beginning of the third Mithridatic war, he drove out the troops of Mithridates from Phrygia. Pompey, when settling the affairs of Asia (63 or 62 B.C.) rewarded him with the title of king and an increase of territory (Lesser Armenia). Deiotarus naturally sided with Pompey in the civil war and after Pharsalus escaped with him to Asia. In 47 Caesar arrived in Asia from Egypt and pardoned Deiotarus for having sided with Pompey. In consequence of the complaints of certain Galatian princes, Deiotarus was deprived of part of his dominions, but allowed to retain the title of king. On the death of Mithridates of Pergamum, tetrarch of the Trocmi, Deiotarus was a candidate for the vacancy. Other tetrarchs also pressed their claims, Deiotarus was accused by his grandson Castor of having attempted to assassinate Caesar when the latter was his guest in Galatia. Cicero undertook his defence, but the assassination of Caesar prevented any final decision. In his speech Cicero deals mainly with the distribution of the provinces, the real cause of the quarrels between Deiotarus and his relatives. After Caesar's death, Mark Antony, for a large sum of money announced that, in accordance with instructions left by Caesar, Deiotarus was to resume possession of all the territory of which he had been deprived. When civil war again broke out, Deiotarus was persuaded to support Brutus and Cassius, but after Philippi went over to the triumvirs. He remained in possession of his kingdom till his death at a great age (see GALATIA).

See Cicero *Philippica*, ii 37, *Ad fem.* vii 10, 12, vi 3, 7, 4, *Ad Att.* xiv 1, *De div.* i 15, ii 36, 37, *De harusp.* resp. 13, and above all *Pro rege Deiotaro*, Appian, *Bell. Mithrid.* 75, 124, *Bellum Alexandr.* xiii, 34–41, 65–77, *Dio Cassius* xli 63, xlii 45, xliii 24, 18, xliiii 33.

DEIR or **DEIR EZ-ZOR**, a town in Syria (French mandated territory until 1941) on the right bank of the Euphrates, 27 mi. above its junction with the Khābūr population 6,659. The chief town of a considerable area it boasts a hotel, bazaar and many shops. It has a French garrison and an acrodrome, macadamized streets and a public garden, and is a centre of commerce. In Ptolemaeus list of towns on the right bank of the Euphrates (Geog. v 18) the following have been identified with Deir ez-Zor: *Gadriha* (Tischer, Herzfeld), *Bertha* (Kiepert), *Azura* (= *Azura*) (Dussaud). The ancient roads from Aleppo and Damascus to Baghdad met here. One of the modern motor routes from Damascus to Baghdad passes through the town.

DEIRA, the southern of the two English kingdoms afterwards united as Northumbria. According to Simeon of Durham it extended from the Humber to the Tyne, but the land was wide north of the Tees. York was the capital of its kings. The date of its first settlement is quite unknown, but the first king of whom we have any record is Ella or Aelle, the father of Edwin, who is said to have been reigning about 585. After his death Deira was subject to Aethelthrin, king of Northumbria, until the accession of Edwin, in 616 or 617, who ruled both kingdoms (see EDWIN) till 633. Osric the nephew of Edwin ruled Deira (633–634), but his son Oswine was put to death by Oswio in 651. For a few years subsequently Deira was governed by Aethelwald, son of Oswio. See Bede, *Historia ecclesiastica*, ii 14, iii 1, 6, 14 (ed. C. Plummer, 1896), Nennius, *Historia Brittonum*, s. 64 (ed. Th. Mommsen, Berlin, 1898), Simeon of Durham, *Opera*, i, 339 (ed. T. Arnold, 1882–85) (F. G. M. B.).

DEIRDRE, in older Irish Derrdru, the heroine of the tale of the *Fate of the Sons of Usnech*, one of the "three sorrowful tales" of Ireland. According to the story, she was the daughter of Feidlimid, son of Dall, the king's story-teller. When the Ultonian braves were drinking in the house of Feidlimid, and his wife, then pregnant, was serving them, the child screamed from the womb of her mother. The druid Cathub prophesied that a girl-child would be born, by name Derrdru, and great evil would come with her. The Ultonians said she should be slain, but King Conchobar interfered, and ordered her to be brought up in seclusion, and kept to be his own wife. Derrdru grew up thus, but having accidentally come in contact with Níosis, son of Usnech, she fell in love with him, and persuaded him and his two brethren, Amle and Ardan, to carry her off to Alha. Here the four lived together for some time, but they were enticed back by guile by King Conchobar's emissaries. The three brethren were slain, and Derrdru taken to Conchobar, but she committed suicide to avoid falling into the king's hands. The *dénouement* of the tale varies, however, in different versions.

The tale is edited (without translation) in Windisch's *Irische Texte*, vol. I (Leipzig, 1886). A convenient edition of a modern version has been published, with translation and vocabulary, by the Society for Preservation of the Irish Language (1898). For a modern Scottish Gaelic version see Alex. Carmichael, *Deirdre* (Paisley, 1914).

(R. A. S. M.)

DEISM is a theological term bearing two accepted meanings. 1. It is the technical name for a particular philosophical doctrine concerning the relation of God to the world. Deism is then contrasted with theism (q.v.), though etymologically the two words are equivalent. Whereas theism asserts God to be continuously active in the world and in touch with human souls, *de*, to be immanent in, or operative upon, nature and man in respect of providential guidance, revelation and grace, deism limits the divine activity to creation of the world and fixation of its primary collocations. It conceives the world-process to be determined by these alone. The world originally received from its Maker a capacity for self-development, or a delegated autonomy describable in terms of proximate causes without invocation of further divine intervention. Thus deism is what is popularly called the doctrine of an absentee God, who, once and for all having wound up the world-machine, has left it to run its course and to work out its self-evolution. In this extreme form, deism has seldom been embraced by theological thinkers, it has rather seemed to be in exaggerated conception of the relative independence of the world and its causal nexus. But unless theism asserts somewhat of relatively fixed order and continuity of causal determination in created things, from which the Deity stands "a handbreadth off" to give free play, so that God is not the sole operative cause in the spheres of physical process and human conduct, it lapses from the doctrine of an immanent God into pantheism. In other words, if deism is to be in earnest with the distinction involved in speaking of God and the world, and is not to adopt Spinoza's identification, expressed in his phrase *God or Nature*, it must accept so much of deistic tincture as to enable it to assert that there is a world-order which, however dependent on God, is in some degree independent of Him in that, when once "planted out," it evolves according to the laws of its being, and so provides a sphere for His continuous energizing. Thus pantheism

and deism are two extremes between which theism is a middle way

2 Deism is also the received name for a trend of theological thought, not explicitly concerned with the philosophical problem above indicated. The term then has an historical, rather than a technically philosophical, signification, and this is its earlier and commoner meaning. The movement which the word indicates was connected primarily with the relation of revealed religion to natural religion, or the relation of Christian doctrine to theology mediated by reason alone, as exercised on the world and man. It manifested itself chiefly, but not exclusively, in England, and most conspicuously in the 18th century. In fact "deism" is very commonly an abridgment of the phrase "English deism of the 18th century." Deistic thought had, indeed, already appeared in the 17th century, but it was then premature and consequently still-born, whereas the movement in the first half of the succeeding century evoked widespread excitement and controversy, and profoundly influenced theological science.

Deism, as it first emerged, was the natural issue, in theology, of historical causes that operated similarly in other fields of thought. The Reformation had brought individual liberty in religion, and toleration had become a politically expedient practice. Consequently, variety of opinion found expression, from allegiance to the orthodox theology such as might be called protestant scholasticism, to the vagaries and "enthusiasms" of individuals and sects. The new physical science, progressing rapidly after the Copernican revolution, was presenting an exemplar of certain knowledge, a sound method and criterion of truth. This was the primary quest of deism. It was first prosecuted by Lord Herbert of Cherbury (1583-1633), the father of English deism, and a contemporary of Descartes. Without denying or repudiating historically "revealed" religion, such as Christianity, Lord Herbert commended a "natural" religion, not transmitted by tradition admitting of corruption, nor accepted on external authority, but demanded and established by reason common to all men, and capable of finding universal acceptance. Adopting as certain, because unquestioned in his age, the belief that in all men there is divinely implanted a faculty, such as was commonly called "natural light," comparable to instinct, save that it is of the nature of intellect rather than of sensibility, he taught that this rational light is the mediator of innate ideas or "common notions" in which the essential elements of all true religion are to be found. These are that God exists, that man's duty is to worship Him, that virtue and piety are the essentials of worship, that repentance and retribution are divinely called for from us, and that there is a future life in which reward and punishment will be meted out. Such, he further held, was the primitive form of religion, from which mankind has been diverted.

As Herbert laid the foundations of deism, in the 17th century, in so far as its positive and its philosophical aspects are concerned, so also, during the same century, did Charles Blount (1654-93) initiate the negative procedure which became the more conspicuous characteristic of deism in the later stages of its development. This procedure consisted in criticism of the Scriptures, of received views as to authorship of the sacred books, of miracles, of specific Christian doctrines, and of ecclesiastical history. It has been called negative, because its aim was not so much to commend the certainty and sufficiency of natural theology, of which deism at first asserted revealed theology to be a more or less superfluous republication, as to suggest the doubtfulness of the data, evidences and arguments, on which revealed religion had hitherto been based. The chief writers who, between 1700 and 1750, conducted this attack upon orthodoxy, were Thomas Woolston, Anthony Collins, Thomas Morgan and Thomas Chubb. They were not scholars of the highest order, nor thinkers of more than mediocre ability. Indeed they were silenced by writers better equipped with learning. Nevertheless deism of this negative or sceptical kind was not merely the exhibition of temporary unrest or discontent. It was an expression of vague suspicions which developed into critical sciences that, in the succeeding century, effected a revolution in Christian apologetics. In its championship of freedom of inquiry, in search for certainty instead of groundless or disputable opinion, in its insistence on reason as

the sole instrument for acquiring and judging of truth, and in its use of the method of doubt, deism may be said to offer a parallel to the Cartesian renaissance in philosophy, and to represent the beginning of modernity in English theology. Hence, even on its negative side, deism is an important movement in the history of theological thought.

This phase of 18th century deism finds its best expression in two works. The first is *Christianity not mysterious*, by John Toland, in which it is argued that there is nothing in the Gospels that is mysterious, either in the sense of being contrary to reason or in the sense of being above or beyond reason. Toland, from one point of view, upheld the certainty of the natural theology which reason could read, and of the revelation that had been divinely vouchsafed to it. Provided they are allowed to put their own interpretation on the vague and ambiguous word "reason," most persons of common sense, as well as most philosophers, will perhaps nowadays accept Toland's conclusion. If reason include the discovery of actual premises, such as science deals with, it does not provide the infallible natural theology that deism prided itself on having found, and in comparison with which it afterwards proceeded to disparage revealed religion. Rather did Bishop Butler, the most considerable critic of the deists, bid the mark in his pregnant dictum, "probability is the guide of life." The other of the two works just now referred to, is Matthew Tindal's *Christianity as old as the Creation, or the Gospel a Republication of the Religion of Nature*. This book states the case in favour of natural religion more comprehensively than any other of its period: it came to be called "the deist's Bible," and it evoked in especial degree the notice of Bishop Butler and other defenders of revealed religion. The deistic creed, here set forth, is essentially similar to that of Lord Herbert, and natural religion is regarded as consisting in rational knowledge, as contrasted with subjectively caused belief, together with morality. Revelation is restricted to communication of ready-made truth, and the "natural" revelation, old as creation, is described as "internal," *se*, as involved or implicated in the constitution of the world and the natures of God and man. Being thus essential or intrinsic, it is an eternal truth of reason, not contingent on historical facts.

If any one of the deists' tenets was more fundamental than another, it was their assertion that revealed religion presupposes natural religion. And this, though it was for the most part overlooked or evaded during the 19th century, may be regarded as their lasting contribution to theological thought. Unfortunately their conception of the content of natural theology, and of the rational grounds on which they supposed it to be infallibly based, involved *a priori* assumptions which, shortly after deism found its completed expression in Tindal, were demolished by Hume, and later by Kant. Genetic sciences as yet scarcely existed, evolution or development was as wanting from the stock of 18th century ideas as it was paramount in the succeeding century. So the deists worked with static ideas, and some of the assumptions, which to them seemed self-evident truths, came to be found inconsistent with facts. Human nature and reason are evolved products, and reason as innate *homo natura*, to which, the deist thought, a just God *must* reveal Himself perfectly and clearly from the first, never existed. It may be observed, however, that none of those free thinkers held the kind of deism that was here first described, but rather repudiated it as "atheism."

See Leslie Stephen, *History of English Thought in the 18th century*, Vol. I (1876 and 1902) and the bibliography therein. (F R T)

BEISTER, a chain of hills in Germany, in the Prussian province of Hanover, about 15 m SW of the city of Hanover. It runs from Springe in the south of Rodenbergs in the north. It has a total length of 14 m and rises in the Höfeler to a height of 1,250 feet. The chain is well-wooded and abounds in game. There are some coal mines and sandstone quarries.

DÉJAZET, PAULINE VIRGINIE (1798-1875), French actress, born in Paris on Aug. 30, 1798, first appeared on the stage at the age of five. In 1820 she started to play soubrette and "breeches" parts at the Gymnase, with such success that such parts became known as "Déjazets." After playing at the Nouveautés and the Variétés she became manager of the Folies,

settled in Jamaica. The boy spent his youth in England with his mother at Lyme Regis and was educated for the army at the college at Great Marlow, but the peace of 1815 changed his career. He joined the Geological Society of London, of which he was president in 1848-49. After a period of travel in Europe he began the detailed investigation of the rocks of Cornwall and Devon. Thrown much into contact with the mining community, he conceived the idea that the nation ought to compile a geological map of the United Kingdom, to aid the scientific development of its mineral industries, and persuaded the government to give him an appointment in connection with the Ordnance Survey. This formed the starting point of the Geological Survey of Great Britain, which was officially recognized in 1835, when De la Beche was appointed director. Eventually Parliament sanctioned the erection of a museum of geology and the organization of a staff of professors. The establishment, in which were combined the offices of the Geological Survey, the Museum of Practical Geology, The Royal School of Mines and the Mining Record Office was opened in Jermyn street, London, in 1851.

De la Beche published numerous memoirs on English geology in the *Transactions of the Geological Society of London*, as well as in the *Memoirs of the Geological Survey*, notably the *Report on the Geology of Cornwall, Devon and West Somerset* (1839). In his *Researches in Theoretical Geology* (1834) he enunciated a philosophical treatment of geological questions much in advance of his time. His *Geological Observer* (1851, 2nd ed., 1853), enlarged from an earlier work, displays his talent for artistic delineation of geological phenomena. He was elected FRS in 1819, was knighted in 1848, and near the close of his life was awarded the Wollaston medal. He died on April 13, 1855.

See Sir A. Geikie's *Memoir of Sir A. C. Ramsay* (1895), which contains a sketch of the history of the Geological Survey, and of the life of De la Beche (with portraits), also *Summary of Progress of the Geological Survey for 1897* (1898).

DELABORDE, HENRI FRANÇOIS, COUNT (1764-1833), French soldier, the son of a Dijon baker, served in the revolutionary war from the beginning. He was created count in 1808 when he was serving under Junot in Portugal. He fought the skilful action of Roliça. In 1812 he was a divisional commander under Mortier in the Russian campaign. He joined Napoleon during the Hundred Days, was court-martialled at the Restoration, but acquitted on technical grounds.

DELAEROIX, FERDINAND VICTOR EUGENE (1798-1863), French historical painter, leader of the romantic movement, was born at Charenton-St. Maurice, near Paris, on April 26, 1798. His father, Charles Delacroix (1741-1805), was foreign minister under the Directory. Eugene was educated at the Lycée Napoléon, and then entered the atelier of Baron Guérin. He studied the works of Rubens and Paolo Veronese at the Louvre, and he was attracted by the work of Jécault, whose influence can be traced in Delacroix's first important picture, "Dante and Virgil," exhibited in 1822 and now in the Louvre. At a time when the classic school was predominant and artists were intent on the representation of scenes of antiquity and mythology the appearance of Delacroix's "Massacre of Chios" in the Salon of 1824 marked a victory for the romantic movement. It represented in a tragic manner the atrocities enacted in Greece, and, like Byron's poetry, enlisted sympathy for the Greek War of Independence. The picture was painted in glowing colours, and contrasted with the dark canvases of the Classicists, whose opposition was roused. The aged Gros is said to have called the "Massacre of Chios" *la massacre de la peinture*. Delacroix spent some months in England in 1825, and drew fresh inspiration from the works of Byron. He was attracted by the fresh and direct painting of Constable's landscapes. His next two pictures, "Marino Faliero Decapitated on the Giant's Staircase of the Ducal Palace" and "Greece Lamenting on the Ruins of Missolonghi," with many smaller works, were exhibited for the benefit of Greek patriots in 1826. Next year he produced "Sardanapalus," from Byron's drama. After this, he says, "I became the abomination of painting, I was refused water and salt"—but, he adds with singularly happy naivete, *J'étais enchanté de moi-même!* The

patrimony he inherited, or what remained of it, was 10,000 *louis de rente*, and with economy he lived on this, and continued to paint large historical pictures. In 1831 he reappeared in the Salon with six works, among which was "Liberty leading the People," now in the Louvre, and immediately after left for Morocco, where he found the colour and light which flooded his later work "The Entry of the Crusaders" into Constantinople is a powerful colour harmony (Louvre). A visit to Madrid acquainted him with the methods of Velasquez and Goya. The "Noce Juive" (1839) in the Louvre shows the influence of Spain. In 1835, through the influence of Thiers, he received a commission to decorate the interior of the chamber of deputies, and between that date and 1861 he completed that and other great decorative works "The Triumph of Apollo," the panel in the centre of the ceiling of the Galerie d'Apollon in the Louvre, subjects from the Divine Comedy in the library of the Luxembourg, and the mural paintings in the church of St. Sulpice, and in the Salon de la Paix in the Hôtel de Ville. Delacroix died on Aug. 13, 1863, at Champrosay, considered the greatest of the romanticist subject painters. Although he was hailed during his life time as a great revolutionary, it is not him, but Ingres, his classicist opponent and rival, whom modern painters claim as their ancestor. His large pictures representing romantic epics have not created a following. It is by his magic colour harmonies that he contributed to the development of painting, and his subtle decomposition of colour taught one of their principal secrets to the impressionists.

See *Journal d'Eugène Delacroix*, ed. P. Plat and R. Piot (1893-95), A. Robaut and Chesneau, *L'Oeuvre complet d'Eugène Delacroix* (1885), E. Dargenty, *Delacroix par lui-même* (1885), G. Moreau, *Delacroix et son oeuvre* (1893), Dorothy Bussy, *Eugène Delacroix* (1907), Ph. Bury, *Lettres d'Eugène Delacroix 1815-1863* (1879), Raymond Escholer, *Delacroix* (1927).

DE LA GARDIE, JAKOB, COUNT (1583-1652), Swedish field-marshal, son of Count Pontus de la Gardie, was born at Reval on June 30, 1583. In 1610 he led an army of mercenaries to Moscow in support of Basil Shuisky, after his abdication La Gardie seized Ingria and Novgorod, which acknowledged the sovereignty of the Swedes, but the Swedish army was held up before Pskov. But with the accession of the Romanovs the Russian situation changed. La Gardie defeated the Russians at Bronitski in July 1614, but Gustavus Adolphus now took charge of the operations, and with him La Gardie returned to Sweden. By the peace of Stolbova (1617) the Swedish possessions on the eastern Baltic were secured. La Gardie was promoted field-marshal, and devoted himself to the organization of the army. In 1625 he was again fighting in the Baltic provinces. On the death of Gustavus Adolphus he was appointed one of the guardians of the child queen Christina. He married in 1618 Countess Ebba Brahe, the early love of Gustavus Adolphus. He died on Aug. 22, 1652.

See A. Hamilton, *Minne af riksmarsken greve Jakob Pontusson de la Gardie* (1880).

DE LA GARDIE, MAGNUS GABRIEL, COUNT (1622-1686), Swedish statesman, was born on Oct. 15, 1622, in Reval, son of the preceding. In 1646 Queen Christina sent him on an extraordinary mission to France, and on his return he married the queen's cousin, Marie Euphrosyne of Zweibrücken. He stood well in Christina's favour and continuously held high office until 1653 when he fell into disgrace and had to leave the court. But in the reign of Charles X (1654-60), his brother-in-law, he held high command in the army fighting in the Baltic provinces against Russia and Poland, and conducted the peace negotiations at Oliva (1660). Charles appointed him grand chancellor and a member of the Council of Regency of Charles XI during his minority. He succeeded in dominating the council, and pursued a policy of reckless extravagance, and in 1674 engineered the alliance with France, which entangled Sweden two years later in the disastrous war with the elector of Brandenburg (See *SWEDEN History*). In 1675 a special commission was appointed to enquire into the conduct of De la Gardie and his associates, and on May 27, 1682, it decided that the regents and the senate were solely responsible for dilapidations of the realm, the compensation due by them to the Crown being assessed at 4,000,000 *daler* or £500,000. De la Gardie was treated with relative leniency, but he "received permission to re-

ture to his estates for the rest of his life" and died there in comparative poverty, a mere shadow of his former magnificent self. He was a man of brilliant social gifts and a great patron of literature and art. He presented to the library at Uppsala the famous late 15th century *Codex Argenteus* of Ullrich's Gothic version of the Gospels.

See Martin Vohall, *Svergers Stortestad* (Stockholm, 1881), *Sv. Hist. iv*, R. N. Bann, *Scandinavia* (Cambridge, 1905), *Konst och Konstnärar* and *M. G. de la Gardes* (1905).

DELAGE, YVES (1854-1920), French zoologist, was born on May 13, 1854, at Avignon. He became zoology professor at the Sorbonne in 1886. In 1901 he was made director of the laboratory of marine biology at Roscoff, Finistère. Delage was one of the first authorities on animal reproduction hybridism and heredity (see *HYBRIDISM*).

He died in Paris on Oct. 8, 1920.

See *L'Hérédité et les grands problèmes de la biologie générale* (1895, 2nd ed., 1903), *La Structure du protoplasma* (1895), *Traité de biologie comparée* (6 vols., 1896-1902), *Les Théories de l'évolution* (1900, Eng. trans. 1912), *Le Parthénogénèse naturelle et expérimentale* (1913), with M. Goldsmith, *La Revue, étude psychologique, philosophique et littéraire* (1919).

DELAGOON BAY (Portuguese for the bay "of the lagoon"), officially known as Bahia de Lourenço Marques (*qv*), an inlet of the Indian ocean on the east coast of South Africa, between 25° 40' and 26° 40' S, with a length of 26 m and a breadth of 22 m. It is the northern termination of the series of lagoons which line the coast from St. Lucia bay. The opening is towards the north-east. The southern part of the bay is formed by the Inyaka (native *Nyaka*) or Malingulu peninsula.

North of the peninsula is Inyaka island, with the fishing village of Pt. Melville at its north west point, and beyond Elephant's island Delagoa Bay forms a valuable harbour, accessible to large vessels at all seasons of the year. The surrounding country is low and very unhealthy, but the island of Inyaka has a height of 240 ft., and could be used as a sanatorium. The Manhusa or Komati river enters the sea just north of the bay, the Matolla, the Umbeluzi and the Tembe, from the Lebombo, meet in the estuary called by the Portuguese the Espírito Santo, but generally known as the English river, and the Maputa, or Lusutu, which has its head waters in the Drakenberg, enters in the south, as also does the Funtl river. These rivers are the haunts of the hippopotamus and the crocodile.

The bay was discovered by the Portuguese navigator Antonio de Campo, one of Vasco da Gama's companions, in 1502. Antonio Caldera explored the lower courses of the rivers entering Delagoa Bay especially the Espírito Santo. The Portuguese visited the district from time to time. In 1721 the Dutch East India company built a fort and "factory" on the spot where Lourenço Marques now stands, but in 1730 the settlement was abandoned. Thereafter the Portuguese had—intermittently—trading stations on the Espírito Santo. In 1771, the Austrian Asiatic company of Trieste attempted to establish a station there, but were expelled. Intermittent native wars followed the building of a fortress on the site of the present town in 1781. In 1823 W. F. W. Owen concluded treaties of cession with native chiefs and appointed British the country from the English river southwards, in 1824 the Portuguese disregarding the British treaties concluded treaties with the natives, and endeavoured (unsuccessfully) to take military possession of the country. The sovereignty of either power was left undecided till the claims of the Transvaal Republic rendered a solution of the question urgent. Great Britain had taken no steps to exercise authority on the spot, while the ravages of Zulu hordes, compared Portuguese authority to the limits of their fort. In 1835 Boers had attempted to form a settlement on the bay, which is the natural outlet for the Transvaal, and in 1868 the Transvaal President Marthinus Pretorius, claimed the country on each side of the Maputa down to the sea. In the following year, however, the Transvaal acknowledged Portugal's sovereignty over the bay. In 1861 Bickford had declared Inyaka and Elephant's island British territory. In 1872 the dispute between Great Britain and Portugal was submitted to the arbitration of M. Thiers, the French President, and on July 24, 1875,

his successor, Marshal MacMahon, declared in favour of the Portuguese. It had been previously agreed by Great Britain and Portugal that the right of pre-emption in case of sale or cession should be given to the unsuccessful claimant to the bay. Portuguese authority over the interior was not established until some time after the MacMahon award, normally the country south of the Manhusa river was ceded to them by the Matshangana chief Umula in 1861. In 1889 another dispute arose between Portugal and Great Britain in consequence of the seizure by the Portuguese of the railway running from the bay to the Transvaal. This dispute was referred to arbitration, and in 1900 Portugal was condemned to pay nearly £1,000,000 in compensation to the share holders in the railway company (See LOURENÇO MARQUES and GAZALAND).

For an account of the Delagoa Bay arbitration proceedings see Sir E. Hertlet, *The Map Of Africa by Treaty* (1909). Consult also the British blue-book, *Delagoa Bay, Correspondence respecting the claims of Her Majesty's Government* (1875), L. van Deventer, *La Hollande et la Baie Delagoa* (The Hague, 1883), G. McC. Theal, *The Portuguese in South Africa* (1896), Tessell, *The Key to South Africa, Delagoa Bay* (1899), and *History of South Africa since September 1795* (1908). *The Narrative of Voyages to explore the shores of Africa performed under direction of Captain W. F. W. Owen, R.N.* (1833) contains much interesting information concerning the district in the early part of the 19th century.

DELAINE A term which applies strictly to an all-woollen fabric of light and fine texture and constructed with the plain calico weave. The fabric may be all white or piece-dyed, i.e., dyeing the cloth in the "piece," after weaving, as distinct from coloured cloth woven from warp and weft yarn dyed previous to weaving. Delaine fabrics are also sometimes figured with patterns in various colours. The pattern may be printed on the warp, before weaving, after the manner adopted in chintzes and cretonnes (*qv*) and in Chinese silk fabrics, while others are printed with patterns after weaving, as in calico printing. One quality of delaine is made with 54 warp ends per inch, of 46's, and 64 picks per inch of 64's Botany wool. Delaine union fabrics are also produced from a cotton warp and Botany weft, with 30's counts of yarn for both warp and weft, and with 64 warp threads and picks per inch. Some fabrics described as "delainettes" are produced from all-cotton both for warp and weft of soft spun yarn, and finished with a soft finish similar to that of the lighter and finer textures of flannel (*qv*).

(H. N.)

DE LA MARE, WALTER JOHN (1873-), British poet and novelist, of Huguenot descent, was born on April 25, 1873, at Charlton, Kent, and educated in London at St. Paul's Cathedral Choir school. From 1889 to 1908 he was engaged in business in London, but he had already printed poems and prose, writing as "Walter Ramal" in *The Cornhill* and other magazines, and in 1902 his *Songs of Childhood* appeared, his novel *Henry Brocken* following in 1904. A grant from the Privy Purse enabled him to devote himself fully to literary work, and he gradually found a growing audience for his delicate and highly individual work. *The Return* (1910) won the Polignac prize. *The Listeners and other Poems* (1912), *Peacock Pie* (1913), *Motley and Other Poems* (1914) brought him to the front rank of his contemporaries, and volumes of his collected poems appeared in 1920, 1935 and 1942, as well as *Collected Rhythms and Verses* in 1944. A lyrical play *Crossings*, was published in 1921, and also further poems, *The Fall*. The long novel, *Memoirs of a Midwife* (1921), showed his prose gifts at their highest. It also showed him to be a master of fantasy (he gives substance and verisimilitude to the fantastic) and of symbolism, and the critics have seen in him the heir of Macbeth tradition. Other prose volumes included *The Riddle* (1921), *Broomsticks* (1925), *The Commoisseur and Other Stories* (1926), *Lewis Carroll* (1932) and *Mr. Bumps and His Monkey* (1942).

See R. I. Mignoz, *Walter de la Mare* (1924).

DELABRE, JEAN BAPTISTE JOSEPH (1749-1822), French astronomer was born at Amiens on Sept. 19, 1749. In 1771 he became tutor to the son of M. d'Assy, receiver-general of finances. He attended the lectures of J. J. Lalande, who induced d'Assy in 1788 to install an observatory for his benefit at his own

residence Here Delambre observed and computed almost uninter-
ruptedly, and in 1790 obtained for his *Tables of Uranus* the prize
offered by the academy of sciences He was admitted to the In-
stitute on its organization in 1795, and became, in 1803, perpetual
secretary to its mathematical section He served from 1795 on
the bureau of longitudes From 1792 to 1799 he was occupied
with the measurement of the arc of the meridian extending from
Dunkirk to Barcelona, and published a detailed account of the
operations in *Base du système métrique* (3 vols, 1806, 1807,
1810) He succeeded Lalande in 1807 as professor of astronomy
at the Collège de France, and was treasurer to the imperial uni-
versity from 1808 until its suppression in 1815 Delambre died
in Paris on Aug 19, 1822 He wrote *Histoire de l'astronomie
ancienne* (2 vols, 1817), *Histoire de l'astronomie au moyen âge*
(1819), *Histoire de l'astronomie moderne* (2 vols, 1821), *His-
toire de l'astronomie au XVIII^e siècle* (edit C L Mathieu, 1827),
Tables éphémériques des satellites de Jupiter, inserted in the third
edition of J J Lalande's *Astronomie* (1792), and republished in
an improved form by the bureau of longitudes in 1817, and other
works

DELAMERE or DE LA MER, GEORGE BOOTH,
1ST BARON (1622-1684), son of William Booth, of Dunham
Massey in Cheshire, was born in Aug 1622 He was returned for
Cheshire to the Long Parliament in 1645 and to Cromwell's parlia-
ments of 1654 and 1656 In 1655 he was appointed military com-
missioner for Cheshire and treasurer at war He was one of the
excluded members who tried and failed to regain their seats after
the fall of Richard Cromwell in 1659 He had for some time been
regarded by the Royalists as a well wisher to their cause, and
now became one of the chief leaders of the new "Royalists" who
at this time united with the cavaliers to effect the Restoration
A rising was arranged for Aug 5 in several districts, and Booth
took charge of operations in Cheshire, Lancashire and North
Wales He seized Chester on the 19th and marched towards York
The plot, however, had failed in other parts of the country, and
Lambert defeated Booth's men at Nantwich Bridge Booth him-
self was captured at Newport Pagnell on the 23rd and was im-
prisoned in the Tower He was soon liberated, sat in the parlia-
ment of 1659-60, and was one of the 12 members deputed to
carry the message of the Commons to Charles II at The Hague
In July 1660 he received a grant of £10,000, and on April 20,
1661, he was created Baron Delamere, with a licence to creat
six new knights The same year he was appointed *custos rotulorum*
of Cheshire He died on Aug 8, 1684, and was buried at Bowdon

His second son, HENRY (1652-1694) who succeeded him in the
barony, was created earl of Warrington in 1690 He was im-
placated in the Rye House Plot (1683), joined William of Orange
in 1688, and received many honours from the new king

DELAND, MARGARETTA WADE (CAMPBELL)
(1857-1945), American writer, was born at Allegheny, Pa, Feb
23, 1857 She studied in private schools and at Cooper Union in
New York, and for a time taught drawing In 1880 she married
L F Deland, of Boston She attracted attention with her first
novel, *John Ward, Preacher* (1881), which dealt with religious
and social questions after the manner of Mrs Humphry Ward
Her books include *The Story of a Child* (1892), *The Awakening
of Helena Richie* (1906), *The Iron Woman* (1911), *The Rising
Tide* (1916), *The Vehement Flame* (1922), *Old Chester Days*
(1935) She was most popularly known for her sympathetic
studies of village life and character, *Old Chester Tales* (1899)
and *Dr Lavendar's People* (1904) She died Jan 13, 1945

DE LAND, a city of Florida, USA, 100 mi SSE of Jack-
sonville, on the St John river, 18 mi from the Atlantic ocean,
the county seat of Volusia county It is served by the Atlantic
Coast Line railroad, and by water to Jacksonville The popula-
tion was 8,536 in 1950 and 7,041 in 1940 by the federal census
It is in a region of beautiful hills, orange groves and lakes, where
winter truck farming and the growing of citrus fruits and *Aspara-
gus plumosus* fern are important Ponce de Leon springs are 7
mi north De Land is the seat of the John B Stetson university,
established as an academy in 1883 by the founder of the town,
and renamed in 1889 after John Batterson Stetson, a Philadelphia

hat manufacturer, who gave it nearly \$500,000 The town was
founded in 1876, by Henry A De Land, a manufacturer of Fair
port, N Y, who built a public school in 1877, a high school in
1883 and the academy mentioned above in 1883

DELANE, JOHN THADDEUS (1817-1879), editor of
The Times, born in London and educated at King's college, Lon-
don, and Mgdalen college, Oxford He was called to the bar at
the Middle Temple in 1847 Delane was editor of *The Times* for
36 years (1841-77), and under his rule the paper acquired very
great influence at home and abroad It had become a power in
British politics under Delane's predecessor, Barnes, and under
Delane it attained a larger cosmopolitan standing He superin-
tended in detail the work of the leader writers and foreign cor-
respondents of the paper Among the latter in Delane's day were
Thomas Chenerly in Constantinople, and Blowitz in Paris An
example of the caution exercised by Delane in foreign affairs may
be cited When in 1875 Blowitz sent word that Bismarck contem-
plated a fresh attack on France, Delane held back the news for a
fortnight until he had been able to send Chenerly to Paris to sub-
stantiate the report Delane had an impartial mind, and built up
a tradition of independence of the Government of the day, even
when it was a Conservative one

See the biographies by Arthur Irwin Dasent (1908) and Sir Edward
Cook (1915)

DELANO, JANE ARMINDA (1862-1919), American
nurse, was born at Townsend, N Y, on March 12, 1862 She
graduated from the Bellevue hospital school of nursing in 1886
In 1888 she was asked to take charge of a temporary hospital
during the yellow fever epidemic in Jacksonville, Florida After
an experience as visiting nurse in Arizona, in the days of the still
war like Apache Indians, she was appointed superintendent of
nurses at the University of Pennsylvania hospital, Philadelphia,
Pa, 1891, and director of nursing at her alma mater in 1902
From 1909-12, she served as superintendent of the U S Army
Nurse Corps During the latter part of this period she accepted
the chairmanship of the National Committee on Red Cross
Nursing Service and began the development of a nursing reserve
In 1909 there were but 950 nurses on the Red Cross records
A month after the outbreak of World War I, ten picked units from
the 5,000, then on the rolls, sailed for Europe Before the end
of the war 20,000 Red Cross nurses served at home and abroad
with the army, navy and the American Red Cross in its work
among the civilian population When in France on a tour of in-
spection she died at Savenay, on April 15, 1919, worn out by war
work After a military funeral overseas her body was brought
home on a U S transport for interment at Arlington National
cemetery, on Sept 18, 1920 Her decorations included Japanese,
Austrian and Pan-American medals, and her country's D SM
awarded posthumously for "extraordinary devotion to duty"

DELANY, MARY GRANVILLE (1700-1788), an Eng-
lishwoman of literary tastes, was born at Coulston, Wilts, on
May 14, 1700, and died on April 15, 1788 She was a niece of the
1st Lord Lansdowne In 1718 she was unhappily married to
Alexander Pendarves, a rich old Cornish landowner, who died
in 1724 During a visit to Ireland she met Dean Swift and his
intimate friend, the Irish divine, Patrick Delany, whose second
wife she became in 1743 After his death in 1768 she passed all
her summers with her bosom friend the dowager duchess of
Portland—Prior's "Peggy"—and when the latter died George III
and Queen Charlotte, whose affection for their "dearest Mrs
Delany" seems to have been most genuine, gave her a small
house at Windsor and a pension of £300 a year At this time
Mrs Delany was a charming and sweet old lady, with a reputa-
tion for cutting out and making the ingenious "paper mosaics"
now in the British Museum, she had known everyone worth
knowing in her day, had corresponded with Swift and Young,
and left an interesting picture of polite society in her *Autobio-
graphy and Letters*, 1700-88, an abridged version of which was
compiled by G Paston, 1900 Burke calls her "a real fine lady"—
"the model of an accomplished woman of former times"

See *Mrs Delany at Court and among the Wits* Arranged from the
"Autobiography and Correspondence" With an introduction by
R Bramley Johnson (1925)

DE LA REY, JACOBUS HERCULES (1847-1914), Boer general, was born in the Lichtenburg district in what is now the Orange Free State, and in his youth and early manhood fought in the Kafir wars. In 1893 he entered the Volksraad of the South African Republic, where he supported the policy of Gen. Joubert. At the outbreak of the war with Great Britain in 1899 De La Rey was made a general, and fought in the western campaign against Lord Methuen and Lord Roberts. He won his first great success at Ntatal's Nek on July 11, 1900, where he compelled the surrender of a strong British detachment. In the second or guerrilla stage of the war De La Rey was conspicuously successful. He was assistant to Gen. Louis Botha and a member of the government with charge of operations in the western Transvaal. The principal actions in which he was successful (see also *TRANSVAAL History*) were Nooitgedacht, Vlakfontein and the defeat and capture of Lord Methuen at Klerksdorp (March 7, 1902). The British general was severely wounded in the action, and De La Rey released him at once, being unable to afford him proper medical assistance. This humanity and courtesy marked De La Rey's conduct throughout the war. After the conclusion of peace De La Rey, who had shared in the negotiations, visited Europe with other Boer generals to raise funds for resettlement. In Dec. 1903 he went on a mission to India, and induced the Boer prisoners of war detained at Ahmednagar to accept the new order of things and to take the oath of allegiance. In Feb. 1907 Gen. De La Rey was returned unopposed as member for Ventersdorp in the legislative assembly of the first Transvaal parliament under self-government. At the outbreak of the World War he was implicated in Maritz's rebellion, and was shot dead by a police patrol at Johannesburg on Sept. 16, 1914.

DE LA RIVE, AUGUSTE ARTHUR (1801-1873), Swiss physicist, was born at Geneva on Oct. 9, 1801. He was the son of Charles Gaspard de la Rive (1770-1834), who became professor of pharmaceutical chemistry at the Academy of Geneva in 1802 and rector in 1823. In 1823 de la Rive was appointed to the chair of natural philosophy in the Academy of Geneva. He devoted himself specially with François Marcat (1803-83), to the investigation of the specific heat of gases, and to observations for determining the temperature of the earth's crust. Electrical studies, however, engaged most of his attention. His experiments on the voltaic cell were of importance in the development of electrical theory, the results were published in 1836. In common with Faraday, de la Rive held the theory that voltaic electricity was due to chemical action. In 1840 he described a process for the electroplating of silver and brass, for which in the following year he received a prize of 3,000 francs from the French Academy of Sciences. Between 1854 and 1858 he published a *Traité de l'électricité théorique et appliquée*, which was translated into several languages. De la Rive's birth and fortune gave him considerable social and political influence. He was distinguished for his hospitality to literary and scientific men, and for his interest in the welfare and independence of his native country. In 1860, when the annexation of Savoy and Nice had led the Genevese to fear French aggression, de la Rive was sent by his fellow-citizens on a special embassy to England, and succeeded in securing a declaration from the English Government, which was communicated privately to that of France. Later (1867) he carried out a series of researches on the discharge of electricity through gases, with observations on the critical pressure and the conductivity of the cathode dark space. He died suddenly at Marseille on Nov. 27, 1873.

DELAROCHE, HIPPOLYTE, commonly known as PAUL, (1797-1856), French painter, was born in Paris on July 17, 1797. He studied under Gros and exhibited for the first time in the Salon of 1822. He visited Italy in 1838 and 1843, when his father-in-law, Horace Vernet, was director of the French Academy. His studio in Paris was in the rue Mazarine, where he never spent a day without some good result, his hand being sure and his knowledge great. His subjects, definitely expressed and popular in their manner of treatment, illustrating certain views of history dear to Parisians, yet romantic in their general interest, were painted with a firm, solid, smooth surface, which gave an

appearance of the highest finish. Delarocche held a course midway between the classicists and the romantics. His long series of historical pictures had a great popular success and were made familiar in thousands of homes by engravings of them. Three of them are in the Louvre: "The Death of Queen Elizabeth" (1827), "The Children of Edward IV" (1830), and "The Young Martyr." But his easel pictures no longer have much importance.

In 1837 Delarocche received the commission for the great picture, 27 mètres long, in the hemicycle of the lecture theatre of the École des Beaux-Arts. This represents the great artists of the modern ages assembled in groups on either hand of a central elevation of white marble steps, on the topmost of which are three thrones filled by the architects and sculptors of the Parthenon. To supply the female element in this vast composition he introduced the geni or muses, who symbolize or reign over the arts, leaning against the balustrade of the steps. The portrait figures are nearly all unexceptionable and admirable. This great and successful work is on the wall itself, an inner wall, however, and is executed in oil. It was finished in 1841 and considerably injured by a fire which occurred in 1855, which injury he immediately set himself to remedy (finished by Robert-Fleury), but he died before he had well begun, on Nov. 4, 1856.

See L. Runtz, *Oeuvre de Paul Delarocche*, photographic reproductions, with a notice by H. Delaborde and Jules Goddard (1858). Rees, *Delarocche* (1880).

DELARUE, GERVAIS (1751-1835), French historical investigator, formerly regarded as one of the chief authorities on Norman and Anglo-Norman literature, was a native of Caen who took refuge in England during the French Revolution. His principal works are *Essais historiques sur les Bardes, les Jongleurs, et les Trouvères normands et anglo-normands* (3 vols., 1834), and books on the history of his native town.

DE LA RUE, WARREN (1815-1889), British astronomer and inventor of the photo-heliograph, son of Thomas De la Rue, was born in Guernsey on Jan. 18, 1815. He constructed in 1850 a 13-in. reflecting telescope, mounted first at Canonbury, later at Cranford, Middlesex, and with its aid executed many drawings of the celestial bodies. In 1851 he saw a daguerotype of the moon by G. P. Bond, shown at the great exhibition of that year. Employing the more rapid wet-collodion process, he succeeded before long in obtaining exquisitely defined lunar pictures, which remained unsurpassed until the appearance of the Rutherford photographs in 1865. In 1854 he turned his attention to solar physics, and in order to obtain a daily photographic representation of the state of the solar surface he devised the photo-heliograph, described in his report to the British Association, "On Celestial Photography in England" (1859), and in his Bakerian Lecture (*Phil Trans vol. cli*). Regular work with this instrument, begun at Kew by De la Rue in 1858, was carried on there for 14 years, and was continued at Greenwich from 1873 to 1882. The results obtained in the years 1862-66 were discussed in two memoirs, entitled "Researches on Solar Physics," published by De la Rue, in conjunction with Professor Balfour Stewart and Mr. B. Loewy, in the *Phil Trans* (vol. cli and vol. cli). The photographs which he took in Spain of the solar eclipse of July 18, 1860, proved beyond doubt the solar character of the prominences or red flames, seen around the limb of the moon during a solar eclipse. In 1873 De la Rue presented most of his astronomical instruments to the university observatory, Oxford, in 1887 he provided it with a 13-in. refractor to enable it to take part in the International Photographic Survey of the Heavens. With Dr. Hugo Müller as his collaborator he published many chemical papers between 1856 and 1862, and investigated, 1868-1883, the discharge of electricity through gases by means of a battery of 14,600 chloride of silver cells. He was twice president of the Chemical Society, and also of the Royal Astronomical Society (1864-66). He died in London on April 19, 1889.

DELATOR, in Rome, one who gave notice (*deferre*) to the treasury officials of moneys due to the imperial *fiscus* (see *ARERITUM*). This meaning was extended to those who lodged information as to punishable offences, and further, to those who brought a public accusation against any person. Although the word *delator* ("common informer") is confined to imperial times,

the right of public accusation had long been in existence. When exercised from patriotic motives its effects were beneficial, but when rewards were introduced this was no longer the case. Cicero expresses his opinion that such accusations should be undertaken only in the interests of the state or for other urgent reasons. Under the empire the system degenerated into an abuse, which reached its height during the reign of Tiberius.

Delatores were drawn from all classes of society. The objects of their attacks were the wealthy, all possible rivals of the emperor and those whose conduct implied a reproach against the imperial mode of life. Special opportunities were afforded by the law of *maiestas* (treason) which (originally directed against attacks on the ruler by word or deed) was made to cover all kinds of irrelevant accusations. The chief motive for these accusations was no doubt the desire of amassing wealth, since by the law of *maiestas* one-fourth of the goods of the accused was assured to the accuser (who was hence called *quadruplator*). Pliny and Martial mention instances of enormous fortunes amassed by those who carried on this hateful calling. But it was not without its dangers. If the *delator* lost his case he was liable to the same penalties as the accused, he was exposed to the risk of vengeance at the hands of the proscribed, or of their relatives, while emperors like Tiberius had no scruples about putting out of the way those creatures for whom they had no further use. Under the better emperors severe penalties were inflicted upon the *delatores*.

Titus drove into exile or reduced to slavery those who had served Nero, after they had been flogged in the amphitheatre. The abuse reappeared under Domitian, they were again banished by Trajan, and threatened with capital punishment in an edict of Constantine.

See J. E. B. Mayor's note on Juvenal, iv, 48, for ancient authorities, also J. E. Sandys, *Companion to Latin Studies* (1921), with useful bibliography.

DELAUNAY, ELIE (1828-1891), French painter, was born at Nantes on June 12, 1828, and died in Paris on Sept. 5, 1891. He studied under Jean Flandrin and at the Ecole des Beaux-Arts. He worked in the classicist manner of Jean Ingres until, after winning the Prix de Rome, he went to Italy in 1856, and abandoned the ideal of Raphaellesque perfection for the sincerity and severity of the quattrocentists. As a pure and firm draughtsman he stands second only to Ingres. After his return from Rome he was entrusted with many important commissions for decorative paintings, including the frescoes in the church of St. Nicholas at Nantes, the three panels of "Apollo," "Orpheus" and "Amphion" at the Paris opera house, and 12 paintings for the great hall of the council of state in the Palais Royal. His "Scenes from the Life of St. Geneviève," which he designed for the Pantheon, remained unfinished at his death. The Luxembourg museum has his famous "Plague in Rome" and a nude figure of "Diana," and the Nantes museum, the "Lesson on the Flute." In the last decade of his life he achieved great popularity as a portrait painter.

DELAUNAY, LOUIS ARSÈNE (1826-1903), French actor, was born in Paris, the son of a wine seller. He studied at the Conservatoire, and made his first formal appearance on the stage in 1845, in *Tartuffe* at the Odéon.

Three years later he made his debut at the Comédie Française as Dorante in Pierre Corneille's *Le Menteur*, and began a long and brilliant career in young-lover parts, which he continued to act until he was 60, his grace, marvellous diction and passion enchanting his audiences. He was especially happy in the plays of Alfred de Musset.

Delauunay was made a chevalier of the Legion of Honour in 1883, and retired in 1887.

See *Souvenirs de M. Delaunay de la Comédie-Française* (1901).

DELAUVIGNE, JEAN FRANÇOIS CASIMIR (1793-1843), French poet and dramatist, was born in April 1793, at Havre, and was educated in Paris at the Lycée Napoléon. His *Dithyrambe sur la naissance du roi de Rome* (1811) secured for him a sinecure in the revenue office. Inspired by the catastrophe of 1815, Delavigne wrote the stirring patriotic poems entitled

Messéniennes. In 1819 his play *Les veupes Siciliennes*, refused for the Théâtre Français, was performed at the Odéon. In *Le Patriote* (1821) he expressed political opinions which led to his deprivation of a comfortable sinecure, but Louis Philippe compensated him by making him librarian at the Palais Royal. Here he wrote the *Ecole des vieillards* (1823), his best comedy, which gained him election to the Academy in 1835. To this period also belong *La Princesse Aurélie* (1828) and *Mario Fabelo* (1829), a drama in the romantic style.

For his success as a writer Delavigne was in no small measure indebted to the stirring nature of the times in which he lived. The *Messéniennes*, as noted above, had their origin in the excitement consequent on the occupation of France by the allies in 1815. Another crisis in his life and in the history of his country, the revolution of 1830, stimulated him to the production of a second masterpiece, "La Parisienne." This song, set to music by Daniel Auber, was on the lips of every Frenchman, and rivalled in popularity the "Marseillaise." A companion piece, "La Var soviétique," was written for the Poles, by whom it was sung on the march to battle. Other works of Delavigne followed each other in rapid succession—*Louis XI* (1832), *Les Enfants d'Edouard* (1833), *Don Juan d'Autriche* (1835), *Une Famille au temps de Luther* (1836), *La Popularité* (1838), *La Fille du Cid* (1839), *Le Conseiller rapporteur* (1840) and *Charles VI* (1842), an opera libretto partly written by his brother, German (1790-1868).

In 1843 he started for Italy in search of health, but died at Lyons on Dec. 11, 1843.

Delavigne's *Poésies* and his *Théâtre* were published in 1853. His *Oeuvres complètes* (new ed., 1855) contains a biographical notice by his brother, German Delavigne, who is best known as a librettist in opera. See also Charles Sainte Beuve, *Portraits littéraires*, vol. V, A. Favrot, *Étude sur Casimir Delavigne* (1894), and F. Vuacheux, *Casimir Delavigne* (1895).

DELAWARE, popularly called the "Diamond State," is one of the 13 original states of the United States. It is situated in the eastern part of the peninsula formed by Chesapeake bay and the estuary of the Delaware river, between approximately 38° 27' and 39° 50' N lat. and 75° 2' and 75° 47' W long. The state has a length of about 100 mi. and an average width of a little more than 20 mi., its total area being 2,057 sq. mi., of which 79 sq. mi. are inland water surface. Excepting Rhode Island, it is the smallest state in the union.

Delaware is bounded north and northwest by Pennsylvania, east by the Delaware river and Delaware bay, which separate it from New Jersey, and by the Atlantic ocean, south and west by Maryland.

Physical Features.—Delaware lies on the Atlantic coastal plain and is for the most part level and low, its average elevation above the sea being about 60 ft. Topographically, the state is two unequal areas, divided by a line following the general course of White Clay and Christina creeks. Northward of this line the country is rolling, with bold hills, moderately deep valleys and rapid streams. Southward, the country is level or gently undulating.

West of Wilmington there rises a ridge which crosses the state in a northwesterly direction and forms a watershed between Christina and Brandywine creeks, its highest elevation above sea level being 440 ft. at Centerville. South of the Christina there begins another elevation, sandy and marshy, which extends almost the entire length of the state from northwest to southeast and forms a second water parting. Numerous streams drain the state throughout its length. Those of the north flow into Brandywine and Christina rivers, whose estuary into Delaware river forms Wilmington harbour, those of the southwest have a common outlet in the Nantuxoke river of Maryland, those of the east empty into Delaware bay and the Atlantic ocean. The principal harbours are those of Wilmington, New Castle and Lewes. The shore of the bay is marshy, that of the Atlantic is sandy. In Kent county there are more than 60,000 ac. of tidal marshland, some of which has been reclaimed by means of dikes, Cypress swamp, in the extreme south, has an area of 50,000 ac. Hornblende, feldspar, granite of the Brandywine region and kaolin are found in the north. The prevailing soils of the region are clays, sometimes mixed with loam. Next, to the southward, come the

Cretaceous formations and clays suitable for terra cotta manufacture. The soils of this region are mainly loams. The remainder of the state has a sandy soil resting on Tertiary white and blue clays.

Minerals of economic value are found only in the north part of the state. Kaolin, mined chiefly in the vicinity of Hockessin, New Castle county, granite, used for road making and rough construction work, found near Wilmington, and brick and tile clays are the products of greatest importance.

The proximity of the Delaware and Chesapeake bays helps to give Delaware a mild climate. The mean annual temperature is approximately 55° F., ranging from 52° in the S to 56° in the N, and the extremes of heat and cold reported by the U.S. weather bureau are 107° in the summer and -12° in the winter. The annual rainfall, greater on the coast than inland, ranges from 40 to 45 in.

History—Before the coming of the white men, the present state of Delaware was inhabited by tribes of aborigines of the Lenape stock, later called Delaware Indians. Of an ancient and proud lineage, they were known as the "original people" and bore the familiar name of "grandfathers of the red men." The Nanticokes, occupying the lower part of Delaware and the eastern shore of Maryland, were Algonkin speaking people like the Lenape. The Minquas Indians, an Iroquois tribe, came from the interior to trade.

Henry Hudson discovered Delaware bay and river for the Dutch in 1609. The following year, Capt Samuel Argall of Virginia named the bay for Lord De la Warr, the governor of that colony. After the Dutch lost this, their "South river," the name Delaware survived.

The territory was more thoroughly explored in 1615-16 by Cornelis Hendricksen, whose reports did much to cause the incorporation of the Dutch West India company (q.v.) in 1621. About the time the Puritans were establishing themselves in New England, the first settlement on Delaware soil was made by members of the Dutch company in 1631 near the site of the present *Lewes*. The leaders, one of whom was Capt David P. de Vries, wished "to plant a colony for the cultivation of grain and tobacco as well as to carry on the whale fishery in that region." The settlement, however, was soon completely destroyed by the Indians (see *Lewes*).

When the Dutch West India company failed to meet the expectations of its founder, William Usselinx, he proposed plans for trade and colonizing to Gustavus Adolphus of Sweden. Swedish and Dutch interest resulted finally in a jointly financed company and an expedition to the Dutch "South river," the Delaware, in charge of Peter Minuit, former Dutch governor of New Netherland. In 1638, Minuit, who was an investor in the New Sweden company as well as expedition leader, established a settlement at what is now Wilmington, naming it "Fort Christina," in honour of the child queen Christina, and naming the entire territory, bought by Minuit from the Minquas Indians and extending indefinitely westward from the Delaware river between Bombay hook and the mouth of the Schuylkill river, "New Sweden." After the Swedish purchase of Dutch holdings in the New Sweden company, the next settlement was made by a group of Dutch Swedes and Germans in 1641. In 1642, mature plans for colonization were adopted. A new company, officially known as the West India, American or New Sweden company, but also popularly known as the South company, was chartered and a governor Johan Printz (c. 1600-63) was sent out by the crown. He arrived early in 1643 and subsequently established settlements, including one on the island of Truam at the site of Derington, Pa. another at the mouth of Salem creek, N.J., and another near the mouth of the Schuylkill river. Printz remained governor of New Sweden for a period of ten years, his mans on, fort and church were on Minimus island. Friction soon arose with New Netherland although the Swedes and the Dutch owing to their common dislike of the English and the common interests of Sweden and the Netherlands in the Thirty Years' War, had maintained a formal friendship. In 1651, Peter Stuyvesant, governor of New Netherland, and more aggressive than his predecessors built Ft. Casimir, near what is

now New Castle. In 1654 Printz's successor, Johan Claudius Rysing, who had arrived from Sweden with a large number of colonists, expelled the Dutch from Ft. Casimir. In retaliation, Stuyvesant, in 1655, with seven vessels and several hundred men, recaptured the fort and also captured Ft. Christina (Wilmington). New Sweden thus passed into Dutch control and became a dependency of New Netherland. In 1656, however, the Dutch West India company sold the region including Ft. Casimir to the city of Amsterdam, which in the following year established a settlement called "New Amstel" at Ft. Casimir (New Castle). This settlement, badly administered, made little progress.

In 1638 the whole of the Delaware country came under the jurisdiction of the city of Amsterdam, but in the following year, with New Netherland, was seized by the English. For a brief interval, in 1673-74, the Dutch were again in control, but in the latter year, by the treaty of Westminster, the "three counties on the Delaware" again became part of the English possessions in America held by the duke of York, later James II. His formal grant from Charles II was not received until March 1683. In order that no other settlements should encroach upon his centre of government, New Castle, the northern boundary was determined by drawing an arc of a circle 12 mi. in radius with New Castle as the centre. This accounts for the curved boundary line between Delaware and Pennsylvania. However, in Aug. 1682, the duke of York conveyed the entire territory to William Penn by deeds of feoffment and leases for 10,000 years, a transfer later challenged by Maryland. But differences in race and religion, economic rivalry between New Castle and Pennsylvania towns, and petty political quarrels over representation and office-holding, similar to those in the other American colonies, were so intense that Penn in 1691 appointed a special deputy governor for the "lower counties."

Although reunited with the "province" of Pennsylvania in 1693, the so called "territories" or "lower counties" secured a separate legislature in 1704 and a separate executive council in 1710, the governor of Pennsylvania, however, was the chief executive until 1776. A protracted boundary dispute with Maryland, which colony at first claimed the whole of Delaware under Lord Baltimore's charter, was not settled until 1767, when the present line separating Delaware and Maryland was adopted. In the American Revolution Delaware furnished only two regiments to the American Continental army, but they were among the best in the service. One of the companies of the first regiment carried a number of gamecocks said to have been the brood of a blue hen, hence the soldiers, and later the people of the state, have been popularly known as the "Blue Hen's Chickens," though the state itself, as already mentioned, is popularly called the "Diamond state."

Although Washington's whole army entered the state of Delaware and was encamped near Newport with a view to blocking Gen. Howe's march to Philadelphia after the landing of the latter's army at the head of the Elk in Aug. 1777, only a brisk skirmish at Cooch's Bridge (contemporaries called it Cooch's Mill) was fought on Sept. 3 between the American light infantry under Gen. Maxwell and some British detachments. Having encamped near Newark, Del., for five days, Howe marched through that town toward Kennett Square, Pa., in an effort to flank Washington's army, causing the American commander to march his men behind the Brandywine river in order to confront Howe at Chadd's Ford. (See *BRANDYWINE*.)

In 1776 a state government was organized, and the name "Delaware State" was first adopted. In the constitution of 1792 the title was changed to "State of Delaware." One of the peculiarities of the government under the first constitution was that, in addition to the regular executive, legislative and judicial departments, there was a privy council without whose approval the governor's power was little more than nominal. In 1786 Delaware was one of the five states whose delegates attended the Annapolis convention (see *ANAPOLIS CONVENTION*) and it was the first (Dec. 7, 1787) to ratify the federal constitution. The state was strongly Federalist for 30 years after the adoption of the federal constitution, and in several presidential elections stood almost alone in choosing Federalist electors. This strong Federalist influence

caused the state to oppose the War of 1812, but after war was declared it loyally supported the union. The slavery sentiment of the state was never strong, as was shown by the assembly's passing a resolution favouring the restrictions placed on further slave expansion by the Missouri Compromise and in 1845 passing a resolution against the annexation of Texas. In 1860 the state cast its electoral votes for John C. Breckinridge, as it was thought he represented the most neutral stand on the question of slavery.

A further effort was made to prevent the rupture on the slave question when the general assembly, in 1861, went on record as favouring the Crittenden compromise (see CRITTENDEN, JOHN JORDAN). In 1850 the Democrats, who had before then elected a few governors and United States senators, secured control of the entire administration—a control unarrested, except in 1863, until the last decade of the 19th century. Although it was a slave state, the majority of the people of Delaware opposed secession in 1861, and the legislature promptly answered President Lincoln's call to arms.

In 1865, 1867 and 1869, respectively, the legislature refused to ratify the 13th, 14th and 15th amendments to the federal constitution. The provision of the state constitution restricting suffrage to those who had paid county or poll taxes and made the tax lists the basis for the lists of qualified voters, opened the way for the disfranchisement of many Negroes by fraudulent means.

Consequently the levy court of New Castle county was indicted in the United States circuit court in 1872, and one of its members was convicted. Again in 1880 the circuit court, by virtue of the federal statute of 1872 on elections, appointed supervisors of elections in Delaware. The Negro vote increased in importance until 1900, when it was approximately one fifth of the total vote of the state, since then it has declined, because of decrease in the percentage of Negro population. In 1901 the legislature ratified the three federal amendments concerning the status of the Negro rejected in former years. Another political problem was representation in the legislature. Since colonial days the unit, from which members were elected at large, had been the county, inasmuch as the population of New Castle county after 1870 exceeded that of both Kent and Sussex, the inequality became a cause of discontent. This was partly eradicated by the new constitution of 1897, which reapportioned representation according to electoral districts, so that New Castle has 7 senators and 15 representatives, while each of the other counties has 5 senators and 10 representatives.

In 1889 the Republicans for the first time since the Civil War secured a majority in the legislature, Anthony J. Higgins (Republican) was elected to the United States senate. Internal dissensions in the Republican party, arising out of a struggle between the so-called Regular Republicans and a personal "machine" built up by J. Edward Addicks, a Wilmington capitalist, prevented the legislature from electing a senator in 1895. The next election brought the Democrats into power, and the vacancy was filled by Richard R. Kenney. The struggle between the Republican factions continued, and with the expiration of Senator Gray's term in 1899 an election was again prevented. The state was wholly without representation in the United States senate from the expiration of Senator Kenney's term in 1901 until 1903, when a compromise was effected whereby two Republicans, one of each faction, were chosen. Again in 1905 the legislature adjourned without being able to fill a vacancy in the senate. The deadlock, however, was broken at a special session of the legislature called in 1906 when in June of that year Henry A. du Pont was elected senator.

Between the Civil War and 1913, conservatism characterized the state. Proposed advances in the administration of government and in provisions for public health, education, and the general welfare received little support in spite of efforts of civic groups and individuals in the promotion of civic ideals. Marked progress began with the administration of Gov. Charles R. Miller (1913-17) and Gov. John G. Tooms (1917-21). The advances proposed and achieved during these terms continued with little interruption on during the depression of World War II. Popular participation in movements for civic betterment greatly increased after that war.

Development of the modern state was marked by the tendency

to base change and reform upon thorough study by experts and to increase efficiency of operation of state and local agencies by employment of trained personnel. A second trend toward efficiency was the provision of adequate buildings for public offices and departments. Concern for architectural merit and pleasing environment gave the state capital, Dover, a well planned administrative area and Wilmington its distinguished Rodney square and marine terminal.

Preservation of historic buildings and sites became an increasing state wide interest during and after the 1930s. In 1931 the tercentenary of the first white settlement was celebrated at Lewes, the Dutch Swanendael, in 1938 the tercentenary of the first permanent settlement, Swedes and Finns at Wilmington, in 1951 the tercentenary of the founding of New Castle by Dutch settlers and their establishment of the first elements of self government on Delaware soil.

Government.—The constitution by which Delaware is governed was adopted in 1897. Like the constitutions of 1776, 1792 and 1831, it was promulgated by a constitutional convention without submission to the people for ratification, and amendments may be adopted by a two-thirds vote of each house in two consecutive legislatures. Fifteen amendments had been adopted to 1951. The property qualification of state senators and the restriction of suffrage to those who had paid county or poll taxes were abolished, but suffrage was limited to adults who can read the state constitution in English and, unless physically disqualified, can write their names, and who have registered. In 1907 an amendment to the constitution was adopted which struck out from the instrument the clause requiring the payment of a registration fee of \$1 by each elector.

Important innovations in the constitution of 1897 were the office of lieutenant governor and the veto power of the governor, which extends to parts and clauses of appropriation bills, a bill may be passed over his veto by a three-fifths vote of each house of the legislature, and a bill becomes a law if not returned to the legislature within ten days after its reception by the governor, unless the session of the legislature shall have expired in the meantime.

The governor's regular term in office is four years, and he is ineligible for a third term. All his appointments to offices where the salary is more than \$500 must be confirmed by the senate, all pardons must be approved by a board of pardons. Elected officers in addition to the governor and lieutenant governor are attorney general, state treasurer, auditor of accounts and insurance commissioner. Appointed by the governor are the judges, the secretary of state, bank commissioner, liquor commissioner, adjutant general and other officers, boards and commissions. A commission created by the 1949 legislature to survey the executive department for more efficient organization reported to the 1951 legislature a plan for consolidation of 92 executive agencies into 8 staff and 11 operating departments and agencies under direct control of the governor.

The constitution requires that a general election be held every two years on the Tuesday next after the first Monday in November and further provides against violations of the honesty and freedom of elections in detail and with heavy penalties.

Representation in the legislature is according to districts, there being ten districts in each county for the election of members in the lower house for two years, and five senatorial districts in each county for the election of members in the upper house for four years, in addition, the city of Wilmington, which is in New Castle county, has five representative districts and two senatorial districts. In November the people of the state elect the governor, lieutenant governor, attorney general, state treasurer, auditor of accounts and insurance commissioner, judges of the supreme and circuit courts, and members of the legislature. The legislature meets in regular session on the first Monday in November following the election. The governor may call special sessions of the legislature at any time.

by the governor, with the consent of the senate, for a term of 12 years.

Certain of the judges hold courts of chancery, general sessions, oyer and terminer, and orphans' courts, the seven together constitute the supreme court, but the judge from whose decision appeal is made may not hear the appealed case unless the appeal is made at his own instance.

In 1949 a proposed constitutional amendment creating a separate supreme court provided the first legislative step.

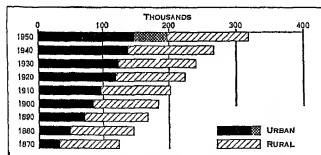
Corporations may be created under general law only, and no corporation may issue stock except for an equivalent value of money, labour or property. The well-interpreted "general corporation law of the state," kept broad in its provisions, combines liberal policy with stability. Use of the word "trust" in the title of corporations is limited to those having trustee or banking business which are under the supervision of the bank commissioner and are required by law to make at least two reports each year to the commissioner.

The major units of local government are the counties, of which Delaware has only three: New Castle, Kent and Sussex. The colonial division of the counties into "hundreds," derived from the English districts of King Alfred's day, persists, although these districts, formerly corresponding to the townships of Pennsylvania, have lost most of their governmental functions.

The state has no unified penal system and no state prison. County jails are maintained in Kent and Sussex counties and a county workhouse in New Castle county. The latter receives some long-term prisoners from the other counties. The whipping post was still maintained in Delaware at mid-20th century, and laws on the statute books prescribed whipping for a number of crimes and misdemeanours. The courts have been forbidden to impose sentence of whipping on females since 1889, and beginning in 1889 under increasing discretionary powers granted the courts, judges tended to avoid sentencing prisoners to be lashed. When imposed, this penalty usually has been for larceny, robbery, or occasionally wife-beating.

By decision of the United States supreme court in 1934 the boundary dispute between Delaware and New Jersey which had almost led to an open "oyster war" was settled. The court upheld Delaware's claim to territory as far as the low water mark on the New Jersey shore within a 12-m. radius of New Castle. Farther down the Delaware river, however, it decreed that the boundary should follow the centre of the ship channel and not, as Delaware had contended, the geographic middle of the river. New Jersey thus succeeded in establishing its right to certain oyster beds.

Population.—The population of Delaware in 1790 was 59,096, in 1830 it was 76,748, in 1870, 125,015, in 1910, 202,322, in 1940,



BY COURTESY OF THE U. S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF DELAWARE 1870 TO 1950
The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition.

266,505, and in 1950, 318,085. This last figure represents an increase of 19.4% over the population in 1940. The population per square mile in 1950 was 160.8, as compared with 134.7 in 1940 and with 50.7 for the U.S. in 1950.

Of the 1950 population 147,890, or 46.5% lived in incorporated places of 2,500 or more, as compared with 52.5% in 1940, when these places constituted the urban area. The entire urban

population, under a new definition set up for 1950 which included also the thickly settled suburb in 1940, or 10.1% of the state total to Wilmington, amounted to 199,121, or 62.6% of the state total.

| Area | Population | | | Per cent of total | |
|------------------|------------|---------|---------|-------------------|---------|
| | 1950 | 1940 | 1910 | 1940-50 | 1910-50 |
| The state | 318,085 | 266,505 | 202,322 | 100.0 | 100.0 |
| Urban* | 199,121 | 147,890 | 115,211 | 62.6 | 57.0 |
| Rural* | 118,964 | 118,615 | 87,111 | 37.4 | 43.0 |
| Per cent urban | 62.6 | 55.5 | 57.0 | | |
| Principal cities | | | | | |
| Wilmington | 110,156 | 112,501 | 106,507 | 34.6 | 52.7 |
| Dover | 6,317 | 5,517 | 4,800 | 1.9 | 2.4 |

*Final figures for 1950 based on new definition. See comment in text.

The number of households in 1950 was 90,362, as compared with 70,541 in 1940.

The average population per household had declined from 3.8 in 1940 to 3.5 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 81.7% native white, 4.4% foreign born white, and 13.9% nonwhite, practically all Negro. There were 96.8 males per 100 females in the native white population, and 101.4 in the Negro population, 8.3% of the population was 65 years old or over, and 54.6% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 11.5% was engaged in agriculture, 11.3% in construction, 34.0% in manufacturing and 22.2% in transportation and trade.

Finance and Taxation.—The fiscal system of the state is based upon operation from current revenues and serial bonds for permanent improvements. Modern budget procedure governs the biennial appropriations for the expenses of all regular agencies and departments. A state tax department provides an efficient system of tax collection. The chief sources of revenue are: graduated income tax, franchise, inheritance and estate taxes, business and occupation licences, permits and motor fuel taxes and federal grants. There is no state real estate tax.

State revenue for the fiscal year ending June 30, 1950, was \$37,579,930, nonrevenue income \$40,243,722, cash balance from the previous fiscal year, \$13,527,305. Appropriations included education \$8,840,728, public welfare \$1,165,740, highways \$3,886,900.

On Dec. 31, 1950, Delaware's state and national banks had assets of \$694,969,000, an increase for the year of \$65,000,000. Deposits in state banks were \$382,000,000, an increase of \$39,000,000.

Education.—The constitutional provision for the maintenance of a public-school system required separate schools for white and Negro children, with additional provision that no distinction be made in financing schools, on account of race or colour. The first public-school law, passed in 1829, was based largely on the principle of "local option," each school district being left free to determine the character of its own school or even to decide against having any school at all.

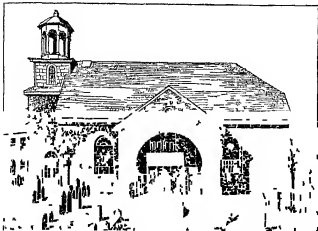
This system was replaced in 1875 by creation of a state board of education and a further step toward uniform administration under a state superintendent. Although the state temporarily reverted to decentralized administration in 1888 and the subsequent progress was halting and intermittent, the state was ready in 1919 and 1920 for the adoption of a modern school code. This code was progressively amended, and the public school system developed rapidly to high rank among the states in administration and facilities, including scientifically designed buildings.

Outstanding advances were a state program of vocational education, a uniform state supported salary schedule for all personnel from clerical to administrative and a unit plan of allocation of state funds.

In the fiscal year 1950 the cost of operating the public schools was \$10,131,119 (state appropriation \$8,686,623, supplemented by local taxation). Expenditure per pupil was \$243.42. The average salary of class room teachers was \$3,379. The state had 142 elementary schools with a teaching staff of 952 for the 28,423 pupils enrolled, 47 secondary schools with a teaching staff of 879

for 16,923 pupils Compulsory attendance was 160 days In 1949 legislative appropriation for school buildings was \$13,700,000

Major contributions to the state's educational development were the good roads program inaugurated by T. Coleman du Pont, who gave the state a model highway costing \$4,000,000, and schools built by Pierre S. du Pont, costing \$9,000,000 and made possible by the roads



OLD SWEDS CHURCH AT WILMINGTON, DELAWARE BUILT IN 1698 BY SWEDISH COLONISTS AND STILL USED AS A PLACE OF WORSHIP

Delaware college at Newark, founded as Newark college in 1833 served as the state's only institution of higher education until 1859, when it closed Reopened in 1870 as a land grant college, it received in addition to federal and private funds, appropriations from the state for permanent improvements and in 1913 became wholly state owned From that year, gifts and bequests in addition to regular funds contributed to a great expansion in facilities

In 1913 the Women's college was founded and affiliated with Delaware college, with the same faculty, but entirely separate in buildings, classes and student organizations In 1921 the two colleges were incorporated as the University of Delaware The fully reorganized university became completely co educational in 1944 The faculty in 1950-51 numbered 520 The total value of university property in 1950 was \$7,000,000, the income for the fiscal year 1950 was \$1,293,286 The total undergraduate attendance in 1950-51 was 1,332 men and 583 women Graduate students numbered 583 Area of campus and farm is 500 ac The agricultural experiment station, established 1888, and its agricultural extension division became affiliated with the university's school of agriculture By taking advantage of the annual summer sessions, students in agriculture and other schools may graduate in three years

Delaware State college near Dover, established in 1891 as a land grant college for Negro students, awards bachelor degrees in arts, science, education, home economics, agriculture and industrial arts Students may do graduate work at the University of Delaware, also undergraduate work if the facilities of State college fall below those of the university

Welfare and Correction—State agencies provide a broad program of health and welfare Of major importance are the state board of health, state board of welfare (children), old age welfare commission, which grants old age pensions, operates the state welfare home (for aged and homeless poor) and administers outside relief, Delaware State Hospital (for the mentally ill), one of the country's most advanced institutions, and the Governor Bacon health centre, a 320 ac estate with buildings for the specialized care and treatment of children and adults who are victims of infantile paralysis, spastics and cardiacs, alcoholics and bedridden aged Other state agencies care for the blind, deaf, dumb, tubercular and feeble minded Kent and Sussex county jails and the New Castle county workhouse are the only penal institutions Juvenile courts in Kent and Sussex counties and the family court

of New Castle county exercise correctional jurisdiction over delinquent children and youth Three state training schools provide academic and vocational education for delinquent children and youth These are Ferris school for white and Negro boys, Kruse school for Negro girls and Woods Haven for white girls

Stenization of the feeble-minded, epileptic and insane is provided for by law

Industry, Trade and Transportation—Delaware's population was chiefly rural and agricultural until 1920, when the urban population exceeded the rural for the first time This change in population ratio was in a great measure due to rapid industrial development during World War I The development of agriculture was also rapid In 1929 the value of all farm crops and livestock sold, traded, or used by farm households amounted to \$21,201,961 In 1945 the total cash farm income was \$93,445,000 In 1949 total cash farm income was \$97,817,000 Of this income, \$60,610,000 was from the broiler industry, making Delaware rank first in this product In 1949-50 the state ranked second highest in farm income per county

Crop production in 1949 included corn, 4,380 bu., wheat, 1,202,000 bu., apples, 624,000 bu., tomatoes (processed) 25,800 tons, lima beans, shelled, 16,200 tons, strawberries, 63,000 crates The extensive peach culture which for several decades before 1900 gave Delaware the name of the "Peach state" remained a minor source of farm income, peaches representing 41% of all fruit trees

The number of farms in 1945 was 9,296, comprising 70.3% of the total land area of the state The majority of farms ranged from 50 to 350 ac There is no state tax on real estate in Delaware The county taxes vary from 35 cents to 65 cents per \$100 of assessed value

The development of manufacturing in Delaware—centred largely within the northern part of New Castle county, including Wilmington and the river shore north and south of the city, New Castle and Newark—had its origin in the abundant water power from the streams and easy access to the state's great waterway, the Delaware river Wilmington, an active shipbuilding and shipping port and centre of mill industries from colonial days, expanded after the Civil War into a notable centre for such special industries as carriage and car building, fibre and paper making and machine tool production with the growth of its regular gun powder, textile, leather and iron manufacturing Early industries along the millstreams of the adjoining county added to the Wilmington area's potential facilities for increased industrial importance during and following World War I Throughout the state canning and other food processing developed into a major industry Production of nylon, chemicals, motor vehicles and parts, aircraft, and steel and iron manufacturing and shipbuilding reached their peaks during and after World War II During this period Wilmington became an outstanding chemical centre of the world with rapidly expanding experimental stations for basic and applied research Additions in this field to one company, E. I. du Pont de Nemours & Co., cost \$30,000,000 to build and equip after the war

In 1950 the chemical industry was responsible for the largest increase in employment in the Wilmington area Second largest was that of plants supplying the building trades

The U. S. business census, 1947, reported value added by manufacturing as \$182,088,000 for 482 plants, of which \$121,594,000 was in 251 plants in New Castle county In the fiscal year ending June 30, 1950, the gross receipts of the state's 979 licensed manufacturers amounted to \$285,273,053 Of the total, food accounted for \$67,461,551, clothing \$75,811,666, drugs and medical supplies \$3,274,467, motor vehicle production and supplies, \$10,227,693, miscellaneous, including chemicals, building supplies, textiles, latex, fibre and machinery, \$126,934,254 Stone, clay and sand products, commercial fishing, and merchantable timber and wood products in the 1945-50 period showed a degree of recovery toward former importance Manufacture of fertilizers also continued to grow

Delaware's transportation facilities include the water-borne traffic of the Delaware river and the Delaware and Chesapeake seacoast canal connecting the Delaware with Chesapeake bay, the

marine terminal at the port of Wilmington with wharf facilities for the largest ocean vessels, airports with passenger and freight service, 3,910 mi. of main highways and connecting roads and approximately 300 mi. of railways. The Pennsylvania, the Baltimore and Ohio and the Reading railway systems cross the northern part of the state. The Pennsylvania system also runs the length of the state below Wilmington and serves the whole of the Del Mar Va peninsula. The Delaware system of wide dual highways and paved secondary roads connects with all adjoining state systems and with New Jersey by ferry at New Castle and a new \$40,000,000 suspension bridge across the Delaware a few miles north of the ferry point.

The Delaware and Chesapeake canal, 19 mi. long and 90 ft. wide, owned and operated by the federal government, is part of the eastern inland waterway system. Tonnage through the canal was 7,414,761 in 1950, transits of vessels, 14,506. Tonnage at the port of Wilmington was 692,042, value of cargoes, \$34,972,934. Lewes, with its 300 ac. of artificial harbour, provides pilot service for river shipping. Regular lines at the New Castle county airport carried 91,122 lb of air mail, 270,468 lb of air express and 764,415 lb of air freight in 1950. Flights of passenger planes numbered 11,776.

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(G. H. R., J. E. N.)

DELAWARE, a city of central Ohio, U.S.A., 24 mi. N. of Columbus, on the Olentangy river, the county seat of Delaware county.

The city is on federal highways 23, 36 and 42, and is served by the Big Four, Chesapeake and Ohio and the Pennsylvania railways. The population was 11,783 in 1950 and in 1940 was 8,944. The city is built on rolling ground, 900 ft. above sea level. It is the seat of the Ohio Wesleyan university, founded in 1841 by the Ohio Conference of the Methodist Episcopal church. Delaware was laid out in 1808 and incorporated in 1815. It was the birthplace of President Hayes.

DELAWARE AND HUDSON COMPANY, THE, a holding company, formerly the oldest operating railway company in America, and a large anthracite carrier, founded by William and Maurice Wurts, Philadelphia merchants, who discovered and acquired anthracite lands in the Lackawanna valley, Pennsylvania, for replacing English coal cut off by the War of 1812. It was

chartered in New York, on April 23, 1823, as "The President, Managers and Company of the Delaware and Hudson Canal Company," which built a canal, Rondout, New York, to Honesdale, Pennsylvania, in 1828, aided by a loan of credit of the State of New York in the amount of \$800,000, and a railroad, Honesdale to the coal beds at Carbondale, Pennsylvania, on which the "Stourbridge Lion," the first locomotive to run on an American railroad, made its famous trial trip on August 8, 1829. The name was changed by act of the New York legislature, passed on April 28, 1899. The canal was abandoned and its cost charged off in 1898. Coal ownership was greatly enhanced by acquisition and lease, after the Civil War, of additional coal properties, at a later time transferred to a wholly owned subsidiary.

By obtaining control of numerous railroads and some construction, the company built up a railway system extending from Plymouth, Pennsylvania, by way of Albany and Schenectady to Rouses Point, New York, at the Canadian border, with branches to Binghamton, Troy, Lake George, Lake Placid, New York, and Rutland, Vermont, and other points, a total of 857.8 miles, consisting of 324.53 owned, 440.51 leased and controlled, and 92.81 trackage rights. On April 1, 1930, the railroad operations were transferred to "The Delaware and Hudson Railroad Corporation," a wholly owned subsidiary, chartered December 1, 1928, in New York.

The company also owns a railroad in Canada, operating 27.11 miles.

(J. H. Nu.)

DELAWARE INDIANS, tribes that occupied the drainage of the river Delaware and the shores of Delaware bay, eastern United States. They called themselves Lenape or Leni-Lenape, and were an association or confederacy of three Algonkin tribes, the Munsee, Unami and Unalachtigo. Their speech seems to have been more similar to the Algonkin dialects of Ohio valley than to the adjacent ones of the Atlantic coast, and their own tradition, in the Walam Olum, brings them out of the west. They were friendly to the whites, but, conquered in 1720 by the Iroquois and their lands more and more encroached on by the English settlers, they began to move westward, successively to central and western Pennsylvania, Ohio, Indiana, Missouri, Texas, Kansas and Oklahoma, with branches in Wisconsin and Ontario. They mixed with other Indian remnants in these migrations and the survivors contain much tribally alien blood. Though not particularly powerful or aggressive at the time of discovery, the Delaware were accorded an honorific pre-eminence by the other eastern Algonkins and were called "Grandfathers." See D. G. Brinton, *The Lenape and their*

DELAWARE LACKAWANNA AND WESTERN RAILROAD COMPANY, THE

providence (now Scranton), Pa., to the Susquehanna river at Great Bend, Pa., to provide an outlet for the anthracite coal and the iron of the Lackawanna valley.

During its early history the road was mainly an anthracite coal carrier, but the inauguration of a comprehensive scheme of improvements subsequent to 1899 enabled the company to handle a larger volume and greater diversity of freight and passenger traffic. In 1899 anthracite coal comprised 53% of all freight traffic, in 1939 it represented but 31%. Revenue in 1899 from transportation of passengers was \$3,951,051, in 1939 \$6,649,041. The gross transportation revenue in 1939 was \$50,454,438, the capital stock, \$87,407,500. Over 60,000 passengers are transported daily over the Lackawanna's New Jersey suburban lines in and out of New York City. Electrification between Hoboken and Dover, N.J. was completed in 1931. Through service is operated to Cleveland and Chicago via the Nickel Plate road, and to Detroit and Chicago via the Michigan Central railroad.

(J. M. D.)

DELAWARE RIVER, a stream of the Atlantic slope of the United States, meeting tidewater at Trenton (N. J.), 130 mi above its mouth. Its total length, from the head of the longest branch to the capes, is 410 mi, and above the head of the bay its length is 296 mi. It constitutes in part the boundary between Pennsylvania and New York, the boundary between New Jersey and Pennsylvania, and, for a few miles, the boundary between Delaware and New Jersey. The main or west branch rises in Schoharie county (N. Y.), about 1,886 ft above the sea, and flows tortuously through the plateau in a deep trough until it emerges from the Catskills. Other branches rise in Greene and Delaware counties, New York. In the upper portion of its course the varied scenery of its hilly and wooded banks is exquisitely beautiful. After leaving the mountains and plateau, the river flows down broad Appalachian valleys, skirts the Kittatinny range, which it crosses at Delaware water gap, between nearly vertical walls of sandstone, and passes through a quiet and charming country of farm and forest, diversified with plateaus and escarpments, until it crosses the Appalachian plain and enters the hills again at Eason's (Pa.). From this point it is flanked at intervals by fine hills, and in places by cliffs, of which the finest are the Nockamixon rocks, three miles long and more than 200 ft high. At Trenton there is a fall of eight feet.

Below Trenton the river becomes a broad, sluggish inlet of the sea, with many marshes along its side, widening steadily into its great estuary, Delaware bay. Its main tributaries in New York are Mongaup and Neversink rivers and Callicoon creek, from Pennsylvania, Lackawanna, Lehigh and Schuylkill rivers, and from New Jersey, Rancocas creek and Musconetcong and Maurice rivers. Commerce was once important on the upper river, but only before the beginning of railway competition (1857). Of the various early canals only two are of any importance now, the canal from Trenton to New Brunswick which unites the waters of the Delaware and Raritan rivers and the Delaware and Chesapeake canal which joins the waters of the Delaware with those of Chesapeake bay. The magnitude of the commerce of Philadelphia has made the improvements of the river below that port of great importance.

At a cost of many millions of dollars to the U. S. Government a 32 ft channel 600 ft wide has been opened from the deep water in Delaware bay to Philadelphia and a 12 ft channel from there to Trenton.

DELAWARE WATER GAP, a borough and summer resort of Monroe county, Pa., U. S., on the Delaware river, about 85 mi N. of Philadelphia and about 88 mi W. by N. of New York on federal highway 611. Population (1950) 734, (1940) 410, (1930) 443. It is served directly by the Delaware, Lackawanna and Western railway. The borough was named from the neighbouring gorge. On the New Jersey side of the river is Mt. Tammany (about 1,600 ft.), a cliff of which has been weather-carved into the profile of an Indian, once so common to this section. On the Pennsylvania side Mt. Minni rises approximately 1,500 ft.

The river elevation is about 300 ft. The gap, some two miles long, is the result of erosion by a river which once flowed northward acting along a line of faulting at right angles to the strike of the tilted rock formations. The river's present course is thought to be young geologically, and the gap exposes Ordovician, Silurian and Devonian strata.

One of the fine remnants of the Wisconsin terrane may be seen in the Delaware water gap. The gap is a fine example of a river cutting through a plateau.

DE LA WARR or **DELAWARE**, 1. 11th baron of Delbrück, died in 1370, and the male line of the family became extinct on the death of Thomas, 5th baron, in 1426.

The 5th baron's half sister, Joan, married Thomas West, 1st Lord West (d. 1405), and in 1415 her second son, Reginald (1394-1451) succeeded his brother Thomas as 3rd Lord West. After the death of his uncle Thomas, 5th Baron De La Warr, whose estates he inherited, Reginald was summoned to parliament as Baron La Warr, and he is thus the second founder of the family. His grandson was Thomas, 3rd (or 8th) baron (d. 1525), a courtier during the reigns of Henry VII and Henry VIII, and the latter's son was Thomas, 4th (or 9th) baron (c. 1472-1554). The younger Thomas was a very prominent person during the reigns of Henry VIII and Edward VI. He died without children in Sept. 1554, when his baronies of De La Warr and West fell into abeyance. His monument may still be seen in the church at Broadwater, Sussex. He had settled his estates on his nephew William West (c. 1519-95), who was disabled by act of parliament (1549) from succeeding to his honours for having sought to poison his uncle. However, in 1570 he was created by patent Baron De La Warr. In 1596 his son Thomas (c. 1550-1602) claimed presidency in the baronage as the holder of the ancient barony of De La Warr, and his claim was admitted.

Thomas West, 3rd or 11th Baron De La Warr (1577-1618), British soldier and colonial governor in America, was born on July 9, 1577, and succeeded to the title in 1602. He fought in Holland and in Ireland under the earl of Essex. He was imprisoned for complicity in Essex's revolt (1600-01), but was exonerated. He became a member of the council of the Virginia company and was appointed (1609) governor and captain general of Virginia for life. Sailing in March 1610 with three ships, 150 settlers and supplies, he arrived at Jamestown on June 10, in time to intercept the colonists who had embarked for England and were abandoning the enterprise. Lord De La Warr's rule was strict but just; he constructed two forts near the mouth of the James river, rebuilt Jamestown, and in general brought order out of chaos. In March 1611 he returned to London, where he published, at the request of the company's council, his *Relation of the condition of affairs in Virginia* (reprinted 1839 and 1868). He remained in England until 1618, when the news of the tyrannical rule of the deputy, Samuel Argall, led him to start again for Virginia. He embarked in April, but died *en route* on June 7, 1618, and was buried at sea. The Delaware river and the State of Delaware were named in his honour. A younger brother, Francis (1586-c. 1634), was prominent in the affairs of Virginia, and in 1627-28 was president of the council, and acting governor of the colony.

In 1761 the 3rd or 12th baron's descendant, John, 7th or 16th Baron De La Warr (1693-1766), was created Viscount Cantelupo and 1st Earl De La Warr. He was a prominent figure in the House of Lords, at first as a supporter of Sir Robert Walpole. He also served in the British army and fought at Dettingen, and was made governor of Guernsey in 1752.

George John West, 5th earl (1795-1869), married Elizabeth Sackville, and in 1843 he and his sons took the name of Sackville-West. The earl was twice lord chamberlain to Queen Victoria, and he is celebrated as "Fair Euryalus" in the *Childs Recollections* of his schoolfellow, Lord Byron. His son, Charles Richard (1815-73), 6th earl, served in the first Sikh war and in the Crimea, and being unmarried was succeeded by his brother Reginald (1817-96) as 7th Earl De La Warr. In 1896 the 7th earl's son, Gilbert George (1860-1915) became 8th Earl De La Warr. He was succeeded as 9th earl by his son, Herbrand Edward (b. 1900).

See G. E. C. (okayano), *Complete Peerage* (1887-96).

DELBRÜCK, HANS (1848-1929), German historian, was born at Bergen on the island of Rugen on Nov. 11, 1848, and studied at the universities of Heidelberg and Bonn. He saw active service in the Franco-German War, and was afterward tutor to Prince Waldemar of Prussia (1874-79). In 1885 he became professor of modern history in the university of Berlin. From 1884-90 he sat as a conservative in the German reichstag. Delbrück's writings are chiefly concerned with the history of the art of war, his most ambitious work being his *Geschichte der Kriegskunst im Rahmen der politischen Geschichte* (first section,

Das Altertum, 1900, second *Romer und Germanen*, 1902, third, *Das Mittelalter*, 1907, fourth vol., 1921. Among his other works are *Die Perserkriege und die Burgunderkriege* (Berlin, 1887), *Historische und politische Aufsätze* (1886), *Erinnerungen, Aufsätze und Reden* (1902), *Die Strategie des Porzells erläutert durch die Strategie Friedruchs des Grossen* (1890), *Die Polenfrage* (1894), *Das Leben des Feldmarschalls Grafen Nuthardt von Gneissau* (1882 and 1894), *Krieg und Politik* (3 vols., 1910), *Länderei, Turpe, Falkenhayn* (1920), *Die Geschichte* (1923-26, 3 vols.) and *Vor und Nach dem Weltkrieg* (1926). Delbrück began in 1883 to edit the *Preussische Jahrbücher*, in which he has written many articles, including one on "General Wolsley über Napoleon, Wellington und Gneissau," and he has contributed to the *Europäischer Geschichtskalender* of H. Schulthess. After the World War he was appointed member of the commission to publish German archives. He died July 14, 1929.

DELBRÜCK, RUDOLF VON, Prussian statesman (1817-1903), was born at Berlin on April 16, 1817. On completing his legal studies he entered the government service in 1837, in 1848 he was transferred to the ministry of commerce. Both Germany and Austria had realized the influence of commercial upon political union. Delbrück in 1851 induced Hanover, Oldenburg and Schwunburg Lippe to join the Zollverein, and the southern states, which had agreed to admit Austria to the union, found themselves forced in 1853 to renew the old union, from which Austria was excluded. Delbrück now began, with the support of Bismarck, to apply the principles of free trade to Prussian fiscal policy. In 1864 he concluded an important commercial treaty with France. In 1867 he became the first president of the chancery of the North German Confederation, and represented Bismarck on the federal tariff council (*Zollbundesrat*). In 1868 he became a Prussian minister without portfolio. In Oct. 1870, when the union of Germany under Prussian headship became a practical question, Delbrück was chosen to go on a mission to the South German states, and contributed greatly to the agreements concluded at Versailles in November. In 1871 he became president of the newly constituted *Reichskanzleramt*. Delbrück, however, began to feel himself uneasy under Bismarck's leanings towards protection and state control. On the introduction of Bismarck's plan for the acquisition of the railways by the state, Delbrück resigned office, normally on the ground of ill-health (June 1, 1876). In 1879 he opposed in the *Reichstag* the new protectionist tariff, and then retired definitely from public life. In 1896 he received from the emperor the order of the Black Eagle. He died at Berlin on Feb. 1, 1903.

See his *Lebenserinnerungen 1817-1867* (2nd ed., 1905), with an additional section on the events of 1870.

DELCASSÉ, THEOPHILE (1852-1923), was born at Pamiers (Ariège) on March 1, 1852, his father being an *hussar* or bailiff. He was educated locally, took his degree of *licence des lettres*, and served as tutor to the children of an official in the ministry of foreign affairs. The taste for politics was ingrained in young Delcassé. He contributed to the *République Française* under Gambetta, made friends, if not with the Tribune himself, at least with Camille Barrère who acted as foreign editor of the paper, besides fulfilling the function of French representative on the Danube commission, and became secretary to Massip, a wealthy man who had been elected to the chamber in the Ariège department. Eventually, he married Massip's widow and, in 1889, succeeded him in the Chamber. Freed once for all from all mat-

ter and minister of the colonies from May 1894 to Jan. 1895, after the Colonial Office had been transformed for his sake into a separate and independent ministerial department.

But the real career of Delcassé began in June 1898 after the general election of that year and the overthrow of the Méline cabinet, with his appointment as minister of foreign affairs in the Radical cabinet headed by Brisson. He retained this office under the subsequent premiership of Dupuy, Waldeck-Rousseau, Combes and Rouvier, until June 6, 1905. In 1898, French diplomacy was roughly divided into two schools. Hanotaux, his predecessor at the Foreign Office, had been striving in an uncertain way to bring about some sort of co-operation between France, Russia and Germany, and he had rather allowed the Franco-Russian alliance to evolve in an anti-British direction. On the other hand, the French ambassadors in Rome and Constantinople, Barrère and Paul Cambon, always insisted that the Franco-Russian alliance should be made compatible with a Franco-British rapprochement, it being absurd for a colonial power like France deliberately to cross the purposes of the supreme maritime power. The foreign office officials were amazed when they saw that the new comers, apparently without any previous experience of practical diplomacy, resolutely cast in his lot with Barrère and Cambon (the latter was appointed to the London Embassy in Dec. 1898) and unhesitatingly acted from the outset on the principle that the only nation France need be afraid of and guard against was Germany, and that, therefore, alliance must be sought with Britain as well as with Russia and that the way must be paved (incredibly paradoxical as it seemed them) for a Russo-British understanding.

As a matter of fact Delcassé had inherited these views from the Gambetta school of thought through Camille Barrère. As early as the autumn of 1898—the grand duke Vladimir happening to be in Paris—Delcassé is reported to have expounded the above policy to his advisers, protesting to them that the grand duke, who was still thinking and speaking in the terms of the Hanotaux period, had misunderstood him. In 1903, when Delcassé came back from London, where he had prepared the Franco-British treaty of April 8, 1904, he told his officials the conversation he had had with Lord Lansdowne and Joseph Chamberlain, and told them that Chamberlain had incited him to bring about a rapprochement between England and Russia. "When I heard this," he said, "I felt my brain turning. I replied to Mr. Chamberlain: 'I shall refrain from making any direct approach to Russia because I should be denounced in Petersburg as having sold her in London. But I promise you I shall take every opportunity of praising the new Entente Cordiale and of inspiring our Russian ally with a desire for some sort of treaty with Great Britain.'" These details are worth stating because they may enable the historian to apply to Delcassé what Cardinal de Retz said about Richelieu: "*Il eut l'intention des choses qu'il fit*."

At the back of Delcassé's political conceptions was a very deep feeling of France's greatness and an unshakable confidence in her destiny. Not that he ever planned war. But he was of opinion (he stated it clearly at the time of the Russo-German intrigue of 1904-1905, which aimed at compelling France, under the threat of an invasion through Belgium, to enter a coalition of Germany and Russia) that if the friendship of England was not secured by French diplomacy, Berlin and London would sooner or later get together, the Triple Alliance be rendered still more formidable, and France pay the cost of that combination on the Continent and in her overseas territories. Only second in importance in Delcassé's mind, to this persistent idea of the Anglo-French-Russian Triple Entente, was the belief that his country's fate was bound up with the consolidation and extension of its North African empire. In his judgment no great nation could exist without a minimum of material power and territorial weight. France could only find that minimum by making use of her North African opportunities.

Delcassé's scheme was carried out in the seven years extending to 1905, under difficulties which seemed well nigh insuperable. In succession, he was confronted by the incident of Fashoda, the South African war, which rekindled anti-British feeling in France, the Dreyfus affair, bringing in its train the distinct weakening of

the French army, and the Russo Japanese war of 1904. The Minister bravely stood his ground. The recall of Captain Marchand from the Nile was announced on Nov. 4, 1898, and the Franco British Convention of June 14, 1898, which Hanotaux had concluded before his resignation, for the delimitation of French and British interests in the region of the Niger, was completed by the fuller settlement of March 21, 1899. As regards the Far East, M. Delcassé unceasingly sought to support in Petersburg the peaceful policy of Count Lamsdorf as against the faction Alexiev-Bezobrazov and, in Oct. 1904, when the Dogger Bank incident occurred, he was fortunate enough to mediate between London and Petersburg. As to the Dreyfus affair, he consistently observed an attitude of reserve and detachment. As a member of the Wildeck, Roussieu and Combes cabinets, he formally proved the whole anti clerical policy, and did nothing openly to check the action of the War Minister, General Andre. He shut himself up in his study at the Quai d'Orsay, enjoying the hearty support of the president of the republic, Loubet, and turning a blind eye to home politics in his passionate attachment to his work. But the time was approaching when he would have to come forward and fight for what he had done. Things changed for him with the advent to power of Rouvier in Jan. 1905.

On April 8, 1904, had been signed the Convention about Morocco and Egypt, the starting point of the Entente Cordiale, the great achievement of Delcassé, Paul Cambon and Lord Lansdowne, not to speak of Edward VII. who consistently favoured it. In Berlin, the Franco-British rapprochement had to the last moment been deemed unthinkable. After some hesitation it was challenged by the Kaiser himself in his famous speech at Karlsruhe on April 27, 1904, and, on March 31, 1905 William II. paid a visit to the representative of the Sultan of Morocco in Tangier, proclaiming that he would stand by the independence of the Sherifian empire. German diplomacy acted throughout on the theory that French parliamentary opinion would not stick to the Entente Cordiale as soon as it understood that it might mean instant war with Germany. To a certain point the calculation proved true enough. Rouvier, a practical financier, who was inclined to believe that the German danger could be disposed of by means of economic co operation between France and Germany, and that the French army was not fit to withstand the onslaught of the German Army, led the battle against his own foreign minister with the assistance of nearly the whole cabinet. In the sitting of the Chamber of April 18, Delcassé was criticized from nearly every side, and though formally supported by the premier, tendered his resignation, which, however, the president of the republic persuaded him to withdraw. But the position of Delcassé quickly became untenable. Germany was pressing for the summoning of an international conference on Morocco, and Rouvier was exchanging views with von Bulow behind the back of his colleague. Towards the end of May, the German Government was in that way acquainted with the British proposal for a military alliance in case war should ensue from the 1904 treaty, a step that immediately led von Bulow to let it be known in Paris, through Tittoni, that any advance of France towards Fez would bring about a declaration of war. Rouvier openly pressed Paul Cambon to discontinue the negotiation for the treaty of alliance with England. Vehement explanations were exchanged in the ministerial council held on June 6, 1905, which culminated in the final resignation of Delcassé.

There is no doubt that technical faults could be put to the debit side of Delcassé's account. He did not take sufficient care to communicate officially to Germany in advance the bargain he was going to make with the British Foreign Office. The information he had given to Prince Radolin on March 13, 1904, can perhaps hardly be regarded retrospectively as fully supplying the missing link in the chain of necessary diplomatic preparation. In April 1905, he evinced some vacillation, and tried to initiate a belated conversation with the German ambassador. At times, his character was not perhaps as resolute as his policy. During his whole career he was prone to make mistakes, which it is even to-day all the more difficult to explain as he usually surrounded himself with complete secrecy, confided in no one, and took care

that his steps should not be easily traced. In 1902, he had been about to sign with Spain, to the amazement of his own officials, a treaty which included Fez in the Spanish zone and did not even provide for the passage of troops between Algeria and the French zone in Morocco, an accident which accounts for the hostility shown to him by Etienne, deputy for Oran and war secretary under Rouvier. However, when he left the Quai d'Orsay, the position of France in Europe had changed beyond recognition. The Triple Entente was virtually in existence, and even the foundation of the Anglo-Russian treaty of January 31, 1907, had been laid. The clauses of the Triple Alliance treaties specially directed against France since 1887 had been suppressed as a result of the Franco Italian convention of 1902 on Tunis and Tripoli, secured by Barrère. Spain had rallied to the Franco-British treaty of April 1904 in October of the same year. On the whole, the system had withstood the test of the most trying developments. As Paul Cambon remarked in a letter of May 1905, the British alliance was perhaps in advance of what French public opinion was ready to stand at the time, and it was not well that it should be possible to denounce it as the work of one man. But what was done in 1898-1905 might perhaps not have been done later.

Having fallen from office, Delcassé remained completely silent for nearly three years but, meanwhile, he was very active in the lobbies. On Jan. 24, 1908, taking the opportunity offered by a debate on Morocco, he suddenly launched a carefully prepared speech which amounted to a vindication of his policy. He was acclaimed by the assembly. On July 20, 1909, as chairman of the marine commission, he engaged in an oratorical duel with Clemenceau, who was clumsy enough to allude to the events of 1905, the Clemenceau cabinet had to resign on the same night. The vacant premiership was not, however, offered to Delcassé, lest the Central Powers should interpret the move as a provocation. He was given the Ministry of Marine in the spring of 1911, and kept it for two years under Monis, Caillaux and Poincaré. He certainly thought of contesting the presidency of the republic in January 1913, but his calculation that his name would be put forward at the second ballot once the other candidates, Poincaré and Pams, had spent their strength, came to nothing. He voted openly for the Radical Socialist, Pams. Notwithstanding the distant and unfriendly relations obtaining between the two men, Poincaré, as president of the republic, endeavoured to induce Delcassé to accept either the premiership or the ministry of foreign affairs. He refused, but, a few days afterwards, was persuaded by Brand and Jonnart (respectively president of the council and foreign secretary) to take charge for several years of the St. Petersburg embassy, which had fared very badly under Georges Louis, to the detriment of the Franco Russian Alliance.

Germany was quickly increasing her armaments, and the whole machinery of the Franco-Russian alliance sadly needed mending and overhauling, it was felt that Delcassé alone would enjoy the moral authority requisite to perform the task. The hope reposed in him was fully fulfilled. With the emperor Nicolas and with Sazonov his credit was unbounded. Yet, he did not make the least attempt to live as an ambassador. His way of living was parsimonious. He stuck to the habits of a little French bourgeois, taking a stroll on the quay at 8 o'clock in the morning. As far as current affairs were concerned, he always favoured a concert of Europe, and urged moderation on Russia in the controversies over Silesia and Scutari. In December 1913, he expressed himself very pessimistically about the consequences of the Luman von Sanders mission in Constantinople. Two months before, he had asked for his recall. No satisfactory explanation of that sudden decision is available. He had not seen eye to eye with the Paris Government over the French claims to Syria and the pourparlers with Germany for the building of French railways in Armenia, as he was steadily opposed to the extension of French commitments in the Near East, which he believed dangerous and likely to resuscitate former Franco British dissensions. But, in 1913, such matters did not loom very large on the horizon.

The word "failure" must unfortunately be written across Delcassé's last tenure of office. In June 1914, after the general election had resulted in the constitution of a radical majority, the

premiership was again pressed upon him in vain by Poincaré. He only agreed to take the War Office in the short lived Ribot cabinet. The temper of the country was very far removed then from the impending European developments. In the midst of the invasion of France by the German army, when Viviani had to transform his ministry into a ministry of national defense, Delcassé, who was hailed by the country as the embodiment of the Russian and British alliances came back, on Aug. 27, to the Quai d'Orsay and remained there until Oct. 13, 1915, when he resigned in order to protest against the Salonika expedition. As far as the winning of Italy to the side of the Allies was concerned, he did all that could be expected of him, and, in April 1915, approved the Treaty of London with the Government of Rome. But, in the Balkans, from beginning to end, he persistently followed the wrong track, and his closest advisers were at loss to understand his conduct, which bore such a striking contrast with his former clearness of judgment and power of vision. He allowed himself to be deceived by Bulgaria, held in check the Serbian army which, left to itself, would have interfered with the mobilization of King Ferdinand's army, allowed Vamizelos to be dismissed by King Constantine and, having approved of the Gallipoli campaign some nine months before, set his face against any assistance being lent to Serbia. Moreover, for unknown reasons, he delayed for fully six months the assent of the French Government to the annexation of Constantinople by Russia as a feature of the eventual peace treaties. On Sept. 16, 1916, in the secret sitting of the Chamber, he harped, for his defense, on the theme that he only wished 500,000 Germans were already encamped in Salonika, since the strength of the Kaiser's army on the western front, where the issue would be settled, could not fail to be all the more impaired. A passionate reply from Brandt, then president of the council, crushed him, and he retired into private life and complete solitude. He entirely disapproved of the policy followed by the French and British cabinets in 1918 and 1919. The British Alliance and the building up of the Rhineland as a bulwark against Germany remained his motto to the end. Hardly any one ever saw him (till his sudden death from arteriosclerosis, on Feb. 21, 1923). He had been very much affected by the death of his son, Jacques, who had been seriously wounded and transferred to Switzerland. His daughter, Suzanne, married General Nogues.

He is reported to have destroyed most of his personal papers. In spite of his limitations, he remains, by general consent, the outstanding figure of the Third republic in the field of foreign affairs.

(A. GÉ.)

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DEL CREDERE. A "del credere agent," in common law, is one who, in consideration of additional remuneration called a del credere commission, undertakes that persons with whom he con-

elementary souls of primitive human beings. Her four masterpieces are *Elias Portoku* (1903), the story of a mystical convict in love with his brother's bride, whom he refuses to marry when she becomes a widow, deciding to consecrate himself to the priesthood, *Cenere* (*Ashes*, 1904), in which an illegitimate son causes the suicide of his mother, *L'Edera* (*The Ivy*, 1908), the story of a servant who kills to save her master from financial ruin, and later finds in her marriage with him only expiation for her sin, *La Madre* (*The Mother*, 1920), the tragedy of a mother who realizes her dream to make a priest of her son only to see him yielding to the temptations of the flesh.

The themes of her other novels are similar, such as *La Vsa di Male* (*The Road to Evil*, 1906), *Colombi e Sparvieri* (*Doves and Hawks*, 1915), *Canne al Vento* (*Reeds in the Wind*, 1913), *L'Incendio nell'Orto* (*The Fire in the Olive Orchard*, 1918), *Marianna Sirca* (1915), *Annalena Balsini* (1927), *Cosima*, published posthumously, in 1937, in which the author describes herself and the life of her early youth.

Grazia Deledda was an interpreter of Sardinian life, the poet of the island which was for her a source of love and experience, of imagination and creation. Her concept of Sardinian psychology was not unlike Giovanni Verga's, and in this sense, after Verga, she is considered by some the greatest representative of *verismo*, the Italian offshoot of French naturalism, which, however, expressed itself not in sociological and scientific theories, but in an evocation of regional life. But the most important characteristic of her work, which includes some 50 volumes, is its lack of literary culture, intellectual construction and stylistic ambitions—an exception in Italian letters, traditionally learned, conscious and sophisticated.

DELESCLUZE, LOUIS CHARLES (1809-1871), member of the Pans commune, was born at Dreux (Eure et Loir) on Oct. 2, 1809. Under Louis Philippe he adopted extreme republican views, fought in the insurrection of June 1832 and in 1836 was forced to leave France. In 1840 he returned, settled at Valenciennes, and took up republican journalism. On the success of the revolution of 1848 he was appointed prefect of the Nord and Pas-de-Calais departments. He was afterward the only communist leader with administrative experience. He resigned his post on the meeting of the national assembly, went to Pans and combated the growing conservatism of the government by means of his journal *La Révolution Démocratique et Sociale*, and by a society called *Republican Solidarity* intended to defend the republic in the provinces. On the failure of the radical *emancipation* in June 1849 he was forced to fly to England. He returned in 1853, was betrayed by a spy and taken to a convict plantation in French Guiana. In 1859 he returned to France, broken in health, and resumed journalism. He was personally hostile to Louis Auguste Blanqui (*q.v.*), but in reality his policy was impregnated with Blanqui's ideas, he was commonly classified neither as a socialist nor as an internationalist, but as a "jacobin." After a further imprisonment he fled to Belgium in 1870, returning on the fall of the empire. He was elected a member of the national assembly and also of the Paris commune in 1871; he chose to sit in the latter, and his seniority, ability and high character gave him the most authoritative position. His energies were not, indeed, equal to producing order in the chaotic administration of the commune (see *COMMUNE*) in two months, but he was its most capable and disinterested leader. On May 9 he took over the department of war, but it was too late for reorganization. The government troops broke in on May 22, and the communist forces separated into their local sections. Delescluze for the next three days attempted to combine and organize the defense, himself fighting with reckless courage, but on May 25, perceiving that defeat was certain, he dressed himself in civilian clothes, with the broad red sash of a member of the commune, and climbed, unarmed, a barricade at the Chateau d'Eau which was under heavy fire. When he reached the crest and his insignia could be seen by the government troops, he was immediately killed, as he had hoped, killed.

See his *De Paris à Cayenne, journal d'un transporté* (Eng. trans. 1872), P. Larousse, *Dictionnaire du XIX^e siècle* (1870) and "Delescluze", and the books cited under *COMMUNE*. (R. W. P.)

ians (see *AMPHICTIONY*). In this synod the allies met under the presidency of Athens. Thucydides (1.97) lays emphasis on the fact that in these meetings Athens, as head of the league, had no more than presidential authority, and the other members were called *συνμαχοί* (allies). Athens appointed a board called the *Hellenotamias* (*ταμίης*, steward) to administer the treasury of the league, which was kept at Delos, and to receive the contributions (*φόρος*) of the allies who paid in money.

The league was therefore a free confederation of autonomous Ionian cities founded with the object of protecting themselves by means of a "counter offensive" (Thuc. 1.96) against the common danger from Persia, and led by Athens in virtue of her predominant naval power. It is a mistake to regard the league during the first 20 years of its existence as an Athenian empire. Thucydides (*loc. cit.*) expressly describes the predominance of Athens as *ἡγεμονία* (leadership, headship), not as *ἐμπύς* (empire), and the attempts made by Athenian orators during the second period of the Peloponnesian war to prove that the attitude of Athens had not altered since the time of Aristides are manifestly unsuccessful.

The first ten years of the league's history was a period of steady, successful activity against the few remaining Persian strongholds (see *ATHENS*, *CIROM*). In these years the Athenian sailors reached a high pitch of training, while certain of the allies became weary of incessant warfare. Athens supported by the synod (*συνεδόν*) of the *Hellenotamias*, enforced the contributions of ships and money according to the assessment. Gradually the allies began to weary of personal service, and persuaded the synod to accept a money commutation. The Ionians were averse to prolonged warfare, and in the prosperity which followed the rout of the Persians a money contribution was held a trifling burden. The result was, however, bad for the allies, whose status in the league became lower in relation to that of Athens, while at the same time their naval resources diminished. Athens became more powerful, and could afford to disregard the authority of the synod. Another new feature appeared in the coercion of cities which desired to secede. The protection of the Aegean would become impossible if some of the islands were liable to be used as piratical strongholds, and it was only right that all should contribute in some way to the security which all enjoyed. In the cases of Naxos and Thasos, the league's resources were employed, not against the Persians, but against recalcitrant Greek islands. Shortly after the capture of Naxos (c. 467 B.C.) Cimón proceeded with a fleet of 300 ships (only 100 from the allies), to the south-western and southern coasts of Asia Minor, and routed the Persians on land and sea at the mouth of the Eurymedon, in Pamphylia. This engagement was the final episode of the struggle between the Greeks and Persia. The very completeness of the victory raised the question of the continuance of the league now that the danger which had given rise to it was effectively removed. It remained to be seen whether Athens would permit secession, which she was theoretically unable to prevent. If she did not, her "leadership" would definitely be converted into an empire. The event proved that Athens had no intention of allowing the dissolution of a body which had brought her such an advance in power. The capture of Thasos (463 B.C.), due to trade rivalry on the Strymon, was a first indication of what the "allies" might expect. About the same time Cimón (*q.v.*), whose philo-Spartan policy was displeasing to the leaders of the new democracy, was successfully overthrown by Ephialtes and Pericles. After his fall the resources of the league were increasingly used in the prosecution of Athens' imperial designs. Between this time and the peace of Callias (446 B.C.) which put an end to the war with Persia (see *CIROM*) all the allies had commuted their naval service for a money payment, with the exception of Chios, Lesbos and Samos. In 454 B.C. the domination of Athens was crystallized by the transference of the federal treasury from Delos to Athens. In the meantime Athens was busy transforming her sea empire into a land and sea empire. By 448 B.C. she dominated not only her former "allies," but also Megara, Boeotia, Phocis, Locris, Achaia and Troezen. The conception of a league of independent allies was still further violated in 451 B.C. by Pericles'

law under which citizenship, with all its advantages, such as the right to sit on paid juries, was restricted to those who could prove themselves the children of an Athenian father and mother. Thus the "allies" saw themselves still further excluded from recognition (see *PERICLES*). The resulting antipathy to Athens, and the centrifugal spirit natural to the Greek in politics, combined for the disruption of a tyranny which had become odious to all alike. The first to secede were the land powers, where the democracies established by Athens as a guarantee of her predominance were overthrown by oligarchies. The reverse of Coroneia (446 B.C.) was followed by the loss of Boeotia, and shortly afterwards by that of Phocis, Locris and Megara. By the "Thirty Years Peace" (445 B.C.) Athens abandoned Nisaea, Pegae, Troezen and Achaia. Her newly acquired land empire was irretrievably lost.

The maritime allies were not slow in attempting to follow the example of Boeotia and the land powers. The next important event is the revolt of Samos (440 B.C.), which had quarrelled with Miletus and refused the arbitration of Athens. The island was conquered with great difficulty by the whole force of the league. It is noticeable that the main body of the allies was not affected, and that the Peloponnesian league, on the advice of Corinthus, recognized the right of Athens to deal with her rebellious subject allies, and refused to help the Samians.

The events which led to the Peloponnesian war are discussed in other articles (see *ATHENS History*, and *PELOPONNESIAN WAR*). Two alone call for special notice. The first is the raising of the allies' tribute in 425 B.C. by a certain Thudippus. The second event belongs to 411, after the failure of the Sicilian expedition. In that year the tribute of the allies was commuted for a 5% tax on all imports and exports by sea.

The Tribute.—Thucydides is almost certainly wrong in saying (1.96) that the amount of the original tribute was 460 talents (about £106,000), this figure cannot have been reached for at least 12 years, when new members had been enrolled (Lycia, Caria, Eion, Lampsacus). He is probably wrong, when he says that it amounted to 600 talents at the beginning of the Peloponnesian war. The moderation of the assessment is shown not only by the fact that it was paid so long without objection, but also by the individual items. Even in 425 Naxos and Andios paid only 15 talents, while Athens had just raised an *eisphora* (income tax) from her own citizens of 200 talents.

The number of tributaries some authorities give as 200, others put it as high as 290. In some cases several towns were grouped together in one payment (*συμμετέδωκεν*). These were grouped into geographical divisions, each division represented by two elective commissioners (*ραῖται*), who assisted the Boule at Athens in the quadrennial division of the tribute. Each city sent in its own assessment before the commissioners who presented it to the Boule. If there was any difference of opinion the matter was referred to the ecclesia for settlement. In the ecclesia a private citizen might propose another assessment, or the case might be referred to the law courts.

Government and Jurisdiction.—There is much difference of opinion regarding the attitude of imperial Athens towards her allies. Grote maintained that on the whole the allies had little ground for complaint, but he seems to leave out of account the Greeks' dislike of external discipline. The fact that the hegemony had become an empire was enough to make the new system offensive to the allies. No strong argument can be based on the paucity of revolts. The indolent Ionians had seen the result of secession, the Athenian fleet was perpetually on guard in the Aegean. Among the mainland cities revolt was frequent, Athenian domination may have been salutary in its effects, but the allies did not regard it with affection.

In the later period of the first league's history the Athenians interfered with the local autonomy of the allies. Though it appears that Athens made individual agreements with various states, and therefore that we cannot regard as general rules the terms laid down in those which we possess, it is undeniable that the Athenians planted garrisons under Athenian officers (*ἀπολόκατοι*) in some cities. All important cases between Athenians and citizens of allied cities were tried before the Athenian courts. Athens im-

posed democratic constitutions on her allies, indeed Isocrates takes credit for Athens on this ground. Though Chios, Lesbos and Samos retained their oligarchic governments, and Selymbria was permitted to choose its own constitution, it is clear that Athens did exercise over many of her allies an authority which extended to local administration. Thus the leadership of Athens in a harmonious league of free Greek states became an empire which proved intolerable to the autonomous states. Her failure was due partly to the commercial jealousy of Corinth working on the dull antipathy of Sparta, partly to the hatred of compromise and discipline characteristic of Greece, and partly also to the lack of tact and restraint shown by Athens and her representatives.

The Second League—The conditions which led to the second Delian Confederacy were fundamentally different, because the enemy was no longer an oriental power, but Sparta, whose ambitious projects since the fall of Athens had shown that there could be no safety for the smaller states save in combination.

As soon as the Athenians began to recover from the victory of Iysander and the government of the Thirty, their thoughts turned to the possibility of recovering their lost empire. The first step in this direction was the recovery of their sea power, which was effected by the victory of Conon at Cnidus (Aug. 394 B.C.). Cities which had formed part of the Athenian empire returned to their alliance with Athens, until Sparta had only Sestos and Abydos of all that she had won by the battle of Aegospotami. No systematic constructive attempt at a renewal of empire was made. Athenian relations were with individual states only, and the terms of alliance were various. The whole position was changed by the successes of Thrasylbulus, who set up a democracy in Byzantium and reimposed the old 10% duty on goods from the Black Sea. Many of the Italian towns subsequently came over, and from inscriptions at Clazomenae and Thasos we learn that Thrasylbulus was deliberately aiming at a renewal of the empire, though he had no general backing in Athens.

The peace of Antalcidas (see ANTALCIDAS) in 387 B.C. was a blow to Athens. Antalcidas compelled the Athenians to give their assent to it by making himself master of the Hellespont by stratagem. By this peace all the Greek cities on the mainland of Asia with the islands of Cyprus and Clazomenae were recognized as Persian, all other cities except Ionia, Lemnos and Scyros as autonomous. Directly, this arrangement prevented an Athenian empire, indirectly, it caused the sacrificed cities and their kinsmen on the islands to look upon Athens as their protector. The selfishness of the Spartans was emphasized by their capture of the Theban citadel, and by the raid upon Attica in time of peace by Sphodrias, and his immunity from punishment at Sparta. The Athenians at once invited their allies to a conference, and the Second Athenian Confederacy was formed. Those represented at it were Athens, Chios, Mytilene, Methymna, Rhodes, Byzantium and Thebes, which joined Athens soon after the Sphodrias raid. In the spring of 377 invitations were sent out to the maritime cities. Some time in that year Tenedos, Chios, Chalis, Naxos, Eretria, Crystus and Erethusa gave in their alliance, followed by Perinthus, Paphlagonia, Sualthus, and other maritime cities.

Sparta was roused to a sense of the significance of the new confederacy, and the Athenian corn supply was threatened by a Spartan fleet of 30 triremes. The Athenians fitted out a fleet under Clearchus, who gained a victory over the Spartans between Naros and Paros (battle of Naros 376 B.C.), both of which were added to the league. Proceeding northwards in 375 Clearchus brought over a large number of the Thracian towns including Abdera, Elassora and Samothrace. The success of Timotheus in the west resulted in the addition to the league of Corcyra and the cities of Cephalonia. Sparta sent out a fleet, but Timotheus, in spite of general agreement held his ground. By this time, however, the alliance between Thebes and Athens was growing weaker and Athens, being short of money, concluded a peace with Sparta. Troubled, however, soon after at Corcyra, and the Spartans not only sent help to the Zanclean oligarchs but even besieged Corcyra (373). Timotheus was sent to relieve

the island, but shortness of money compelled him to search for new allies. This delay in sending help to Corcyra was condemned by the Athenians, who dismissed Timotheus in favour of Iphicrates. An expedition followed, but the absence of any positive success, the pressure of financial difficulty, and the high handed action of Thebes in destroying Phlacia (373), induced Athens to renew the peace with Sparta. An agreement was made by a congress at Sparta on the basis of the autonomy of the cities. The Thebans at first accepted the terms, but, realizing that they were balked of their pan Boeotian ambition, severed themselves from the league.

The peace of 371 B.C. may be regarded as the conclusion of the first period in the league's existence. The original purpose of the league—the protection of the allies from the ambitions of Sparta—was achieved. Athens was recognized as mistress of the sea, Sparta as the chief land power. The weakness of the coalition had, however, become apparent. The enthusiasm of the allies waned rapidly before the financial exigencies of successive campaigns, and it is clear that Thebes had no interest save the extension of her power in Boeotia. There were not wanting signs that the league was not destined to remain a power in the land.

The remaining history may be broken up into two periods, the first from 371 to 357, the second from 357 to 338 B.C. Throughout these two periods, which saw the decline and dissolution of the alliance, examples of corporate action are few.

Period 371–357 B.C.—The first event in this period was the battle of Leuctra (July 371), in which, no doubt to the surprise of Athens, Thebes temporarily asserted itself as the chief land power in Greece. To counterbalance the new power Athens tried to induce the states which recognized the hegemony of Sparta to transfer their allegiance to the Delian league. It seems that the states adopted this policy with the exception of Elis. The policy of Athens was mistaken for two reasons: (1) Sparta was not entirely humiliated, and (2) alliance with the land powers of Peloponnese involved Athens in enterprises which could not awaken the enthusiasm of her maritime allies. This new coalition alarmed Sparta, which at once made overtures to Athens on the ground of their common danger from Thebes. The alliance was concluded in 369 B.C. About the same time Iphicrates was sent to take possession of Amphipolis according to the treaty of 371. Some success in Macedonia roused the hostility of Thebes, and the subsequent attempts on Amphipolis caused the Chalcidians to declare against the league. The old suspicion of the allies was now awakened, and we find Athens making great efforts to conciliate Mytilene by honorific decrees. This suspicion, due primarily, no doubt, to the agreement with Sparta, was strengthened by the exchange of compliments with Dionysius I. of Syracuse, who received the Athenian citizenship, and by the Athenian alliance with Alexander of Phaeae (368–367). The maritime allies had no desire to be involved in the quarrels of Sicily, Thessaly and the Peloponnese.

In 366 Athens lost Oropus, a blow which she endeavoured to repair by forming an alliance with Arcadia and by an attack on Corinth. Timotheus was sent in 366–365 to make a demonstration against the Ionian League of cities in the hands of Cyprothemis, a servant of the satrap, who was captured it after a ten months' siege, and established a clergy.

The next important event was the attempt on the part of Ephraimides to challenge Athenian naval supremacy. Though Ephraimides held his ground the confederacy was undoubtedly weakened. In 362 B.C. Athens joined in the opposition to the Theban expedition which ended in the battle of Mantinea. In the next year the Athenian generals failed in the north in their attempt to control the Hellespont. In Thessaly Alexander of Phaeae became hostile and after several successes even attacked the Peloponnese. Chores was ordered to make reprisals, but instead sailed to Corcyra where he made the mistake of siding with the oligarchs. The league failed in the period was a success, the recovery of Ionia (357) which was once more added to the league.

During these years the policy of Athens towards her maritime allies was short-sighted and inconsistent. Alliances with land powers and an inability to understand the true relations

which alone could unite the league, combined to alienate the allies, who could discover no reason for the expenditure of their contributions on protecting Sparta or Corinth against Thebes. There was ground for suspecting disloyalty in many quarters. On the other hand, though the Athenian fleet became stronger and several cities were captured, the league itself did not gain any important adherents.

Period 357-338 B.C.—Chios, Rhodes, Cos, Byzantium, Erythrae and other cities were in revolt by the spring of 356 B.C., and their attacks on loyal members of the confederacy compelled Athens to take the offensive. Chabrias had been killed in an attack on Chios, and the fleet was under the command of Timotheus, Iphicrates and Chares, who sailed against Byzantium. The enemy sailed north from Smyrna, and in a battle off Embita (between Erythrae and Chios) defeated Chares, who, without the consent of his colleagues, had ventured to engage them in a storm. Chares sought to replenish his resources by aiding the Phrygian satrap Artabazus against Artaxerxes Ochus, but a threat from the Persian court caused the Athenians to recall him, and peace was made by which Athens recognized the independence of the revolted towns. The league was further weakened by the secession of Corcyra, and by 355 B.C. was reduced to Athens, Euboea and a few islands. By this time, moreover, Philip II of Macedonia (q.v.) had begun his career of conquest. In 355 his advance temporarily ceased, but the financial exhaustion of the league was such that its destruction was only a matter of time. Resuming operations in 354, Philip, in spite of temporary checks at the hands of Chares, took from the league all its Thracian and Macedonian cities. In 352-351 Philip actually received help from former members of the confederacy. In 351 Chandemus, Chares and Phocion were sent to oppose him, but no successes were gained. In 346 the peace of Philocrates was made between the league and Philip on terms which were accepted by the Athenians. It is very remarkable that, in spite of the powerlessness of the confederacy, the last recorded event in its history is the steady loyalty of Tenedos, which gave money to Athens about 340 B.C. The victory of Philip at Chaeroneia in 338 finally destroyed the league.

In spite of the precautions taken by the allies, the policy of the league was, almost throughout, directed in the interests of Athens. Founded with the object of thwarting the ambitious designs of Sparta, it was plunged by Athens into enterprises which exhausted the resources of the allies without benefiting them in any respect. There is no doubt that the cities were held to their allegiance solely by the superior force of the Athenian navy.

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See also E. A. Freeman, *Federal Government*, and articles ARISTIDES, PERICLES, Cimon, etc., and *Greek History*, *Ascent to 246 B.C.* with works quoted. For the last years of the league see also PELOPONNESIAN WAR. For inscriptions, see E. L. Hicks and G. F. Hill, *Greek Historical Inscriptions* (Oxford, 1907), G. F. Hill, *Sources of Greek History*, 478-431, 2nd ed. (1907).

The Second League.—The chief modern works are G. Busolt, "Der zweite athenische Bund" in *Neue Jahrbücher für klassische Philologie*, supp. vol. viii, pp. 641-866 (1873-75), and F. H. Marshall, *The Second Athenian Confederacy* (1906), one of the Cambridge Historical Essays (no. xii). The latter is based on Busolt's monograph and includes subsequent epigraphic evidence, with a full list of authorities. The meagre data given by ancient writers are collected by Busolt and Marshall.

DELIBES, CLÉMENT PHILIBERT LÉO (1836-1897), French composer, was born at Saint Germain du Val on Feb. 21, 1836. He studied at the Paris Conservatoire, and became accompanist at the Théâtre Lyrique. His first essay in dramatic composition was his *Deux sous de charbon* (1853), and during several years he produced a number of operettas. His cantata *Alger* was heard at the Paris opera in 1865. Having become second chorus master of the Grand Opéra, he wrote the music of a ballet entitled *La Source* (1866) for this theatre, in collaboration

with Minkowski, a Polish composer. The composer returned to the operetta style with *Malbrough s'en va t'en guerre*, written in collaboration with Georges Bizet, Emile Jonas and Legouaux, and given at the Théâtre de l'Athénée in 1867. Two years later came *L'Écossais du Chatou*, a one-act piece, and *La Cour du roi Pétard*, a three act opera bouffe. The ballet *Coppélia* was produced at the Grand Opéra on May 25, 1870, with enormous success.

Delibes gave up his post as second chorus master at the Grand Opéra in 1872 when he married the daughter of Mademoiselle Denain, formerly an actress at the Comédie Française. His first important dramatic work was *Le Roi Pa dit*, a charming comic opera, produced on Nov. 24, 1873 at the Opéra Comique. Three years later, on June 14, 1876, *Sylvia*, a ballet in three acts, one of the composer's most delightful works was produced at the Grand Opéra. This was followed by *La Mort d'Orphée*, a grand scena (Trocadéro concerts in 1878), *Jean de Nivelle* (Opéra Comique, March 8, 1880), and by *Lakmé* (Opéra Comique, April 14, 1883). *Lakmé* has remained his most popular opera. The composer died in Paris on Jan. 16, 1891, leaving *Kavaya*, a four act opera, in an unfinished state. In 1881 Delibes became a professor of advanced composition at the Conservatoire, and in 1884 he took the place of Victor Massé at the Institut de France.

See E. Guiraud, *Delibes* (1892).

DEILAH, in the Bible, the heroic of Samson's last love story (Judges xvi). She was a Philistine of Sorek (mod. Sürük), west of Zorah, who, bribed by the "lords of the Philistines" to entrap him, coaxed him (after several failures) into telling her the secret of his strength, whereupon she took advantage of his confidence to incapacitate him and betray him to his enemies. (See SAMSON.)

DELILLE, JACQUES (1738-1813), French poet, was born at Ague Perse in Auvergne. He was an illegitimate child, and was descended by his mother from the chancellor De l'Hôpital. He was educated at the college of Lisieux in Paris and became an elementary teacher. He gradually acquired a reputation as a poet by his epistles, in which things are not called by their ordinary names but are hinted at by elaborate periphrases. Sugar becomes *le miel américain que du suc des roseaux exprima l'Africain*. The publication (1769) of his translation of the *Georgics* of Virgil made him famous. Voltaire recommended the poet for the next vacant place in the academy, but his admission was deferred until 1774 on the ground of his youth. He showed a real love of nature, of an 18th century cultivated landscape, in his other poems, *Jardins* (1782), *L'Homme des champs* (1800), *Les trois règnes de la nature*, 2 vol. (1808).

Delille had become professor of Latin poetry at the Collège de France, and abbot of Saint Severin, when the outbreak of the revolution reduced him to poverty. He retired to St. Die, where he completed his translation of the *Aeneid*. He emigrated first to Basle and then to Glarus in Switzerland, and he passed some time in London, chiefly employed in translating *Paradise Lost*. In 1802 he was able to return to Paris, where, although nearly blind, he resumed his professorship and his chair at the academy, but lived in retirement.

His *Oeuvres*, 16 vol., were published in 1824. See C. A. Sainte-Beuve, *Portraits littéraires*, vol. ii.

DELIRIUM, the commonest of all psychoses, is characterized by incoherent thinking and confusion, ranging from mere bewilderment to complete insensibility, and by restlessness that at times may reach a pitch of maniacal excitement. Hallucinations, chiefly of the visual variety, are frequently present as well as shifting, unsystematized delusions. The predominant mood is that of fear, shading off to feelings of doubt or apprehension. Consequently, the delusions and other misinterpretations of the environment are often of a suspicious or defensive kind provoked by imagined threats of harm. The condition tends to become worse late in the day and at night.

All true deliriums result from disturbances of the chemical processes of the brain. Thus, delirium may occur as a complication of many different general disorders. It is most often seen in fevers (especially in children), in drug intoxications of many kinds, in states of circulatory failure or of extreme exhaustion, in chronic

debilitating diseases, following surgical operations, and in cases of severe head injury. Ordinarily, the mental symptoms run a brief and rapid course and have a favourable outcome. However, a more prolonged psychosis need arouse no great alarm. At times, especially in elderly persons, symptoms persist unchanged for months but with ultimate recovery (See *PSYCHOSIS*).

Treatment is essentially supportive and protective—support of nutrition, circulation, etc., and constant surveillance of the patient to protect him from the possible consequences of his excitement. Special sedative measures such as continuous baths or drugs may be necessary but should be used only under medical supervision. Because a strange or changing environment aggravates the symptoms, the surroundings should be kept as familiar, simple and neutral as possible.

Delirium tremens is a toxic psychosis associated frequently with chronic alcoholism. While it conforms to the features of delirium in general, *delirium tremens* has, to a certain extent, a peculiar symptomatic stamp of its own. After a preliminary period of uneasiness and irritability, the psychosis proper comes on abruptly. Often it is precipitated by an acute infection or an injury but the prevalent view that the symptoms are brought on by enforced abstinence from alcohol is probably erroneous. The hallucinations, which are almost exclusively visual and tactile, are extraordinarily vivid and animated. Small animals or insects, in great numbers and in motion, are a common subject of hallucination as are strings and wires and other filamentous objects. The patients continuously busy themselves, sometimes by responding in terror to the hallucinated visions or by performing the actions of their habitual occupations. Of the physical symptoms, tremor is the most prominent. When present it is coarse and irregular and produces movements of all parts of the body including the lips and tongue. The duration of the acute attack is usually from four to six days.

Treatment does not differ from that of delirium in general. Because of the severe malnutrition that is almost invariably present, it is especially important that a diet of high caloric and vitamin content be supplied. Alcohol is probably never of value in treatment and may be harmful. (R. B. R.)

DELISLE, JOSEPH NICOLAS (1688–1768), French astronomer, was born in Paris on April 4, 1688. He proposed in 1715 the "diffraction theory" of the sun's corona, visited England and was received into the Royal Society in 1724, and left Paris for St. Petersburg on a summons from the empress Catherine toward the end of 1725. Having founded an observatory there, he returned to Paris in 1747, was appointed geographical astronomer to the naval department, and installed an observatory in the Hotel Cluny. Charles Messier and J. J. Lalande were among his pupils. He died of apoplexy at Paris on Sept. 12, 1768.

Delisle is chiefly remembered as the author of a method for observing the transits of Venus and Mercury by instants of contacts which was first proposed by him in a letter to J. Cassini in 1743.

In his *Mémoires pour servir à l'histoire et au progrès de l'astronomie* (St. Petersburg, 1738), Delisle gave the first method for determining the heliocentric co-ordinates of sunspots.

DELISLE, LEOPOLD VICTOR (1826–1910), French bibliophile and historian, was born at Valognes (Manche). At the Ecole des Chartes, where his career was remarkably brilliant, his valedictory thesis was an *Essai sur les revenus publics en Normandie au XII^e siècle* (1846), and it was to the study of his native province that he devoted his early work. Of *l'histoire de l'Inde sur la condition de la classe agricole et l'état de l'agriculture en Normandie au moyen âge* (1851) condensing an enormous mass of facts drawn from the local archives was reprinted in 1907, without change, and remains authoritative. In Nov. 1852 he entered the manuscript department of the Bibliothèque Impériale (Nationale), of which, in 1874, he became the official head in succession to Jules Taschereau. Delisle was responsible for the catalogue of printed books in the library, and under his administration the library was enriched with numerous acquisitions, notably by the purchase of a part of the Ashburnham MSS. He was elected member of the Académie des Inscriptions et Belles-Lettres

in 1859, and became a member of the staff of the *Recueil des historiens de la France*, collaborating in vols. xxii (1865) and xxiii (1876) and editing vol. xxiv (1904), which is valuable for the social history of France in the 13th century. After his retirement (Feb. 21, 1905) he prepared a catalogue and description of the printed books and MSS in the Musée Condé at Chantilly, left by the duc d'Aumale to the French Institute. Of his other works may be mentioned his *Mélanges de paléographie et bibliographie* (1880) with atlas, *Mémoire sur les actes d'Innocent III* (1857), and *Mémoire sur les opérations financières des Templiers* (1889), a collection of documents of the highest value for economic history. The 32nd volume of the *Histoire littéraire de la France*, which was partly his work, is of great importance for the study of 13th and 14th century Latin chronicles. Delisle was undoubtedly the most learned man in Europe with regard to the middle ages, and his knowledge of diplomatics, palaeography and printing was profound. His output of work, in catalogues, etc., was enormous, and his services to the Bibliothèque Nationale in this respect cannot be overestimated. His wife, a daughter of Eugene Burnouf, was for many years his collaborator.

The *Bibliographie des travaux de D. Delisle* (1902, supplement 1911), by Paul Lacombe, may be consulted for a full list of his numerous works.

DELITZSCH, FRANZ (1813–1890), German Lutheran theologian, Hebrew scholar and orientalist, was born at Leipzig on Feb. 23, 1813. He studied in the university of his native town, becoming in 1830 professor of theology at Erlangen, and in 1867 at Leipzig, where he died on March 4, 1890. Delitzsch was a strict Lutheran. With a view to the conversion of the Jews he edited the periodical *Saat auf Hoffnung* from 1863, revived the "Institutum Judaicum" in 1880, founded a Jewish missionary college, and translated the *New Testament* into Hebrew. He acquired such a mastery of post-biblical, rabbinic and talmudic literature that he has been called the "Christian Talmudist." Though never an advanced critic, his article on Daniel in Herzog's *Realencyclopädie* (2nd ed.), his *New Commentary on Genesis* and the fourth edition of his *Isaiah* show that his sympathy with higher criticism increased—so much so that Prof. Cheyne has included him among its founders.

He wrote valuable commentaries on *Habakkuk* (1843), *Genesis* (1852), *Neuer Kommentar über die Genesis* (1887, Eng. trans. 1888), *Psalms* (1869, Eng. trans. 1886), *Job* (1864), *Isaiah* (4th ed., 1889, Eng. trans. 1890), *Proverbs* (1873), *Epistle to the Hebrews* (1857, Eng. trans. 1865), *Song of Songs* and *Ecclesiastes* (4th ed. 1875). Other works are *Lutherthum u. Lugenthum* (1839), *Geschichte der jüd. Poesie* (1836), *Jesus und Hillel* (1867), *Handwerkerleben zur Zeit Jesu* (1868, Eng. trans. 1902), *Poesien aus vormuhammedanischer Zeit* (1874), *Iris, Farben studien und Blumenstücke* (1888, Eng. trans. 1889), *Messiasche Weissagungen in geschichtlicher Folge* (1890), and a popular devotional work *Das Sakrament des wahren Leibes und Blutes Jesu Christi* (1844).

DELITZSCH, FRIEDRICH, German orientalist, son of the preceding, born at Erlangen on Sept. 3, 1850, and educated at Leipzig, became professor of Semitic languages and Assyriology successively at Leipzig, Breslau and Berlin. His chief works are *Assyrische Lesestücke* (1876), *Wo lag das Paradies* (1881), *Assyrisches Wörterbuch zur gesamten bisher veröffentlichten Keilschriftliteratur* 3 pts. (1887–90), *Assyrische Grammatik* (1889, Eng. trans. 1889), *Geschichte Babyloniens u. Assyriens* (1891), *Babel u. Bibel* (1902, Eng. trans. 1903), *Grundzüge der Sumerischen Grammatik* (1914), *Die Welt des Islam* (1915) and *Die grosse Täuschung Israels Eindringen in Kanaan* (1920). *Babel und Bibel*, two lectures delivered before the German emperor, caused a great controversy because it denied the verbal inspiration of the Old Testament and contended that it was largely inspired by Babylonian stories and that Semitic monotheism had gradually developed. While this attitude was not in itself new, the public letter of the emperor proclaiming the need of orthodoxy and of a realization of the distinction between reason and revelation brought the position of scholars before the public, and thereby aroused violent discussions.

DELITZSCH, town, in the Prussian province of Saxony, Germany, on the Lober, an affluent of the Mulde, 12 m N of Leipzig at the junction of the railways, Bitterfeld-Leipzig and Halle-Cottbus. Pop. (1939) 17,973. It has an old castle of the 14th century now a female penitentiary. Besides *Kulschwanz*, a peculiar kind of beer, it manufactures tobacco, cigars, chemicals, shoes and hosiery, and coal mining is carried on in the neighbourhood. Originally a settlement of the Sorbian Wends, and in the 12th century part of the possessions of the bishops of Merseburg, Delitzsch ultimately passed to the Saxe-Merseburg family, and on their extinction in 1738, was incorporated with Electoral Saxony but was finally transferred to Prussia in 1815.

DELIUM, BATTLE OF, 424 B.C. This battle, in the Peloponnesian War (q.v.) was the outcome of the Athenians' attempt to get control of Boeotia by a converging attack at three points, helped by expected uprisings of the democratic faction. But the Boeotians were forewarned and the risings forestalled. Nevertheless the main Athenian force was duly disembarked at Delium, on the coast, whither the Boeotians advanced to dislodge it. The significance of the subsequent battle is as a foreshadowing of the great era of Theban generalship under Epaminondas (q.v.), and of his method at Leuctra (q.v.). Room for deployment being restricted, the Theban commander, Pagondas, formed his right wing in exceptional depth—25 ranks, whereas the Athenians were the customary eight deep. When the two sides clashed, Pagondas's Boeotian left wing was driven in but the concentrated punch of his massive Theban phalanx on the right crushed their opponents. At this juncture Pagondas despatched his cavalry from the right wing, where it was unnecessary, to move round behind the hill from which he had advanced and to fall upon the Athenian right wing. This, disordered by its victorious encounter, was broken by the charge of Pagondas's cavalry, all the more effective because of the rarity of mounted shock tactics at that period. The defeated Athenian army was hotly pursued back to its landing place, and there embarked for home.

DELIUS, FREDERICK (1863–1934), British musical composer, was born at Bradford, Yorks, Jan. 29, 1863, the son of Julius Delius, a German, who, in 1860, became a naturalised British subject. He was educated at Bradford Grammar School and the International College, Isleworth, London. Declining the business career offered him in Bradford he went to Florida as an orange planter, but devoted his spare time to such musical study as he could obtain from the books in his possession. In 1886 he left Florida for Leipzig and there underwent a more or less regular training from Jadassohn and came under the influence of Grieg, then living in that town. His first published work, a *Légende* for violin solo with orchestral accompaniment, was issued in 1892, since when he has gained in ever-increasing measure, though very slowly, the recognition which is his due as one of the most considerable masters of his time. His music is as a whole however too delicate and restrained in character to be likely ever to secure wide general favour. Delius might be defined indeed as a musician's musician and although general recognition has come to him so slowly, and even still in such limited measure, among the discerning few he has never lacked warm and whole-hearted appreciation. His not very extensive output comprises examples in most of the leading forms, including no fewer than six operas, *Irmling*, *The Magic Fountain*, *King's Heart*, *The Sea*, *The Fisherman's Song*, and *The*

He was educated at Bonn and Berlin, and in 1855 was appointed professor of Sanskrit, Provençal and English literature at Bonn, a post he held until his death. His greatest literary achievement was his scholarly edition of Shakespeare (1854–61). He also edited Wace's *St. Nicholas* (1850), a volume of Provençal songs (1853), and published a *Shakespeare Lexikon* (1852). As a critic of Shakespeare's text he stands in the first rank.

See the biographical notice by J. Schipper in *Englische Studien*, vol. 14 (1890).

DELLA BELLA, STEFANO (1610–1664), known in France as *Étienne de la Belle*, Italian engraver, was born at Florence. He was apprenticed to a goldsmith, but turned his attention to engraving, and studied the art under Santa Gallina. By the liberality of Lorenzo de' Medici he was enabled to spend three years in study at Rome. In 1642 he went to Paris, where Cardinal Richelieu engaged him to make drawings at Arras of the siege and taking of that town by the royal army. About 1650 he returned to Florence. His productions numbered over 1,400 separate pieces. His masterpiece is the view of the Pont Neuf in Paris.

DELLA CASA, GIOVANNI (1503–1556), Italian poet, was born at Mugello, in Tuscany. He studied at Bologna, Florence and Rome, and Pope Paul III. made him nuncio to Florence, where he was elected a member of the celebrated academy, and then to Naples. He was appointed to the archbishopric of Benevento, and it was believed that it was only his openly licentious poem, *Capitoli del forno*, and the fact that the French court seemed to desire his elevation, which prevented him from being raised to a still higher dignity. He died in Rome on Nov. 14, 1556. Casa was the leader of a reaction in lyric poetry against the universal imitation of Petrarch, and originated a style, which, if less soft and elegant, was more nervous and majestic than that which it replaced. His principal prose work is *Il Galateo* (1558), a treatise of manners, which has been translated into several languages. A reproduction of the English translation by R. Peterson (1576) was edited by H. J. Reid in 1897.

A complete edition of his works, which include translations from Thucydides, Plato and Aristotle, was published at Florence in 1707, to which is prefixed a life by Casotti. The best edition is that of Venice, 1752.

DELLA COLLE, RAFFAELLINO, Italian painter, was born at Colle, near Borgo San Sepolcro, in Tuscany, about 1490. A pupil of Raphael, whom he is held to have assisted in the Farnesina and the Vatican, Della Colle, after his master's death, was the assistant of his chief pupil, Giulio Romano, at Rome and afterwards at Mantua. In his later years Della Colle resided at Borgo San Sepolcro, where he kept a school of design, among his many pupils of note may be mentioned Gherardi and Vecchi. His works, which are to be found at Urbino, at Perugia, at Pesaro and at Gubbio, are fine examples of the Roman school of Raphael.

DELLA CRUSCANS, THE, a group of insignificant versifiers, the leaders of which were R. Merry (actually a member of the Florentine academy *della Crusca*—see *ACADEMIES*) and Hannah Cowley. Their first production was a *Florentine Miscellany* (1785) to which Mrs. Prynne contributed. Returning to England in 1787 Merry began to publish verses in *The World*, and the collected poems of the group appeared in *The British Album* (1789, four editions). In 1791 William Gifford fell upon them in *The Bannad*, giving in his footnotes quotations which amply justify the severity of his satire. He renewed the attack in *The Maevad* (1795) and there are references to the Della Cruscans in T. J. Mathias's *Pursuits of Literature* (1794–97). The Della Cruscan manner, beyond furnishing a name for a particular kind of fantastic and misapplied verse had no consequences for literature.

DELLA PORTA, GIOVANNI BATTISTA (c. 1538–1615), Italian natural philosopher, was born of a noble and ancient family at Naples about the year 1538. He travelled extensively in Italy, France and Spain, and was still a youth when he published *Magia naturalis, sive de miraculis rerum naturalium lib. IV* (1558), the first draft of his *Magia naturalis*, in 20 books, published in 1589. He founded in Naples the *Accademia Secretorum Naturae*, otherwise known as the *Accademia degli Onosi*, and in 1610 he became a member of the *Accademia dei Lincei* at Rome.

He died at Naples on Feb. 4, 1615.

Porta is the author of a number of books on cryptography, physiology of plants, farming, gardening optics, etc. He also wrote several Italian comedies. His most important work, the *Magna naturalis*, deals with a strange medley of subjects, including the reproduction of animals, the transmutation of metals, pyrotechny, domestic economy, statistics, hunting, the preparation of perfumes. Most of his work contains descriptions of experiments which were never performed and is much exaggerated. The only portions of any great interest are the experiments on magnetism and the optical experiments which include a description of the camera obscura (q.v.).

DELLA QUERCIA, or **DELLA FONTE**, **JACOPO** (1374-1438), Italian sculptor, was born at Siena. He was the son of a goldsmith of repute, Pietro d'Agnolo. In 1394 he made an equestrian statue of Gian Tedesco. In 1402 he was one of six artists who submitted designs for the great gates of the baptistry in Florence, in which competition Ghiberti was the victor. In 1406 he executed one of his finest works, the monument of Ilaria del Caretto, wife of Paolo Guinigi, at Lucca, and received a commission for the famous Fonte Gaia, at Siena, early in 1409. This work was not seriously begun by him until 1414, and was only finished in 1419. In 1858 the remains of the fountain were removed to the Opera del Duomo, where they are now preserved, a copy of the original by Sarocchi being erected on the site. After another visit to Lucca in 1422, he returned to Siena, and in March 1425 undertook the contract for the doors of S. Petronio, Bologna. He was known, in following years, to have gone to Milan, Verona, Ferrara, and Venice, but the rest of his life was chiefly divided between his native city and Bologna. In 1430 he finished the great font of S. Giovanni at Siena, which he had begun in 1417, contributing himself only one of the bas-reliefs, "Zacharias in the Temple," the others being by Ghiberti, Donatello, and other sculptors. Among the work known to have been done by Jacopo may be mentioned also the reliefs of the *predella* of the altar of S. Frediano at Lucca (1422), and the Bentivoglio monument which was unfinished at the time of his death on Oct. 20, 1438. Jacopo della Quercia's work exercised a powerful influence on that of the artists of the later Italian Renaissance. He himself reflects not a little of the Gothic spirit, admirably intermingled with some of the best qualities of neo-classicism. His powers have hardly yet received the recognition they deserve.

See C. Cornelius, *Jacopo della Quercia eine Kunsthistorische Studie* (1896), and works relating generally to the arts in Siena (E. F. S.).

DELLA ROBBIA, the name of a family of great distinction in the annals of Florentine art. Its members are shown in the following table:

| Simone di Marco | | | | |
|---|---|--------------------------------|--|--------------------------------|
| Marco | | Luca (1400-1482) | | |
| Andrea (1435-1525) | | | | |
| Girolamo (1488-1556), worked mostly in France | Luca (1475-1556), worked in Florence and Rome | Paolo (1470-?), Dominican monk | Giovanni (1460-1520?), worked mainly in Florence | Marco (1468-?), Dominican monk |

LUCA DELLA ROBBIA (1399 or 1400-1482) was the son of a Florentine named Simone di Marco della Robbia. According to Vasari he was apprenticed to the silversmith Leonardo di Ser Giovanni, this, however, appears doubtful from the great age which it would give to Leonardo and it is more probable that Luca was the pupil of Ghiberti. During the early part of his life Luca executed many important and exceedingly beautiful pieces of sculpture in marble and bronze. No sculptured work of the 15th century ever surpassed the singing gallery which he made for the cathedral at Florence between 1421 and 1438 with its ten magnificent pannels of singing angels and dancing boys. This splendid work is now in the Museo del Duomo, and there is a cast in the Victorian and Albert museum, London, which also

possesses a study in *gesso duro*, apparently Luca's original sketch, for one of the pannels.

In 1437 Luca received a commission from the signorina of Florence for five reliefs for the campanile, to complete the series begun by Giotto and Andrea Pisano. These pannels, with representative figures typifying grammar, logic, philosophy, music and science, are much in the earlier style of Giotto. In 1439 Luca in association with Donatello received in order for two marble altars for chapels in the cathedral. The reliefs from one of them—St. Peter's Deliverance from Prison and his Crucifixion—are now in the Bargello. A tabernacle made by Luca in 1442 is now at Peretola, near Florence, in the church of S. Maria. In 1437 Donatello received a commission to cast a bronze door for one of the sacristies of the cathedral, but, as he delayed to execute this order, the work was handed over to Luca in 1446, with Michelozzo and Maso di Bartolomeo as his assistants. Part of this wonderful door was cast in 1448, and the last two panels were finished by Luca in 1467. It is divided into ten square panels, with small heads in the style of Ghiberti projecting from the framing. The subjects are the Madonna and Child, the Baptist, the four Evangelists, and the four Latin Doctors, each with attendant angels. The heads are full of life, and the treatment of the drapery in broad simple folds is worthy of a Greek sculptor of the best period of Hellenic art.

The most important existing work in marble by Luca (executed in 1455-56) is the tomb of Benozzo Fedeghi, bishop of Fiesole, originally in the church of S. Pancrazio at Florence, but removed to S. Francesco di Paola in 1783 and in 1898 to the church of SS. Trinita in Florence. A very beautiful effigy of the bishop lies on a sarcophagus sculptured with graceful reliefs of angels holding a wreath which contains the inscription. Above are three quarter length figures of Christ between St. John and the Virgin. The whole is surrounded by a rectangular frame of tiles of exquisite beauty, each painted in enamel pigments, with a bunch of flowers and fruit in brilliant realistic colours.

In the latter part of his life Luca was mainly occupied with the production of enamelled terra cotta reliefs. The rationale of this process was to cover the clay relief with an enamel formed of the ingredients of glass (*maraccotto*), made white and opaque by oxide of tin (See POTTERY and PORCELAIN *Italian Maiolica*). Though Luca was not the inventor of the process he extended its application to fine sculptured work in terra cotta, so that it is known now as Della Robbia ware. The great majority of these reliefs which in Italy and elsewhere are ascribed to Luca are really the work of some of the younger members of the family or of the atelier which they founded. Among the earliest of the comparatively few which can with certainty be ascribed to Luca himself are medallions of the four Evangelists in the vault of Brunelleschi's Pazzi chapel in S. Croce. These fine reliefs are coloured with various metallic oxides in different shades of blue, green, purple, yellow, and black. It has often been wrongly asserted that the polychromatic reliefs belong to Andrea or his sons, and that Luca's were all in pure white, or in white and blue. A relief in the Victoria and Albert museum furnishes a striking example that colours were used freely by Luca and is of especial value from its great size and because it is known. This is an enormous medallion containing the arms of S. Andrew and other heraldic devices. It is surrounded by a splendidly modelled and brilliantly coloured wreath of fruit and flowers especially apples, lemons, oranges, and fir cones. This medallion was set up on the facade of the Pazzi Chapel to commemorate Rucellai's visit to Florence in 1412. Other reliefs by Luca, also in glazed terra cotta, are those of the Ascension and Resurrection in the tympanum of the doors of the sacristies in the cathedral, executed in 1442 and 1446 and the tympanum relief of the Madonna between two Angels in the Via dell'Agnolo, a work of exquisite beauty, and another formerly over the door of S. Pierino di Mercatello but now removed to the Bargello. Among the few existing statues by Luca are two lovely enamelled figures of kneeling angels holding candles, now in the Victoria and Albert Museum. A very fine work executed between 1449 and 1452 is the tympanum relief of the Madonna and four Monastic Saints, over

the door of S. Domenico at Urbino. He also made the four coloured medallions of the Virtues set in the vault over the tomb of the young cardinal prince of Portugal in a side chapel of S. Miniato in Florence and various polychromatic medallions out side Or San Michele. The Victoria and Albert museum possesses 1. circular plaques of majolica were painted in blue and white with the Occupations of the Months, these have been attributed to Luca but their origin is doubtful.

In 1471 Luca refused to serve as president of the Florentine Guild of Sculptors, on account of his age and infirmity. He died on Feb. 20, 1482. His chief pupil was his nephew Andrea, and Agostino di Duccio, who executed many pieces of sculpture at Rimini, and the marble reliefs of angels on the facade of S. Bernardino at Perugia, may have been the work of one of his assistants.

ANDREA DELLA ROBBIA (1435-1525), the nephew and pupil of Luca was born Oct. 20, 1435, and died Aug. 4, 1525. He carried on the production of the enameled reliefs on a larger scale and also extended its application to various architectural uses, such as friezes and to the making of lavabos, fountains and large reliefs. Though the finest reliefs from the workshop of Andrea were but little if at all inferior to those from the hand of Luca, some of those by pupils and assistants reached only a lower standard of merit. Only one work in marble by Andrea is known, an altar in S. Maria delle Grazie near Arezzo.

Andrea sometimes omitted the enamel on the face and hands (nude parts) of his figures, especially when he had treated the heads in a realistic manner, as in the noble tympanum relief of the meeting of St. Dominic and St. Francis in the loggia of the Florentine hospital of S. Paolo—a design suggested by a fresco of Fra Angelico's in the cloister of St. Mark's. One of the most remarkable works by Andrea is the series of medallions with reliefs of Infants in white on a blue ground set on the front of the founding hospital at Florence. He produced a large number of reliefs of the Madonna and Child, varied with much invention and all of extreme beauty of pose and sweetness of expression. These are frequently framed with realistic yet decorative garlands of fruit and flowers painted with coloured enamels, while the main relief is left white. The hospital of S. Paolo, near S. Maria Novella, has also fine medallions with reliefs of saints, two of Christ Healing the Sick, and two fine portraits, under which are white plaques inscribed "DALL' ANNO 1451 ALL' ANNO 1495." Arezzo possesses a number of fine enameled works by Andrea and his sons, a tablet in the cathedral and in the chapel of the Campo Santo a fine relief of the Madonna and Child with four saints at the sides. In S. Maria in Grado is a very noble tablet with angels holding a crown over a standing figure of the Madonna. Perhaps the finest collection of works of this class is at La Verna, not far from Arezzo. The three large tablets with representations of the Annunciation, the Crucifixion, and the Madonna giving her Girdle to St. Thomas are probably the work of Andrea himself, the others being by his sons. In 1489 Andrea made a beautiful relief of the Virgin and two Angels, now over the archive room door in the Florentine Opera del Duomo. In the same year he modelled the fine tympanum relief over a door of Prato cathedral, with a half length figure of the Madonna between St. Stephen and St. Lawrence, surrounded by a frame of angels' heads.

In 1491 he was still working at Prato, where many of his best reliefs still exist. A fine bust of S. Lino exists over the side door of the cathedral at Volterra, which is attributed to Andrea. Other late works of known date are a magnificent bust of the Protomartyr Almachiano, made in 1510 for the church of S. Giovanni del Fiorentino at Viterbo, now preserved in the Palazzo Comunale there, and a medallion of the Virgin in Glory, surrounded by angels, made in 1505 for Pistoia cathedral. One of the latest works attributed to Andrea, though apparently only a workshop production of 1515, is a relief representing the Adoration of the Magi, made for a little church, St. Maria in Pian di Mugnone near Florence. Portions of this work are still in the church, but some fragments of it are at Oxford.

Five of Andrea's seven sons worked with their father and after

his death carried on the Robbia studio (see table).

LUCA II. The chief existing work known to be by the second Luca is the very rich and beautiful tile pavement in the upper most story of Raphael's loggia at the Vatican, made at Raphael's request and under his supervision in 1518.

GIOVANNI DELLA ROBBIA (1469-1529) was born May 19, 1469. He worked as assistant to his father, Andrea, and in many cases the enameled sculpture of the two cannot be distinguished. Some of Giovanni's independent works are of great merit, especially the earlier ones, during the latter part of his career his reliefs deteriorated in style, owing to the universal decadence of the time. One of his finest works is a tablet representing the Last Judgment at Volterra in the church of S. Girolamo, dated 1501. Quite equal in beauty to anything of his father's is the lavabo in the sacristy of S. Maria Novella at Florence, made in 1497. In the tympanum of the arch is a very lovely white relief of the Madonna between two Adoring Angels. This part is of enameled clay, but the basin of the fountain is of white marble. Neither Luca nor Andrea was in the habit of signing his work, but Giovanni often did so, usually adding the date, probably because other potters had begun to imitate the Robbia ware. Among the very numerous other works of Giovanni are a relief in the wall of a former convent in the Via Nazionale at Florence, and two reliefs in the Bargello dated 1521 and 1522. At Pisa in the Campo Santo is a relief in Giovanni's later and poorer manner dated 1520, it is a Madonna surrounded by angels, with saints below. Giovanni's largest and perhaps finest work is the polychromatic frieze on the outside of the Del Corno hospital at Pistoia, for which he received various sums of money between 1525 and 1529, the subjects of this frieze are the Seven Works of Mercy. Six of these reliefs are by Giovanni, the seventh, Giving drink to the Thirsty, was made by Filippo Paladini of Pistoia in 1585. Giovanni's chief pupil was Benedetto Bugnioni (1461-1521), and a pupil of his, one Santi Bugnioni (b. 1494), entered the Robbia workshops in 1521, and assisted in the later works of Giovanni.

GIROLAMO DELLA ROBBIA (1488-1566), another of Andrea's sons, was an architect and a sculptor in marble and bronze as well as in enameled clay. During the first part of his life he worked with his father, but in 1528 he went to France and spent nearly 40 years in the service of the French Royal family. Francis I. employed him to build a palace in the Bois de Boulogne called the Château de Madrid, decorated richly with terra cotta medallions, friezes and other architectural features. For this purpose he set up kilns at Suresnes. Though the palace has been destroyed, drawings of it exist.

The best collections of Robbia ware are in the Florentine Bargello, Accademia, and Museo del Duomo, the Victoria and Albert museum (the finest out of Italy), the Louvre, the Cluny and the Berlin museums, while fine examples are to be found in New York, Boston, Leningrad and Vienna. Many fine specimens exist in private collections in England, France, Germany and the United States. The greater part of the Robbia work still remains in the churches and other buildings of Italy, especially in Florence, Fiesole, Arezzo, La Verna, Volterra, Barga, Montepulciano, Lucca, Pistoia, Prato, and Siena.

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DELMEDIGO, a Cretan Jewish family, of whom the following are the most important

ELIJAH DELMEDIGO (1460-1497) philosopher, taught in several Italian centres of learning. He translated some of Averroes' commentaries into Latin at the instigation of Pico di Mirandola. In the sphere of religion, Delmedigo represents the tendency to depart from the scholastic attitude in which religion and philosophy were identified. His principal work, *B'huah ha Dath* (Investigation of Religion), was devoted to this end.

JOSEPH SOLOMON DELMEDIGO (1591-1655), pupil of Gahlelo, wrote many books on science and philosophy, and bore a considerable part in initiating the critical movement in Judaism. He belonged to the sceptical school, and though his positive contributions to literature were not of lasting worth, Graetz includes him among the important formative influences within the synagogue of the 17th century.

DELMENHORST, a town, *Land* of Oldenburg, Germany, on the Delme, 8 m by rail W from Bremen, at the junction of a line to Vechta. Pop. (1939) 38,147. It is engaged in wool-combing, weaving, jute spinning and the manufacture of linoleum. Delmenhorst was founded in 1230, and from 1247 to 1679, when it was destroyed by the French, was protected by a strong castle.

DELOLME, JEAN LOUIS (1740-1806), Swiss jurist and constitutional writer, was born in Geneva in 1740 and died at Sewen, July 16, 1806. Having given offense to the authorities by a pamphlet entitled *Examen de trois parts de droit*, he was forced to take refuge in England, where he stayed until 1775. During his exile Delolme made a careful study of the English constitution, the results of which he published in his *Constitution de l'Angleterre* (Amsterdam, 1771), of which an enlarged and improved edition in English appeared in 1772. Along with a translation of Hume's *History of England* it supplied the philosophes with most of their ideas about the English constitution. It thus was used somewhat as a political pamphlet. Several editions were published after the author's death. Delolme also wrote in English, *Parallel between the English Government and the former Government of Sweden* (1772), *A History of the Flagellants* (1782), based upon a work of Boileau's, *An Essay on the Union of Scotland with England* (1787), and one or two smaller works. Notice by C. Coote prefixed to the 1807 edition of the English translation of the *Constitution*.

DELONEY (OF DELONE), THOMAS (1543?-1607?), English ballad-writer and pamphleteer. In 1588 the coming of the Armada inspired him to write three broadsides, which were reprinted (1860) by J. O. Halliwell-Phillips. A collection of *Strange Histories* (1607), known in later and enlarged editions as *The Royal Garland of Love and Delight* and *The Garland of Delight*, consists of historical ballads by Deloney, with some poems from other hands.

See the works of Thomas Deloney, ed. F. O. Mann, Oxford (1912).

DE LONG, GEORGE WASHINGTON (1844-1881?), American explorer, was born in New York city on Aug. 22, 1844. He graduated at the U.S. Naval Academy in 1865, entered the U.S. navy, attaining the rank of lieutenant in 1869, and lieutenant-commander in 1879. In 1873 he took part in the voyage of the "Junata", sent to search for and relieve the American Arctic expedition in the "Polaris", which was sent out from Upernavik, Greenland. In 1879 he again set out for the Arctic in the "Jeannette". The "Jeannette" was caught in the polar ice-pack Sept. 5, 1879, and drifted helplessly until June 13, 1881, when she was crushed and sunk. About 14 members of the expedition survived. De Long succeeded in reaching the mouth of the Lena river in one of the boats, only to die of starvation. His journal, in which he made regular entries until the day of his death, was edited by his wife and published in 1885, under the title of *Voyage of the "Jeannette"*. Three years after the ship was wrecked several articles belonging to the crew of the "Jeannette" were found on an ice-floe on the eastern coast of Greenland, a fact that added fresh evidence to the theory of a continuous ocean current passing along the unknown Polar regions.

DELOLME, MARION (1613-1650), French courtier and the daughter of Jean de Lou, seigneur de l'Orme, president of the

treasurers of France in Champagne, and of Marie Chastelain. She was born at her father's chateau near Champaubert on Oct. 3, 1613. Initiated into the philosophy of pleasure by the epicurean and atheist, Jacques Vallee, seigneur de Barbezieux, she soon left him for Cinq Mars, whom she is said to have married secretly. Her salon became one of the most brilliant centres of elegant Parisian society. After the execution of Cinq Mars she is said to have numbered among her lovers Charles de St. Evremont (1610-1703) the wit and litterateur, the second duke of Buckingham (Villiers), the great Condé, and even Cardinal Richelieu and the king of France. Under the Fronde her salon became a meeting place for the disaffected, and her arrest is said to have been pending when she died on July 2, 1650. Legendary accounts declared that she lived until 1706 or even 1741, after having had the most fantastic adventures, including marriage with an English lord and an old age spent in poverty in Paris. She figures in Alfred de Vigny's *Cinq-Mars*, and in Victor Hugo's *Marion Delorme*.

See J. Peladan, *Histoire et légende de Marion de Lorme* (1927).

DE L'ORME, PHILIBERT (c. 1510-1570), French architect, one of the great masters of the Renaissance, was born at Lyons, the son and pupil of the architect Jehan de L'Orme. At an early age Philibert was sent to Italy to study (1533-36) and was employed there by Pope Paul III. Returning to France he was patronized by Cardinal du Bellay at Lyons, and was sent by him about 1540 to Paris, where he began the Chateau de St. Muir, in 1545 he was made architect to Francis I and given the charge of works in Brittany. In 1548 Henry II gave him the supervision of Fontainebleau, Saint Germain and the other royal buildings, but on his death (1559) Philibert fell into disgrace. Under Charles IX, however, he returned to favour, and was employed to construct the Tuileries, in collaboration with Jean Brillant. He died in Paris on Jan. 8, 1570. An ardent humanist and student of the antique, he yet vindicated resolutely the French tradition in opposition to Italian tendencies, he was a man of independent mind and a vigorous originality. His masterpiece was the Chateau d'Anet (1553-59), built for Diane de Poitiers, the plans of which are preserved in Du Cerceau's *Plus excellents bastimens de France*, and his designs for the Tuileries (also given by Du Cerceau), begun by Catherine de' Medici in 1565, were magnificent. His work is also seen at Chenonceaux and other famous châteaux, and his tomb of Francis I at St. Denis remains a perfect specimen of his art. He wrote two books on architecture (1561 and 1567).

See Chevalier, *Lettres et devis relatifs à la construction de Chenonceaux* (1864). Piorr, *Monographie du château d'Anet* (1867). Marus Vachon, *Philibert de L'Orme* (1887), Herbet, *Travaux de P. de L'Orme à Fontainebleau* (1890).

DELOS (mod. *Mikra Dili*, or Little Delos, to distinguish it from Megali Dili, or Great Delos), an island in the Aegean, the smallest but most famous of the Cyclades, and, according to the ancient belief, the spot round which the group arranged itself in a nearly circular form. It is a rugged mass of granite, about 3 m. long and 1 m. to 1½ m. broad, about ½ m. E of Megali Dili or Rhenea, and 2 m. W of Myconus. Towards the centre it rises to its greatest height of 350 ft. in the steep and rocky peak of Mount Cynthus, which, though overtopped by several eminences in the neighbouring islands, is very conspicuous from the surrounding sea.

Archaeology—Excavations have been made by the French school at Athens slowly but systematically since 1877. The sacred precinct of Apollo has been recovered, as well as the commercial quarter of Hellenistic and Roman times, the theatre, the temples of the ten gods, the temples on the top of Mount Cynthus, and the many private houses. Sculpture of all periods has been found, and extensive series of inscriptions throwing light upon temple administration.

The ancient mole faces the channel between Delos and Rhenea. The precinct is approached by an avenue flanked by porticoes, with upon the seaside bearing the name of Philip V of Macedonia, who dedicated it about 200 B.C. This was the usual approach for sacred embassies and processions, but Nicias, on the occasion of his embassy, built a bridge from the island of Hecate to Delos, that the Athenian procession might not miss its full effect. Facing

the avenue were the propylaea, the chief entrance, with a projecting portico of four columns. The sacred road continued across an open space, with the precinct of Artemis on its west side, and, on its east side, a terrace on which stood three temples. The southernmost of these was the temple of Apollo, but only its back was visible from this side. The other two faced west and were either dedicated to heroes or minor deities or were treasuries. Beyond them the road sweeps round to the front of the temple of Apollo. The outer side of this curve is bounded by a row of treasuries, similar to those at Delphi and Olympia, to house the offerings of various islands or cities. The temple of Apollo could also be approached directly from the entrance, through a passage with a porch at either end. Just to the north of this is the base of the colossal Apollo dedicated by the Naxians, with its well-known archaic inscription and two large fragments of the statue itself.

The temple of Apollo, the centre of the whole precinct, was of Doric style, built early in the 4th century B.C. Its sculptural decoration was poor but scanty; the metopes were plain. The acroteria were now in the national museum at Athens, at the one end was Boreas carrying off Oreithyia, at the other Eos and Cephalus, the centre in each case being occupied by the winged figure. To the east of the temple was an oblong Prytaneum or other official building with colonnade on each side. Beyond it is the most interesting and characteristic of all the monuments of Delos, a long narrow hall, entered by a portico at its south end. At the north end was the famous altar, built out of the horns of the victims, which was sometimes reckoned among the seven wonders of the world. The rest of the room is taken up by a paved space, surrounded by a narrow gangway, and on this it is supposed that the *γῆραιος* or stork dance took place. The most remarkable architectural feature of the building is the partition that separated the altar from this long gallery, it consists of two columns between *antae*, with capitals of a very peculiar form, consisting of the fore parts of bulls set back to back, from these the whole building is sometimes called the sanctuary of the bulls. Beyond it, on the east, was a sacred wood filling the space up to the wall of the precinct, and at the south end of this was a small open space with the altar of Zeus Phoebus.

At the north of the precinct was a broad road, flanked by votive offerings and exedrae, and along the boundary were porticoes, reception chambers and two entrances through extensive propylaea. At the north-west corner is a building of limestone, often mentioned in the inventories of treasures. South of it is the precinct of Artemis, containing within it the old temple of the goddess, her more recent temple was to the south, opening into the precinct of Apollo. The older temple is mentioned in some of the inventories as "the temple in which were the seven statues", and close beside it was found a series of archaic draped female statues, which was the most important of its kind until the discovery of the finer and better preserved set from the Athenian Acropolis. Outside the precinct of Apollo, on the south, was an open place, between this and the precinct was a house for the priests, and within it, in a kind of court, a set of small structures identified as the tombs of the Hyperborean maidens. To the east was the temple of Dionysus, of peculiar plan, on the other side of it was a large court, forming a commercial exchange, with a temple to Aphrodite and Hermes.

To the north between the precinct and the sacred lake, are extensive ruins of the commercial town including a sort of club or exchange and the new and the old palaestra. The shore of the channel facing Rheneia is lined with docks and warehouses, and behind them are private houses of the 2nd or 3rd century B.C. Each consists of a single court surrounded by columns and often paved with mosaic, various chambers open out of the court, including usually one of large proportions, the *ἀνδράων* or dining room for guests. The theatre, set in the lower slope of Mount Cynthus, has the wings of the auditorium supported by massive substructures. The *scenae* consisted of an oblong building of two storeys, surrounded by a low portico reaching to the level of the first floor. This was supported by pillars, set closer together along the front than at the sides and back. An inscription showed that

this portico, or at least the front portion of it, was called the *proscenium* or *logaeum*, two terms of which the identity was previously disputed. On the summit of Mount Cynthus, above the primitive cave temple which has always been visible, is a small precinct dedicated to Zeus Cynthus and Athena Cynthis. Some way down the slope of the hill, between the cave-temple and the ravine of the Inopus, is a terrace with the temples of the foreign gods, Iuss and Serapis, and a small odeum.

History.—Many alternative names for Delos are given by tradition, one of these, *Otrivga*, is elsewhere also assigned to an island sacred to Artemis. Of the various traditions that were current among the ancient Greeks regarding the origin of Delos, the most popular describes it as drifting through the Aegean till mooted by Zeus for the wandering Leto, as a birthplace for Apollo and Artemis. The island first appears in history as the seat of a great Ionic festival to which the various Ionic States, including Athens, were accustomed annually to despatch a sacred embassy, at the anniversary of the birth of the god on the 7th of Thargelion (about May). In the 6th century B.C. the influence of the Delian Apollo was at its height, Polycrates of Samos dedicated the neighbouring island of Rheneia to his service and Peisistratus at Athens closed all the area within sight of the temple to be cleared of the tombs by which its sanctity was impaired. After the Persian wars, the predominance of Athens led to the transformation of the Delian amphictyony into the Athenian empire. (See *DELIAN LEAGUE*.) In 426 B.C., in connection with a reorganization of the festival, which henceforth was celebrated in the third year of every Olympiad, the Athenians instituted a more elaborate lustration, caused every tomb to be removed from the island, and established a law that ever after any one who was about to die or to give birth to a child should be at once conveyed from its shores. And even this was not accounted sufficient, for in 422 they expelled all its secular inhabitants, who were, however, permitted to return in the following year.

At the close of the Peloponnesian War the Spartans gave to the people of Delos the management of their own affairs, but the Athenian predominance was soon after restored, and survived an appeal to the amphictyony of Delphi in 345 B.C. During Macedonian times, from 322 to 166 B.C., Delos again became independent, and the temple and its possessions were administered by officials called *eporoi*. After 166 B.C. the Romans restored the control of Delian worship to Athens, but granted to the island various commercial privileges which brought it great prosperity. In 87 B.C. Mnemonphanes, the general of Mithradates VI of Pontus, sacked the island, which had remained faithful to Rome. From this blow it never recovered, the Athenian control was resumed in 42 B.C., but Pausanias (viii. 32) mentions Delos as deserted but for a few Athenian officials, and several epigrams of the first or second century A.D. attest the same fact, though the temple and worship were probably kept up until the official extinction of the ancient religion. A museum has now been built to contain the antiquities found in the excavations, otherwise Delos is now uninhabited, though during the summer months a few shepherds cross over with their flocks from Myconus or Rheneia. As a religious centre it is replaced by Tenos and as a commercial centre by the flourishing port of Syra.

BIBLIOGRAPHY.—The French excavations are fully published in *Fouilles de Delos* (in progress), see also Th. Homolle, *Les Archives de l'administration sacrée à Delos* (with plan). For history, see Sir R. C. Jebb, *Journal of Hellenic Studies*, i. (1889), pp. 7-69, and Pauly-Wissowa. For works of art found at Delos see *Greek Art*.

DE LOUTHERBOURG, PHILIP JAMES (1740-1812), English artist, was born at Strasbourg on Oct. 31, 1740, where his father, of Polish descent, practised miniature painting, but he spent the greater part of his life in London, where he was naturalized, and exerted a considerable influence on the scenery of the English stage. De Louthembourg studied under Vanloo in Paris, and painted landscapes, sea storms, battles, all of which had some celebrity. He travelled in Switzerland, Germany and Italy, distinguishing himself as much by mechanical inventions as by painting. One of these, showing quite new effects produced in a model theatre, was the wonder of the day. The exhibition of lights behind canvas representing the moon and stars, the illusory

appearance of running water produced by clear blue sheets of tinsel and gauze, with loose threads of silver, and so on, were his evicils. In 1771 he came to London, and was employed by Garrick, who offered him £500 a year to apply his inventions to Drury Lane and to superintend the scene painting, which he did with complete success. Garrick's own piece, the *Christmas Tale*, and the pantomime, 1781-82, introduced the novelties to the public, and the delight not only of the masses, but of Reynolds and the artists, was unbounded.

"Lord Howe's Victory off Ushant" (1794), and other large naval pictures were commissioned for Greenwich Hospital gallery, his finest work was the "Destruction of the Armada." A pamphlet published in 1780, entitled *A List of a few Cures performed by Mr and Mrs De Louthembourg without Medicine*, shows that he had taken up faith healing and he seems to have associated at the same time with Cagliostro. He died on March 11, 1812.

DELPHI (the Pytho of Homer and Herodotus, in Boeotian inscriptions Δελφοί, on coins Δελφοί), a place in ancient Greece in the territory of Phocis, famous as the seat of the most important temple and oracle of Apollo. It was situated about 6 m. from the north shore of the Corinthian gulf, in a rugged glen, closed on the N. by the wall-like under cliffs of Mount Parnassus known as the Phaeiads or shining rocks, and on the S. by Mount Cirphis. Between the two mountains the Pleistocene stream flowing from east to west, receives the brooklet which rises at the Castalian fountain in a deep gorge in the Parnassian cliff. About 7 m. to the north, on the side of Mount Parnassus, was the famous Corycian cave, which afforded the people of Delphi a refuge during the Persian invasion. It is now called in the district the Sarant' Auloi or Forty Courts, and is said to be capable of holding 3,000 people.

I Site.—The site of Delphi was occupied by the modern village of Castri until it was bought by the French government in 1891. Systematic excavation began in 1892. The plan of the precinct is now easily traced, and with the help of Pausanias many of the buildings have been identified.

The ancient "Hellenico" will running east and west and the two boundary walls running up the hill at each end of it, are clear. In the eastern part was the main entrance by which Pausanias entered along the Sacred Way. This road zigzags up the hill, with recesses and bases of offerings on both sides. First westwards to an open space, then eastwards till it reaches the eastern end of the terrace wall that supports the temple. Here it curves up north and then west towards the temple. Above this, are the Lesche and the theatre, and on a higher level still, to the west, is the stadium. In describing the monuments, the simplest plan is to follow Pausanias. Outside the entrance is a paved court flanked by a Roman colonnade. On the north side of the Sacred Way, close to the main entrance, stood the offering dedicated by the Lacedaemonians after the battle of Aegospotami, a quadrangular building with a back wall but stood open to the road. On a stepped pedestal stood statues of the gods and the admirals.

The statues of the Epigoni stood on a semicircular basis on the south side of the way, opposite them another semicircular basis carried the statues of the Argive kings. Farther west was the Sicyonian treasury south of the way, a small Doric temple *in antis*, with its entrance on the east. The sculptures from this treasury (in the museum) are in rough limestone, and not likely to belong to the temple building.

The Corinthian treasury (originally assigned by the excavators to the treasury of Siphnos) stands south of the way farther west. It is a small Ionic temple on a rubble with two columns, likely to be even ante on a substructure. The sculpture from its pediment and pediment is of great interest, and the fragments of white marble mouldings etc. of great elegance and beauty, perhaps the most perfect example of the transitional style of the last 5th century. Standing back from the path as it bends, is the Ionic treasury, then where the path turns again, the Athenian. This structure a small Doric temple *in antis*, has been rebuilt with the original blocks. There can be no doubt about the identity of the building, for the basis bears the remains of the dedicatory inscription, stating that it was erected from the spoils of Marathon. The sculptured metopes are of the highest interest. The famous inscriptions with hymns to Apollo accompanied by musical notation were found on stones belonging to this treasury.

Above the Athenian treasury is the 'Sybil's rock.' Here, too, was placed the curious column, on which stood the colossal sphinx, dedicated by the Naxians, now in the museum.

A little farther on, but below the Sacred Way, another open space, of circular form, is perhaps the sacred threshing floor on which the drama of the slaying of the Python by Apollo was periodically performed. Opposite, and backed against the beautifully jointed polygonal wall which supports the terrace on which the temple stands, is the colonnade of the Athenians, now assigned to the end of the 6th century. The polygonal wall at the back is covered with inscriptions concerning the immolation of slaves.

After passing the Great Altar, dedicated by the Chians, on the left the way enters the space in front of the temple, with remains of offerings by the Cyrenians and by the Cornithians. The site of the temple shows successive structures. Of that built by the Alcmaeonids in the 6th century B.C. considerable remains have been found. Sculptures assigned to this building are archaic and resemble those from the early temple of Athena at Athens. The existing foundations are of the 4th century. They give no certain information as to the sacred cliff and other matters relating to the oracle. Up in the north eastern corner of the precinct, at the foot of the cliffs, is the interesting Cnidian clubhouse, a long narrow building, the famous paintings were probably disposed so as to meet in the middle of the north side. Scanty fragments of the frescoed walls are not enough to give information as to the work of Polygnotus.

At the north western corner of the precinct is the theatre. The stadium lies to the north-west on a narrow plateau supported by a terrace wall. The seats are well preserved, some are hewn in the rock. An immense number of inscriptions have been found in the excavations, and many works of art, including a bronze chryseion (See GREEK ART).

II History.—Our information as to the oracle at Delphi and how it was consulted is confused, probably ritual varied. The title of intoxicating "mephitic" vapour has no early authority, nor is it scientifically probable. The questions had to be given in writing, and the responses were uttered by the Pythian priestess, in early times a maiden, later a woman over 50 uttered as a maiden. After chewing the sacred bay and drinking of the spring Cassotis, which was conducted into the temple by artificial channels, she took her seat on the sacred tripod in the inner shrine. Her utterances were reduced to verse and edited by the prophets and the "holy men" (dovoi). (See also ORACLE.)

Delphi also contained the "Omphalos," a sacred stone bound with fillets, supposed to mark the centre of the earth. It was said Zeus had started two eagles from the opposite extremities and they met there. Other tales said the stone was the one given by Rhea to Cronus as a substitute for Zeus.

For the history of the Delphic Amphictyony see under ΑΜΦΙΚΤΥΟΝ. The oracle at Delphi was asserted by tradition to have existed before the introduction of Apollo worship and to have belonged to the goddess Earth (Ge or Gaia). The Homeric Hymn to Apollo evidently combines two different versions, the approach of Apollo from the north by land, and the introduction of his votives from Cithra. The earliest stone temple built by Trophonius and Agamedes, was destroyed by fire in 548 B.C., and the contract for a building was given to the exiled Alcmaeonidae from Athens who started the cult of Apollo. Portions of the pediments of this temple have been found in the excavations, but no sign of the original decoration. Pausanias, representing on the east Apollo and the Muses, and on the west Dionysus and the Thyades (Bacchantes), and Agamedes by Praxias the pupil of Calamias. The temple seen by Pausanias (of which the foundations were found in the excavations) was that of which the building is recorded in inscriptions of the 4th century.

A raid on Delphi attempted by the Persians in 480 B.C. was said to have been frustrated by the god himself, by means of a storm or earthquake which hurled rocks down on the invaders, a similar tale is told of the raid of the Gauls in 279 B.C. But the

sacrilege thus escaped was inflicted by the Phocian defenders of Delphi during the Sacred War, 356–346 B.C., when many precious offerings were melted down. The Phocians were condemned to replace their value to the amount of 10,000 talents, which they paid in instalments. In 86 B.C. the sanctuary and its treasures were put under contribution by L. Cornelius Sulla for the payment of his soldiers. Nero removed no fewer than 500 bronze statues from the sacred precincts. Constantine the Great enriched his new city by the sacred tripod and its support of intertwined snakes dedicated by the Greek cities after the battle of Plataea. This still exists, with its inscription, in the Hippodrome at Constantinople. Julian afterwards sent Onbasus to restore the temple, but the oracle responded to the emperor's enthusiasm with nothing but a wail over the glory that had departed.

Provisional accounts of the excavations appeared during the excavations in the *Buletin de correspondance hellénique*. A summary is given in J. G. Frazer, *Pausanias*, vol. V. The official account is entitled *Fouilles de Delphes*. For history see Hiller von Gärtringen in *Pauli, Wissowa, Realencyclopädie*, s.v. "Delphi." For cult see L. R. Farnell, *Cults of the Greek States*, iv, 179–218.

DELPHINIA, a festival of Apollo Delphinus held annually on the 6th (or 7th) of the month Munychion (April) at Athens. All that is known of the ceremonies is that a number of girls proceeded to his temple (Delphinium) carrying supphants' branches and seeking to propitiate Apollo, probably as a god having influence on the sea. It was at this time of the year that navigation began again after the storms of winter. According to the story in Plutarch (*Thesens*, 18), the festival was instituted by Theseus (q.v.) to commemorate his voyage to Crete.

See A. Mommsen, *Festder Stadt Athen* (1898), Preller-Robert, I, 260, P. Stengel, *Die griechische Kultus-altentum* (1898), Darnberg and Saglio, *Dictionnaire des antiquités*, G. F. Schoemann, *Griechische Altertüm* (4th ed., 1897–1902).

DELPHINIUM, a genus of herbaceous plants of the crow-foot family (Ranunculaceae), comprising 150 or more species, native to north temperate regions, several of which are widely cultivated for their irregular but very showy flowers. The rocket larkspur (*D. Ajacis*) occurs in Great Britain and is somewhat naturalized in the eastern United States and Canada. Upwards of 40 species are natives of North America, most numerous in the Rocky Mountain region and on the Pacific coast, some of which are poisonous to grazing animals. Among the best known are the dwarf larkspur (*D. tricolor*), the tall larkspur (*D. exaltatum*), and the prairie larkspur (*D. carolinianum*) of the eastern and central states, the mountain larkspur (*D. occidentale*), of the central Rockies, and the cardinal larkspur (*D. cardinale*), and the red larkspur (*D. nudicaule*), of the Pacific coast. Among the most extensively cultivated forms are the rocket larkspur, native to Europe, the field larkspur (*D. consolida*), native to Asia, the bouquet larkspurs derived from *D. grandiflorum*, of eastern Asia, and the candle larkspurs, probably derived chiefly from *D. elatum*, of Eurasia.

DELPHINUS, a small constellation (q.v.) appearing in the northern hemisphere not far from Altair, the brightest star of the constellation Aquila (q.v.). As its name signifies, it was supposed by the ancients to represent a dolphin. γ Delphinus is a double star, the yellowish component being of magnitude 4, and the bluish component of the 5th magnitude (see STAR).

DELPHOS, a city of western Ohio, U.S.A., in Allen and Van Wert counties, 70 mi. SW of Toledo. It is on federal highway 30, and is served by the Nickel Plate, the Akron, Canton and Youngstown and the Pennsylvania railways. The population in 1950 was 2,669, in 1940, 5,746 by federal census. The city has railroad shops, a galvanizing plant and other manufacturing industries.

DEL RIO, a city of southwestern Texas, U.S., on the Rio Grande, 150 mi. W of San Antonio, county seat of Val Verde county. Del Rio is on federal highways 90 and 277 and the Southern Pacific railway.

Across the Rio Grande is the Mexican city of Villa Acuña. Population of Del Rio, 1950 census, was 14,191. Val Verde county (Del Rio) is the largest wool, sheep and lamb producing county in the United States.

Shipped annually from Del Rio are 8,000,000 lb. of wool, 400,-

000 hams and 5,000,000 lb. of mohair. The city was founded in 1872 and has a commission form of government.

DELTA, the tract of coastal land bounded by the most divergent branches of a river's mouth, and traversed by other tributaries of the stream. The name comes from the shape of the delta resembling the Greek (Δ) letter of that name. This triangular area is formed from the fine silt brought down in suspension by a muddy river and is deposited when the river's current becomes ineffective on reaching the sea. When tidal currents are insignificant, the delta advances seawards, forming a local addition to the coastal land. The term, by analogy, is now applied to like deltas and also to tributary river deltas. In the latter case the feature is usually small and occurs where a swift muddy tributary enters a slowly flowing main stream. Lake deltas formed by an entering stream at the side of a lake occasionally grow outwards as far as the opposite shore and result in the lake being divided into two separate water areas, e.g., Thun and Brienz in Switzerland.

DELTA RAYS, a stream of slowly moving electrons emitted when α particles impinge on matter (see RADIOACTIVITY, NATURAL).

DELUC, JEAN ANDRE (1727–1817), Swiss geologist and meteorologist, was born at Geneva on Feb. 8, 1727 and spent his early manhood in business and politics in his native city. He settled in England in 1773, and became reader to Queen Charlotte, a position which gave him a competency and leisure to travel in pursuit of his scientific studies. Deluc, who was a fellow of the Royal Society, died at Windsor on Nov. 7, 1817.

His principal geological work *Lettres physiques et morales sur les montagnes et sur l'histoire de la terre et de l'homme* (1778, enl. ed. 1779) explained the six days of the Mosaic creation as so many epochs preceding the actual state of the globe. Deluc discovered many important facts relating to heat and moisture. He noticed the disappearance of heat in the thawing of ice about the same time that J. Black founded on it his ingenious hypothesis of latent heat. He ascertained that water was more dense about 40° F (4° C) than at the temperature of freezing, expanding equally on each side of the maximum, and he was the originator of the theory, revived later by Dalton, that the quantity of aqueous vapour contained in any space is independent of the pressure or density of the air, or of any other elastic fluid.

In the *Phil. Trans.*, 1773, appeared his account of a new hygrometer, which resembled a mercurial thermometer, with an ivory bulb, which expanded by moisture, and caused the mercury to descend. The first correct rules ever published for measuring heights by the barometer were those he gave in the *Phil. Trans.*, 1771, p. 158. He sent to the Royal Society, in 1809, a long paper on separating the chemical from the electrical effect of the pile, with a description of the electric column and aerial electroscope, in which he advanced opinions so little in unison with the latest discoveries of the day, that the council deemed it inexpedient to admit them to the *Transactions*. The paper was afterwards published in Nicholson's *Journal* (xxvi), and the dry column described in it was constructed by various experimental philosophers. This dry pile or electric column has been regarded as his chief discovery.

His other works include *Recherches sur les modifications de l'atmosphère* (Geneva, 2 vols., 1777), which contains accounts of many physical experiments, and *Traité élémentaire de géologie* (1809, Eng. trans., 1809), in refutation of the Vulcanian theory of Hutton and Playfair. Many of his papers on subjects kindred to those mentioned are to be found in the *Transactions* and in the *Philosophical Magazine*. See *Philosophical Magazine* (Nov. 1817).

DELUGE is the name given to a great flood of water submerging the whole or a large part of the earth's surface. Legends of such floods occur in the traditions of many peoples. Collections of these legends have been made by several scholars, notably R. Andree (*Die Flutungen*, 1891), M. Winternitz (*Die Flut sagen des Alterthums und der Naturvölker*, 1901), and J. G. Frazer (*Polklore in the Old Testament*, vol. 1, pp. 104–361).

Hebrew Traditions—The most familiar of these stories is that related in Genesis vi–ix. It has long been recognized that the Biblical record consists of two distinct traditions which have been dovetailed by an editor to make a consecutive story. One of

these comes from the Yahwist document J, the other from the "priestly" source P. The matter common to the two traditions tells of God's anger at the iniquity of mankind, whom He therefore proposes to destroy by a flood. Noah, whose piety finds favour in God's eyes, is instructed to take into his "ark" his family and specimens of all beasts and birds. (In J the animals fit for sacrifice are taken by sevens, the others by twos, but in P all alike by twos.) A great flood is caused by rain—P adds also an uprush of the subterranean waters—in which all men other than those in the ark perish, but God promises that no similar flood shall ever occur again. Peculiar to the J story are the details that Noah sends out birds from the ark to test the subsidence of the waters and that Noah, after he comes out of the ark, offers a sacrifice, which God smells. Peculiar to the P story are the warning given to Noah, the elaborate instructions as to the making of the ark, and in particular the mention of bitumen, the resting of the ark upon a mountain in Ararat, and the rainbow sign. No doubt there were parallels to some features in one or other documents which have disappeared in the dovetailing process. The time notes show considerable variation. In J the flood culminates in 40 days, in P it reaches its climax in 150 days. In J the animals take seven days to enter the ark, but seemingly only one in P.

Babylonian Traditions.—Numerous traditions resembling the Genesis story have been found in Babylonia. Most of them are, unfortunately, but fragments. The best-known forming the 11th tablet of the Gilgamesh Epic, is elaborate, and the experiences of Utnapishtim, bear striking resemblances to those of Noah. The Gilgamesh story, for example, relates the sending forth from the ark of three birds in succession—dove, swallow, raven, instead of a dove three times as in Genesis (where the raven probably does not belong to the original text). It mentions the bitumen, using the same word as Genesis, and speaks of the ark grounding on a mountain. The offering of the sacrifice is mentioned, with the detail, in almost identical words, that the gods smell the savour. The Babylonian traditions reflect a higher level of civilization. Utnapishtim takes into his ark not only animals but treasure and craftsmen of all kinds, so that not only all kinds of animals but all different crafts may be preserved. One of the craftsmen was a sailor, to whom, very prudently, Utnapishtim entrusted the navigation of his vessel during the flood. The version of Berossus, a Babylonian priest who wrote at Babylon c. 300 B.C., which is doubtless much older than its recorder, shows also a care for literature in the detail that its hero buries before the flood a written account of "the beginning, middle and end of all things," dismaying it when the flood had gone. But the Biblical story reaches the higher religious and ethical levels. Its majestic conception of God is in striking contrast with the many gods of the Babylonian story, who suffer from human weaknesses such as cowardice, intrigue and deceit. It is hardly fair to say that the Babylonian record is without ethical qualities. In at least one version the piety of the hero is emphasized. In the Gilgamesh version the god Ea protests that only the guilty should have been punished, from which it may be inferred that the flood was intended as a punishment for sinful men. But in any case the sense of sin is much more definitely expressed in Genesis.

Relation Between Hebrew and Babylonian Traditions.—However clear may be the moral and religious superiority of the Biblical versions it remains true that the many striking points of resemblance make it absolutely certain that they are not independent of the Babylonian traditions. Since the latter are the older—even some of the written forms in which they come to us are several centuries older than the Mosaic period—they must, if the dependence be direct, be regarded as the cruder material which the Genesis tradition has received. It would have been possible for the early Hebrews to learn the story either from Babylon itself or, more probably from the Chaldeans, for Chanaan was very much under the influence of Babylonia. This is, indeed, the view most generally held by scholars. It is urged that the story is much more likely to have arisen in a country liable to inundations like Babylon than in Chanaan. The elaborate description of the ark, too, seems much more plausible to

have originated in Babylonia than among a people so little accustomed to the sea and its ways as were the Hebrews. A. T. Clay, however, has effectively criticized the proposition that the descriptions of the deluge exactly fit the alluvial plain of Babylonia. In the cuneiform records the cause of the flood is invariably heavy rain, and not inundation from river or sea. Statistics seem to show that the average rainfall in Babylonia is by no means heavy, and therefore one of the main arguments for thinking the story indigenous to Babylonia is weakened. The theory of Suss, that the real cause of the flood was water driven in by a typhoon from the Persian gulf, though accepted by many scholars, has no foundation in the tradition itself. On the whole it is safer to conclude that, while there is undoubtedly a close kinship between the Biblical and the Babylonian traditions, the evidence hardly warrants a dogmatic assertion that the former are derived directly from the latter. In view of the widespread prevalence of similar traditions, and of the fact that, like the account in Genesis, the one in the Gilgamesh Epic is probably composite, it would be safer to say that both derive material from some common source.

Greek Traditions.—The most familiar of the Greek flood stories—later elaborated by Ovid—is that told by Apollodorus. It recounts how Deucalion, king of the country round Phthia, and his wife, Pyrrha, escaped from a flood caused by Zeus pouring water on the earth. The escape was made in a chest, which Deucalion had previously constructed on the advice of his father Prometheus. In this they floated for nine days over the sea, until the chest grounded on Mt. Parnassus. After the rain had ceased Deucalion emerged from the chest and offered sacrifice to Zeus. Being granted a boon by the god he chose men, Zeus bade him throw stones over his head, and these became men, while stones similarly thrown by Pyrrha became women. It is true that the story in this form is not older than the 2nd century B.C., but Hellanicus, a historian of the 5th century B.C., has a version of it in which the chest grounds on Mt. Othrys in Thessaly, and slightly older is the version of Pindar, in which the mountain is Parnassus. A Megarian account specifies Mt. Gerania.

But the tradition varies in features more important than this in some versions Deucalion is replaced by Ogiges, founder of Thebes in Boeotia, or by Dardanus, who was a king in Arcadia. Frazer hazards the guess that the Ogiges story may be founded on an extraordinary inundation of the Copac lake, which formerly occupied a large part of central Boeotia, and thinks this theory may find some support from the Dardanus legend, for in one tradition the birthplace of Dardanus was Pheneus in northern Arcadia, and "no valley in Greece is known to have been from antiquity subject to inundations on so vast a scale and for such long periods as the valley of Pheneus." On the whole, however, he is more inclined to the theory that the story may have been suggested by a desire to explain the origin of the gorge of Tempe, which was thought to be the opening burst by a vast lake once dammed by the circle of the Thessalian mountains. It is not easy to trace connection between the Greek and Babylonian traditions. The most likely link would be Hittite tradition. But though it is asserted that the Hittite deluge hero Ul (Ilush) is the same as Ulysses (=Odysseus) this does not help very much.

Other Traditions.—Apart from Greek flood legends are comparatively rare in Europe. Examples are found in Wales, Lithuania and Iceland, the last-named has a striking note of difference in that its deluge is caused by flood flowing from a wounded giant. India furnishes much material in the later Sanskrit literature. The earliest record goes back to the 6th century B.C. It tells how the hero, Manu, was warned by a fish of the coming flood, and advised to prepare a ship as a means of escape. When the flood came Manu's fish towed the ship to a mountain in the far north. After the waters had receded Manu offered a sacrifice, from the materials of which a woman was evolved. This story is repeated, with variations, in still later Sanskrit books, and similar stories are found in the folk-lore of existing Indian tribes. In Frazer's opinion the main theme of the legend may be aboriginal and form the source of the Sanskrit versions. He is also inclined to agree with Sir Marc Aurel

Stein that one at least of the stories may be explained as the product of imagination working on the existence of a gorge, which, like the gorge of Tempe mentioned earlier, drains an area enclosed by mountains

Deluge stories are found in China, Burma, Cochín China, Malay, the Indian archipelago, among the aborigines of Australia, in New Guinea, and abundantly in the islands of Melanesia, Polynesia and Micronesia. They are plentiful also in South, Central and North America.

A survey of the whole field shows that deluge stories are common in Southern Asia, but not found in the rest of that continent, the examples quoted from China and Japan generally not answering to the description of universal inundations. Europe furnishes a few, Africa hardly any. It is especially noteworthy that we have none from the valley of the Nile. On the other hand, America and the islands of the Southern Seas are prolific in these stories.

Origin of Traditions.—Are these widespread legends connected? The Sumerian story seems to be the oldest, but it is difficult to derive the others from it. Frazer is certain that the Hebrew story descends from the Babylonian, but sees no decisive grounds for believing that the others do. He emphatically, and rightly, rejects the view that the various deluge traditions were originally myths relating to the voyages of the sun and moon in the heavens. His own view is that many of the stories may arise from the inundations caused by the far-reaching tidal waves that accompany earthquakes, and some from inundations caused by rain. Frazer's final verdict is "while many diluvial traditions are based on reminiscences of catastrophes which actually occurred, there is no good ground for holding that any such traditions are older than a few thousand years at most, wherever they appear to describe vast changes in the physical configuration of the globe they probably embody, not the record of contemporary witnesses, but the speculation of much later thinkers."

BIBLIOGRAPHY.—Besides the collections named at the beginning of the article see Skinner, "Genesis," *Internal Crit. Comm.* pp. 147-181 (1912); W. L. Wardle, *Israel and Babylon*, pp. 207-235, (1914); articles "Deluge" in *Encyc. of Religion and Ethics* and *Encyclopædia Biblica*, "Flood" in Hastings' *Dictionary of the Bible*. (W. L. W.)

DELUSION is an erroneous belief, usually rather persistent and more elaborate in character than hallucinations or illusions, inasmuch as it is commonly based on more or less elaborate, if fallacious, reasoning. Delusions may result from ignorance or prejudice, or they may be due to mental abnormality, known as "delusional insanity." In the most serious cases they are confined to a few subjects such as persecution or personal eminence, etc. See ABNORMAL PSYCHOLOGY, HALLUCINATION, ILLUSION.

DELYANNI, THEODOROS (1826-1905), Greek statesman, was born at Kalavryta, Peloponnesus, in 1826. He studied law at Athens, and entered the civil service. In 1862, he became minister for foreign affairs. In 1867 he was minister at Paris. In the so-called "Occasional Ministry" of 1877 he voted for war with Turkey, and on its fall he entered the cabinet of Koumoundouras as minister for foreign affairs. He was a representative of Greece at the Berlin congress in 1878. From this time forward, and particularly after 1882, when Tricoupi again came into power at the head of a strong party, the duel between these two statesmen was the leading feature of Greek politics (See GREECE, *Modern History*). Deliyanni first formed a cabinet in 1885, but his warlike policy ended in failure. He returned to power in 1890, with a radical programme, but his failure to deal with the financial crisis produced a conflict between him and the king, and his disrespectful attitude resulted in his summary dismissal in 1892. In 1895, however, he again became prime minister, and was at the head of affairs during the Cretan crisis and the opening of the war with Turkey in 1897. The humiliating defeat which ensued—though Deliyanni himself had been led into the disastrous war policy to some extent against his will—caused his fall in April 1897, the king again dismissing him from office when he declined to resign. Deliyanni kept his own seat at the election of 1899, but his following dwindled to small dimensions. He was again president of the council and minister of the interior when, on June 13, 1905, he was murdered in revenge for the rigorous measures taken by him against gambling houses.

DEMADES (c. 380-315 B.C.), Athenian orator. At one time a common sailor, he rose by his eloquence and unscrupulous character to a prominent position. He espoused the cause of Philip in the war against Olynthus, and thus became the enemy of Demosthenes, whom he at first supported. He fought against the Macedonians at Chaeroneia, and was taken prisoner. On his release he helped to negotiate peace between Macedonia and Athens. He continued to be a favourite of Alexander, and, prompted by a bribe, saved Demosthenes and the other obnoxious Athenian orators from his vengeance. It was also chiefly owing to him that Alexander, after the destruction of Thebes, treated Athens so leniently. His conduct in supporting the Macedonian cause, yet taking bribes from the opposite party, caused him to be heavily fined more than once, and he was finally deprived of his civil rights. He was reinstated (322) on the approach of Antipater, to whom he was sent as ambassador. Before setting out he persuaded the citizens to pass sentence of death upon Demosthenes and his followers, who had fled from Athens. The result of his embassy was the conclusion of a peace greatly to the disadvantage of the Athenians. In 318 (or earlier) he was again sent to Antipater, who, learning that he had intrigued with Perdiccas, put him to death.

A fragment of a speech (*Περὶ δολοχίας*), bearing his name, in which he defends his conduct, is to be found in C. Müller's *Oratores Attici*, ii. 438, but its genuineness is exceedingly doubtful.

DEMAGOGUE, a leader of the popular as opposed to any other party (*Gr. δημαγωγός*, from *δημ*, to lead, and *ἄγωγος*, the people). Used in an invidious sense, a mob leader or orator, one who for his own political ends panders to the passions and prejudices of the people.

DEMAND. In economics, as in trade, demand denotes the extent of the outlet or market which the wants and preferences of buyers, joined to their purchasing power, establish for particular goods or services. Demand is always relative to price, and the character of the relation is commonly exhibited in treatises on economics either arithmetically (in "demand schedules") or diagrammatically (in "demand curves") by showing in sequence the amount of a commodity which supposedly would be purchased at each price in an ordered series of prices. The inaccurate statement that "an increase of prices will diminish demand" really means that an increase in price will diminish the volume of potential sales. The statement "an increase of demand will raise the price" means that a shift to the right in the position of the demand curve tends to raise the price. The relationship between price and the amounts which buyers will purchase is generally inverse, that is, sales volume is commonly larger at lower than at higher prices. This elementary theorem rests in the first instance upon common observation of the facts of the market, but it can be explained by or related to the way in which households and individual consumers apportion their expenditures. Most goods serve a variety of purposes, and these purposes differ greatly in importance. If the price of a commodity increases, consumers generally cannot continue to buy it in undiminished quantities without cutting into their expenditures for other goods so deeply as to sacrifice some of their relatively important uses. They will prefer to give up some relatively unimportant uses of the commodity which has increased in price, and will therefore reduce their purchases of it.

The extent to which a change of price affects the quantity of a commodity which can be sold is called the elasticity of demand. The greater the ratio of the proportionate change in potential sales volume to the proportionate change in price, the greater is said to be the elasticity of demand. This ratio is called the co-efficient of elasticity. Thus if a large wheat or cotton crop will sell for less in the aggregate than a smaller crop would have sold for, within certain limits, the demand for wheat and cotton is comparatively inelastic, and the co-efficient of elasticity is less than unity. In general, the demand for necessities, for goods for which there are no substitutes, and for goods the use of which creates a habit is relatively inelastic. The elasticity of the demand for any commodity is rarely the same over any considerable range of prices. The demand for salt,

for example, would be much less elastic at high than at low prices. H. L. Moore and other scholars, by making skilful use of statistics of the production and prices of certain commodities and of the general movements of prices, have been able to find formulae which express approximately the relations (for the time being) between the prices of those commodities and the demand for them. These empirical laws of demand add materially to our economic knowledge, and promise to be useful in forecasting the probable effects of increased or decreased production upon prices.

The demand for any one commodity is dependent not only upon its own price but upon the prices of other goods as well. There are many instances of joint demand, as where a falling off in the price of fresh fruit leads to increased purchasing of sugar, and of competing demand, as where a reduction of the cost of electric lighting leads to a smaller use of illuminating gas. So far, indeed, as a change of the price of any commodity whatsoever affects the amount of money expended for it, the demand for other goods must be affected. The demands for labour, land, and productive instruments are derived from the demands for their products. In some instances the relation between the demand for consumer's goods and the demand for productive goods and services is fairly direct and simple. More often, however, this relation is exceedingly intricate, because productive agents can be combined in various ways and in various proportions. What the most economical combination of productive agents for any one purpose is will depend upon the demand not for one but all of their possible products.

See also ECONOMICS, SUPPLY AND DEMAND, PRICE (W I K)

DEMAND AND SUPPLY see SUPPLY AND DEMAND

DEMAND LOAN see CALL MONEY

DEMANDOID see GARNET

DEMARATUS, king of Sparta of the Euryponid line, successor of his father Ariston (Doric *Δαμάρτωρ*, Ionic *Δαμάρορος*). He is known chiefly for his opposition to his colleague Cleomenes I (*q.v.*) in his attempts to make Isagoras tyrant in Athens and afterwards to punish Aegina for medizing. He did his utmost to bring Cleomenes into disavow at home. Thereupon Cleomenes urged Leotychides, a relative and personal enemy of Demaratus, to claim the throne on the ground that the latter was not really the son of Ariston. The Delphic oracle, bribed by Cleomenes, pronounced in favour of Leotychides, who became king (497 B.C.). Soon afterwards Demaratus fled to Darius, who gave him the cities of Pergamum, Teuthræa and Halisarna, where his descendants were still ruling at the beginning of the 4th century (Xen. *Anabasis*, II 3, VI 8 17, *Hellenica*, II 26), to these Gambreus should perhaps be added (Athenæus I 29 f.). He accompanied Xerxes on his expedition to Greece, but the stories told of the warning and advice which on several occasions he addressed to the king are scarcely historical.

See Herodotus V 75, VI 50-70, VII, later writers either reproduce or embellish his narrative (Faustmann II 4, 3-5; 7, 7-8; Diodorus VI 6; Polyænus II 40; Seneca, *De beneficiis*, VI 33, 4-12). The story that he took part in the attack on Argos which was repulsed by Telesilla, the poetess, and the Argive women, can hardly be true (Plutarch, *Mul. virt.* 4; Polyænus, *Strat.* VII 33; G. Busolt, *Griechische Geschichte*, II 543, note 4).

(M N T)

DEMAVEND, MOUNT An extinct volcano in the Elburz mountains, Persia, with an altitude of 17,930 feet. It has supplies of sulphur and pumice.

DEMENTIA PRAECOX: see INSANITY

DEMERARA, one of the three counties of British Guiana, taking its name from the river Demerara (See *GUIANA*).

DEMESNE, that portion of the lands of a manor not granted out in freehold tenancy, but (a) retained by the lord of the manor for his own use and occupation or (b) let out as tenement land to his retainers or "villani". This demesne land, originally held at the will of the lord, in course of time came to acquire fixity of tenure, and developed into the modern copyhold (see *MANOR*). It is from *demoine* *a-* used in *sarpe* (a) that the modern restricted use of the word comes *etc.*, land immediately surrounding the manor or dwelling house, the park or chase. *Demesne of the Crown*, or royal demesne was that part of the crown lands not granted out to feudal tenants, but which

remained under the management of stewards appointed by the crown. These crown lands, since the accession of George III., have been appropriated by parliament, the sovereign receiving in return a fixed annual sum (see *CROWN LANDS*, CIVIL LIST). *Ancient demesne* signified lands or manors vested in the king at the Norm. Conquest. There were special privileges surrounding tenancies of these lands, such as freedom from tolls and duties, exemption from danegeld and amercement, from sitting on juries, etc. Hence, the phrase "ancient demesne" came to be applied to the tenure by which the lands were held. Land held in ancient demesne is sometimes also called customary freehold (see *COPYHOLD*).

DEMETER, in Greek mythology, daughter of Cronus and Rhea and sister of Zeus, goddess of agriculture. Her name has been explained as (1) "gram mother," from *gram*, the Cretan form of *seal*, "barley," or (2) "earth mother," or rather "mother earth," *da* being regarded as the Doric form of *gē*. She is rarely mentioned in Homer, nor is she included among the Olympian gods.

The central fact of her legend was the story of her daughter Persephone. After her carrying off by Hades (see *PERSEPHONE*), Demeter revealed to the people of Eleusis, where she had been hospitably received, her secret rites (see *TRIPTOLEMUS*). This is the legendary origin of the famous Eleusinian mysteries (see *MYSTERY*). The Eleusinia, sometimes confused with them, were a distinct festival.

Demeter is a mother goddess. Besides Zeus, she has as consort Iasion, who "lay with her in a thrice ploughed field" (Homer, *Od.* V 125 *et seq.*), and to whom she bore Plutus (*q.v.*)—"Wealth," (i.e., abundant produce of the soil). The story is compared by Frazer (*Golden Bough*, 3rd ed. VII 207) with the West Prussian custom of the mock birth of a child on the harvest field, the object being to ensure a plentiful crop for the coming year. In Homer the scene is laid in Crete, and may well represent part of the ritual or mythology of the Cretan goddess Erysichthon ("tearer up of the earth"), son of Tropas or Myrmidon, having cut down the trees in a grove sacred to the goddess, was punished by her with terrible hunger (Callimachus, *Hymn to Demeter*, Ovid, *Metam.* VII 738 878). Of this story no very convincing explanation has yet been put forward, perhaps Erysichthon may be explained as the personification of the labourer, who, by the systematic cultivation and tilling of the soil, endeavours to force the crops instead of allowing them to mature unmolested as in the good old times.

Demeter, however, was not limited to corn, but extended to vegetation generally and all the fruits of the earth, with the curious exception of the bean, the use of which was forbidden at Eleusis, and for the protection of which a special patron was invented. In this wider sense Demeter is akin to *Gē*, with whom she has several epithets in common, and is sometimes identified with Rhea-Cybele, thus Pindar speaks of Demeter *χαλκώρεος* ("bronze-rustling"), an epithet obviously more suitable to Rhea-Cybele than Demeter (See *CORYMBANTES*).

Another important aspect of Demeter was that of a divinity of the under-world, as such she is *χθονία* (earth-goddess) at Sparta and especially at Hermione in Argolis where, at the festival Chthonia, a cow (representing, according to Mannhardt, the spirit of vegetation), which voluntarily presented itself, was sacrificed by three old women. Those joining in the procession wore garlands of the flower called *haskanthos*. The remarkable epithets, *Ἐρινός* (*ερινός*) and *Μελαιρά* ("the black one"), as applied to Demeter, were both localized in Arcadia, the first at Telespaea (or

rather *Onkeion* close by), the second at Phigaleia (see W. Immerwahr, *Die Kulte und Mythen Arkadiens*, 1891). According to the Thelupian story, Demeter, during her wanderings in search of Persephone, changed herself into a mare to avoid the persecution of Poseidon. The god, however, assumed the form of a stiltion, and the fruit of the union was a daughter of mystic name and the horse Arion or Arion (*q.v.*). Demeter, at first enraged, afterwards calmed down, and washed herself in the river Ladon by way of purification. An almost identical story was current in the neighbourhood of Tilphossa, a Boeotian spring, and a similar one at Phigaleia, where, in a cave still called *Μαυροπέλα* ("black cave"), there was an image of the goddess, a female form seated on a rock, but with a horse's head and mane, to which were attached snakes and other wild animals. It was clothed in a black garment reaching to the feet, and held in one hand a dolphin, in the other a dove.

Both *μολαῖνα* and *εἰρηνη*, according to Farnell, are epithets of Demeter as an earth goddess of the under-world. The first has been explained as referring to the gloom of her abode, or the blackness of the withered corn. According to Farnell, the meaning of the epithet is to be looked for in the original conception of Erinyes, which was that of an earth-goddess akin to *Gē*, thus naturally associated with Demeter, rather than that of a wrathful avenging deity.

Various interpretations have been given of the horse-headed form of the Black Demeter: (1) that the horse was one of the forms of the corn-spirit in ancient Greece, (2) that it was an animal "devoted" to the chthonian goddesses, (3) that it is totemistic, (4) that the form was adopted from *Poseidon Hippios*, who is frequently associated with the earth-goddess and is said to have received the name *Hippios* first at Thelupia, in order that Demeter might figure as the mother of Arion (for a discussion of the whole subject see Farnell, *Cults*, i, p. 502). In any case the association of Poseidon, representing the fertilizing element of moisture, with Demeter, who causes the plants and seeds to grow, is quite natural.

Demeter also appears as a goddess of health, of birth and of marriage, and a certain number of political and ethnic titles is assigned to her, the most important being *Ἀφικτωμένης*, at Anthela near Thermopylae, as patron goddess of the Amphictyonic league, subsequently so well known in connection with the temple at Delphi.

Brief mention may here be made of certain agrarian festivals held in honour of Demeter.

1 *Halāa*, obviously connected with *ἅλως* ("threshing floor"), begun at Athens and finished at Eleusis, where there was a threshing floor of Triptolemus, in the month Poseideon (December). This date, which is confirmed by historical and epigraphical evidence, seems inappropriate, and it is suggested (A. Mommsen, *Feste der Stadt Athen*, p. 365 et seq.) that the festival, originally held in autumn, was subsequently placed later, so as to synchronize with the winter Dionysia. Dionysus, as the god of vines, and (in a special procession) Poseidon *φύρλιμος* ("god of vegetation") were associated with Demeter. In addition to being a harvest festival, marked by the ordinary popular rejoicings, the *Halāa* had a religious character. The *ἀρχαῖα* ("first fruits") were conveyed to Eleusis, where sacrifice was offered by a priestess, men being prohibited from undertaking the duty. A *τελετή* ("initiation ceremony") of women by a woman also took place at Eleusis, characterized by obscene jests and the use of phallic emblems. The sacramental meal on this occasion consisted of the produce of land and sea, certain things (pomegranates, honey, eggs) being forbidden for mystical reasons. Although the offerings at the festival were bloodless, the ceremony of the presentation of the *ἀρχαῖα* was probably accompanied by animal sacrifice. Mommsen, however, considers the offerings to have been pastry imitations. Certain games (*πάτριος ἀγών*), of which nothing is known, terminated the proceedings. In Roman imperial times the ephebi (*q.v.*) had to deliver a speech at the *Halāa*.

2 *Chloea* or *Chlona*, the festival of the corn beginning to sprout, held at Eleusis in the early spring (Anthesterion) in honour of Demeter Chloea, "the green," the goddess of growing

vegetation. This is to be distinguished from the later sacrifice of a ram to the same goddess on the 6th of the month Thargelion, probably intended as an act of propitiation. It has been identified with the *Procharistia* (sometimes called *Procharereia*), an other spring festival, but this is doubtful. The scholiast on Pindar (*Ol.* ix 150) mentions in Athenian harvest festival *Eucharistia*. 3 *Proerosia*, at which prayers were offered for an abundant harvest, before the land was ploughed for sowing. It was also called *Proarktouriā*, an indication that it was held before the rising of Arcturus. According to the traditional account, when Greece was threatened with famine, the Delphic oracle ordered first fruits to be brought to Athens from all parts of the country, which were to be offered by the Athenians to the goddess Deo on behalf of all the contributors. The most important part of the festival was the three sacred ploughings—the Athenian *ὑπὸ ῥόδῳ*, the Eleusian on the Rhanian plow, and the Sorian (a corn promise between Athens and Eleusis). The festival itself took place, probably some time in September, at Eleusis. In later times the ephebi also took part in the *Proerosia*.

4 *Thalasia*, a thanksgiving festival, held in autumn after the harvest in the island of Cos (see Theocritus vii).

5 The name of Demeter is also associated with the *Skrophoria* (see ATHENA). It is considered probable that the festival was originally held in honour of Athena, but that the growing importance of the Eleusinia caused it to be attached to Demeter and Kore.

The attributes of Demeter are chiefly connected with her character as goddess of agriculture and vegetation—ears of corn, the poppy, the mystic basket (*kalathos*) filled with flowers, corn and fruit of all kinds, the pomegranate being especially common. Of animals, the pig is her favourite, owing to its productivity and the cathartic properties of its blood. As a chthonian divinity she is accompanied by a snake, the myrtle, asphodel and narcissus (which Persephone was gathering when carried off by Hades) also are sacred to her.

In Greek art, Demeter resembles Hera, but she is more maternally and of milder expression, her form is broader and fuller.

She is sometimes riding in a chariot drawn by horses or dragons, sometimes walking, sometimes seated upon a throne, alone or with her daughter. The Demeter of Cnidus in the British Museum, of the school of Praxiteles, apparently shows her mourning the loss of her daughter.

The Italians identified Demeter with their own Ceres (*q.v.*). BIBLIOGRAPHY—Besides authorities cited in the text, see W. Mannhardt, *Mythologische Forschungen* (1884), J. E. Harrison, *Prolegomena to the Study of Greek Religion* (1903), Preller-Robert, *Griechische Mythologie*, Ath. ed. 1, p. 741 et seq., O. Gruppe, *Griechische Mythologie und Religionsgeschichte*, ii (1907), and the classical dictionaries.

DEMETRIA, an obscure festival or rite of Demeter, probably Athenian, in which the participants beat each other with whips of twisted bark, a well-known fertility charm (Pollux i 37, Hesych s.v. *μύρτορον*). Also a name given to the Attic *Dionysia* in compliment to Demetrius Poliorcetes (Plut., *Demetrius*, 12).

See Stengel in Pauly Wissowa, *Realencycl.* iv 2, 754.

DEMETRIUS, king of Bactria, was the son of the Graeco-Bactrian king Euthydemus, for whom he negotiated a peace with Antiochus the Great in 206 (Polyb. xi 34). Soon afterwards he crossed the Hindu Kush and began the invasion of India (Strabo vi 516), he conquered the Punjab and the valley of the Indus down to the sea and to Gupatar. The city of Sangala, a town of the Kathaceans in the Punjab (Arrian v 22, 2 et seq.) he named after his father Euthydemus (Ptol. vii 1 46). That his power extended into Arachosia (Afghanistan) is proved by the name of a town Demetrias near Kandahar (Isidor. Charac. 10, cf. Strabo vi 516). On his coins he wears an elephant's skin with trunk and teeth on his head, on bronze coins, which have also an Indian legend in Kharoshthi letters (see BACTRIA), he calls himself the unvanquished king (*Βασιλεύς ἀνίκητος Σαμηνήριος*). One of his coins had already the square form used in India instead of the circular. Eventually he was defeated by the usurper Eucratides (*q.v.*), who meanwhile had risen to great power in Bactria. About

his death we know nothing, his young son Euthydemus II (known only from coins) can have ruled only a short time (Eo M)

DEMETRIUS I (335–283 B.C.), King of Macedonia, surnamed *Polorocetes* ("Bosieger"), son of Antigonus Cyclops and Stratonice. In 321 he married Phila, daughter of Antipater. At the age of twenty-two he was left by his father to defend Syria against Ptolemy the son of Lagos, he was totally defeated near Gaza (312), but soon partially repaired his loss by a victory in the neighbourhood of Myus. After an unsuccessful expedition against Babylon, and several campaigns against Ptolemy on the coasts of Cilicia and Cyprus, Demetrius sailed with a fleet of 250 ships to Athens. He freed the city from the power of Cassander and Ptolemy, expelled the garrison which had been stationed there under Demetrius of Phalerum, and besieged and took Munychia (307). After these victories he was worshipped by the Athenians as a tutelary deity under the title of *Soter* ("Preserver"). In the campaign of 306 against Ptolemy he defeated Menelaus (the brother of Ptolemy) in Cyprus, and completely destroyed the naval power of Egypt.

Demetrius and his father then adopted the royal title, thereby (and by their consage) claiming the whole of Alexander's empire. A joint expedition into Egypt, Demetrius in command of the fleet, was a failure. In 305 he endeavoured to punish the Rhodians for having deserted his cause, and his ingenuity in devising new instruments of siege, in his unsuccessful attempt to reduce the capital, gained him the appellation of *Polorocetes*. He returned to Greece to deal with Cassander again. After a riotous winter in which he even shocked Athens, he drove the Cassandrian party out of the Peloponnese, called a conference at the Isthmus, and re-organized Philip's League of Corinth, much on the same lines, except that it rested on democracies in the constituent states. It was to meet at the Great Games (6 times in 4 years), and to include tribes (ἔθνη), i.e., peoples not organized into city states. Eventually Seleucus, Cassander and Lysimachus united to destroy Antigonus and his son. The hostile armies met at Ipsus in Phrygia (301). Antigonus was killed in the battle and Demetrius retired to Ephesus, defeated. Many enemies rose up against him, even the Athenians refused to admit him to their city. Demetrius ravaged the territory of Lysimachus, and effected a reconciliation with Seleucus who married his daughter. Demetrius gained possession of Athens then oppressed by the tyranny of Lachares. In the same year (294) he established himself on the throne of Macedonia by the murder of Alexander, son of Cassander, but, expelled by the combined forces of Pyrrhus, Ptolemy and Lysimachus, he passed into Asia where he was forsaken by his troops and surrendered to Seleucus. His son Antigonus offered all his possessions and even his own liberty to have his father set free but without avail. Demetrius died in 283 after a confinement of three years.

See Life by Plutarch, *Diod. Sic. xix, xx*, Wilamowitz-Moellendorf, *Antigonus von Korymbos*, De Sanctis, *Contributio alla storia Ateniese* in Beloch's *Studi di storia antica* (1893), Ferguson in Lehmann's *Beiträge z. alt. Gesch. (Klio)*, vol. v (1905), also authorities under **MACEDONIAN EMPIRE**.

DEMETRIUS II, son of Antigonus Gonatas, reigned from 239 to 229 B.C. He had already during his father's lifetime distinguished himself by defeating Alexander of Epirus at Derinda and so saving Macedonia (about 260). On his accession he had to face a coalition which the two great powers usually rivalled, the Aetolians and Seleucids formed against the Macedonian power. He succeeded in dividing this coalition by a clever blow - restoring Boeotia from their alliance. The revolt on in Locris, which substituted a republican league for the monarchy, greatly weakened his position. Demetrius had also to defend Macedonia against the wild hordes of the north. A battle with the Dardanian, which he distributed, led he died shortly afterwards leaving Philip, his son, and Chryseus, still a child. Formerly one of Demetrius' were Stratonice, the daughter of the Seleucid king Antiochus I, Philba, the daughter of Alexander of Cyprus and Niceta, the widow of his cousin Alexander.

See *Thirlwall Hist. of Greece*, vol. xii (1817); *Ad. Hübner Griech. Gesch.* vol. i (1811); *H. Niese Griech. u. röm. u. mittelalt. S. d. Altert.*, vol. ii (1895); *J. Beloch Griech. Gesch.*, vol. iii (1904).

DEMETRIUS, the name of three kings of Syria.

DEMETRIUS I (d. 150 B.C.), surnamed *Soter*, was sent to Rome as a hostage during the reign of his father, Seleucus IV. Philopator, but after his father's death in 175 B.C. he escaped and seized the Syrian throne (162 B.C.) after murdering King Antiochus V. Eupator. He was called *Soter*, or Saviour, by the Babylonians, whom he delivered from the tyranny of the Median satrap, Timarchus, and is famous in Jewish history for his contests with the Maccabees. Demetrius fell in battle against the usurper, Alexander Balas, in 150 B.C.

DEMETRIUS II (d. 125 B.C.), surnamed *Nicator*, son of Demetrius I, fled to Crete after the death of his father, but about 147 B.C., with the help of Ptolemy VII, Philometor, king of Egypt, regained his father's throne. In 140 B.C. he marched against Mithridates, king of Parthia, but was held captive for ten years, regaining his throne about 129 B.C. on the death of his brother, Antiochus VII, who had usurped it. But he was hated for his cruelty, and during another civil war was defeated at Damascus, and killed near Tyre. His successor was his son, Antiochus VIII. Grypus.

DEMETRIUS III (d. 88 B.C.), called *Euergetes* and *Philometor*, was the son of Antiochus VIII. Grypus. By the assistance of Ptolemy VIII. Lathyrus, king of Egypt, he recovered part of his Syrian dominions from Antiochus X. Eusebes, and held his court at Damascus. In attempting to dethrone his brother, Philip Epiphanes, he was defeated by the Arabs and Parthians, and kept prisoner in Parthia by King Mithridates until his death.

DEMETRIUS, a Cynic philosopher, born at Sumum, who lived at Corinth and in Rome during the reigns of Caligula, Nero and Vespasian. He was an intimate friend of Thrasea Paetus and Seneca. He was equally impervious to the bribes of Caligula and the anger of Vespasian who banished him. He reached the logical conclusion of Cynicism in attaching no real importance to scientific data.

DEMETRIUS, a Greek sculptor of the early part of the 4th century B.C., who is said by ancient critics to have been notable for the life-like realism of his statues. His portrait of Pelliclus, a Corinthian general, was admired by Lucian. He was contrasted with Cresilas (q.v.), an idealizing sculptor of the generation before. Since, however, the peculiarities mentioned by Lucian do not appear in Greek portraits before the 3rd century B.C., and since the Greek art of the 4th century consistently idealizes, there would seem to be a difficulty to explain. The date of Demetrius is confirmed by inscriptions found on the Athenian Acropolis (P.G.).

DEMETRIUS DONSKOI ("OF THE DON") (1350–1389), grand duke of Vladimir and Moscow, son of the grand duke Ivan Ivanovich by his second consort Alexandra, was placed on the grand-ducal throne of Vladimir by the Tatar khan in 1362, and married the princess Eudoxia of Nizhny Novgorod in 1364. He built the Kremlin of Moscow and waged war with Michael, prince of Tver, for supremacy. Demetrius was generally successful. In 1371 he won over the khan by a personal visit to the Horde, and in 1372 he defeated the Lithuanian supporters of Tver at Lyubutsk. Demetrius then formed a league of all the Russian princes against the Tatars, and in 1380 encountered them on the plain of Kulikovo, between the rivers Nepryadava and Don, where he completely routed them, the grand khan Mamai perishing in his flight from the field. But now Toktamish, the deputy of Tamerlane, organized a punitive expedition against Demetrius. Moscow was taken by treachery, and the Russian lands were again subdued by the Tatars (1381). Nevertheless, while compelled to submit to the Horde, Demetrius maintained his hegemony over Tver, Novgorod and the other recalcitrant Russian principalities, and even held his own against the Lithuanian grand dukes. Demetrius was one of the greatest of the north Russian grand dukes. He was not merely a cautious and tactful statesman, but also a valiant and capable captain, in striking contrast to most of the princes of his house.

See Sergiy Solov'ev, *History of Russia* (Rus.), vols. 1–4 (St. Petersburg, 1857), etc.; Nikolai Savelev, *Demetrius Ivanovich Donskoi* (Rus.) (Moscow 1887).

DEMETRIUS PHALEREUS (c. 345–283 B.C.), Attic orator, statesman and philosopher, born at Phalerum, was a pupil of Theophrastus and an adherent of the Peripatetic school. He governed the city of Athens as representative of Cassander (q.v.) for ten years from 317. On the restoration of the old democracy by Demetrius Poliorcetes, he was condemned to death and obliged to leave the city. He escaped to Egypt, where he was protected by Ptolemy Lagus, to whom he is said to have suggested the foundation of the Alexandrian library. Having incurred the displeasure of Lagus's successor Philadelphus, Demetrius was banished to Upper Egypt, where he died (according to some, voluntarily) from the bite of an asp. Demetrius composed a large number of works on poetry, history, politics, rhetoric and accounts of embassies, all of which are lost.

The treatise *De Euphemis* (on rhetorical expression), which is often ascribed to him, is probably the work of a later Alexandrian (1st century A.D.) of the same name, it has been edited by L. Radermacher (1901) and W. Rhys Roberts (1902), the last named providing English translation, introduction, notes, glossary and complete bibliography. Fragments in C. Müller, *Grec. Hist. Graec.* ii p. 362. See A. Holm, *History of Greece* (Eng. trans.), v. 60.

DEMETRIUS, PSEUDO- (or FALSE), the name by which three Muscovite princes and pretenders, who claimed to be Demetrius, son of Ivan the Terrible, are known in history. The real Demetrius had been murdered, while still a child, in 1591, at Uglich, his widowed mother's appanage.

1. In the reign of Tsar Boris Godunov (1598–1605), the first of these pretenders, whose real name does not have been Yuri or Gregory, first appears in history circa 1600, when his learning and assurance impressed the Muscovite patriarch Job. Tsar Boris, however, ordered him to be seized and examined, whereupon he fled to Prince Constantine Ostrozhsky at Ostrog, and subsequently entered the service of another Lithuanian, Prince Wisniowiecki, who tried to enlist the sympathy of the Polish king, Sigismund III, in his favour. The king refused to support him officially, but his cause was taken up by the Polish magnate Yuri Muszkiecki, whose daughter Marina he afterwards married. The Jesuits also seem to have believed in the man, who was evidently an unconscious impostor brought up from his youth to believe that he was the real Demetrius. Finally he set out, at the head of an army of Polish and Lithuanian volunteers, Cossacks and Muscovite fugitives, to drive out the Godunovs, after having received into the Church of Rome. At the beginning of 1604 Sigismund presented him at Cracow to the papal nuncio Rangoni. His public conversion took place on April 17. In October the false Demetrius crossed the Russian frontier, and shortly afterwards routed a large Muscovite army beneath the walls of Novgorod-Seversk. After the sudden death of Tsar Boris (April 13, 1605) the principal Russian army, under P. E. Basmanov, at once went over to him (May 7), on June 20 he made his triumphal entry into Moscow, and on July 21 he was crowned tsar by a new patriarch, the Greek Isidore. He at once proceeded to introduce a whole series of political and economic reforms. He did his best to relieve the burdens of the peasantry, he formed the project of a grand alliance between the emperor, the pope, Venice, Poland and Muscovy against the Turk, and he displayed an amazing toleration in religious matters which made people suspect that he was a crypto-Anan. But his assumption of the title of emperor, and his predilection for Western civilization, alarmed the ultra-conservative boyars (the people were always on his side), and a conspiracy was formed against him, headed by Basil Shusky, whose life he had saved a few months previously. On May 8, 1606, when Demetrius was married to Marina Muszkiecki, the boyars urged the citizens to rise against the Poles who had accompanied Marina to Moscow, while they themselves attacked and slew Demetrius in the Kremlin on the night of May 17.

See Sergey Soloviev, *History of Russia* (Rus.), vol. viii (St. Petersburg, 1857, etc.), Nikolai Kostomarov, *Historical Monographs* (Rus.) vols. iv–vi (St. Petersburg, 1863, etc.), Orest Levitsky, *The First False Demetrius or the Propaganda of Catholicism in Russia* (Rus.) (St. Petersburg, 1886), Paul Pierling, *Rome et Demetrius* (Paris, 1878), R. N. Bain, "Poland and Russia," *Cambridge Hist.* chap. 10 (Cambridge, 1907).

2. The second pretender, called "the thief of Tushino," first appeared on the scene circa 1607 at Starodub. He is supposed to have been either a priest's son or a converted Jew, and was well educated. He pretended at first to be the Muscovite boyar Nagai, but confessed, under torture, that he was Demetrius Ivanovich, whereupon he was taken at his word and joined by thousands of Cossacks, Poles and Muscovites. He captured Karachev, Bransk and other towns, was reinforced by the Poles, and in the spring of 1608 advanced upon Moscow, routing the army of Tsar Basil Shusky, at Bolkov, on his way. He entrenched him self at the village of Tushino, 12 versts from the capital, which he converted into an armed camp. In the course of the year he captured Marina Muszkiecki, who acknowledged him to be her husband (subsequently quenching her conscience by privately marrying this impostor who in no way resembled her first husband), and brought him the support of the Lithuanian magnates Muszkiecki and Sapieha so that his forces soon exceeded 100,000 men. He raised the rank of patriarch another captive, Philaret Romanov, and won over the towns of Yaroslavl, Kostroma, Volokna, Kashin and other places to his allegiance. But subsequent disasters, and the arrival of King Sigismund III, induced him to fly his camp disguised as a peasant and go to Kostroma, where Marina joined him and he lived once more in regal state. He also made another but unsuccessful attack on Moscow, and, supported by the Don Cossacks, recovered a hold over all south eastern Russia. He was killed, while half drunk, on Dec. 11, 1610, by a Tatar whom he had flattered.

See Sergey Soloviev, *History of Russia* (Rus.), vol. viii (St. Petersburg, 1857, etc.).

3. The third, a more enigmatical person than his predecessors, supposed to have been a deacon called Siderka, appeared suddenly, "from behind the river Yana," in the Ingrian town of Ivanogorod (Narva), proclaiming himself the tsarevich Demetrius Ivanovich, on March 28, 1611. The Cossacks, ravaging the environs of Moscow, acknowledged him as tsar on March 2, 1612, and under threat of vengeance in case of non compliance, the gentry of Pskov also kissed the cross to "the thief of Pskov," as he was usually nicknamed. On May 18, 1612, he fled from Pskov, was seized and delivered up to the authorities at Moscow, and there executed.

See Sergey Soloviev, *History of Russia* (Rus.), vol. viii (St. Petersburg, 1857, etc.).


DEMIDOV, the name of a famous Russian family, founded by Nikita Demidov (b. c. 1665), who was originally a blacksmith serf. He made his fortune by his skill in the manufacture of weapons, and established an iron foundry for the Government. Peter the Great, with whom he was a favourite, ennobled him in 1720. His son, Akimfy Demidov (d. c. 1740), increased his inherited wealth by the discovery and working of gold, silver and copper mines. The latter's nephew, Paul Grigoryevich Demidov (1738–1821), was a great traveller who was a benefactor of Russian scientific education, he founded an annual prize for Russian literature, awarded by the Academy of Sciences. Paul's nephew, Count Nikolai Nikitch Demidov (1774–1828), raised and commanded a regiment to oppose Napoleon's invasion, and carried on the accumulation of the family wealth from mining, he contributed liberally to the erection of four bridges in St. Petersburg, and to scientific education in Moscow. Paul's son, Prince Anatoli Demidov (1813–1870), was a well-known traveller and patron of art, he married Princess Mathilde, daughter of Jerome Bonaparte.

DEMIJOHN, a glass bottle or jar with a large round body and narrow neck, encased in wicker-work and provided with handles. The word is also used of an earthenware jar, similarly covered with wicker. The capacity of a demijohn varies from two to twelve gallons, but the common size contains five gallons. According to the *New English Dictionary* the word is an adaptation of a French *Dame Jeanne*, or Dame Jane, an application of a personal name to an object which is not uncommon.

DEMING, an incorporated town of south-western New Mexico, U.S.A., in the Mimbres valley, 35m from the Mexican border, at an altitude of 4,321 ft., the county seat of Luna county.

It is on federal highways 70, 80 and 260, is served by the Santa Fe and Southern Pacific railways and has a municipal airport. Pop was 5,667 in 1950 and 3,668 in 1940. Farming by irrigation, cattle grazing, and mining of copper, manganese, fluorspar and zinc constitute the chief industries of the region. Near by are medicinal springs, and 40 mi. N. of the city is the Gila National forest, in which is the Gila Cliff Dwellings National monument.

DEMISE, an Anglo-French legal term for a transfer of an estate, especially by lease (see **LANDLORD AND TENANT**). The phrase "demise of the Crown" is used in English law to signify the immediate transfer of the sovereignty, with all its attributes and prerogatives, to the successor without any interregnum in accordance with the maxim "the king never dies." At common law the death of the sovereign *eo facto* dissolved parliament, but this was abolished by the Representation of the People Act, 1867, s. 51. Similarly the common law doctrine that all offices held under the Crown determined at its demise has been negated by the Demise of the Crown Act, 1901.

DEMISEMIQUAVER, in music, a note of the duration of half a semiquaver, a quarter of a quaver, and so on, represented as follows:  In the German nomenclature, which, in English

equivalents, is also that employed in the United States, it is known as a *Zweundrestigstel*, or two-and-thirtieth note, being, as it is, a thirty-second part of a semibreve.

DEMIURGE (dē-mi-urj) (Gr. *dēmourgos*, artisan or handicraftsman). In Homer it includes hand-workers and heralds and physicians. In Attica the *dēmourgos* formed one of the three classes, with the Eupatridae (qv) and the *geōmoroi*, into which the early population was divided (See **EUPATRIDAE**). The word was used in the Peloponnese, with the exception of Sparta, for a higher magistrate. The *dēmourgos* represented Elis and Mantinea at the treaty of peace between Athens, Argos, Elis, and Mantinea in 420 B.C. (Thuc. v. 47). In the Achaean League (qv) the name is given to ten officers who presided over the assembly, and Corinth sent *Epideiourgos* to Potidaea.

In Plato *dēmourgos* is the name given to the "creator of the world" (*Timaeus*, 40) and the word was so adopted by the Gnostics (See **GNOSTICISM**).

DEMMIN, town in the *Land* of Prussia, Germany, on the navigable river Peene, 72 mi. WNW of Stettin, on the Berlin-Stralsund railway. Pop. (1939) 15,745. It has manufactures of textiles, and an active trade in corn and live stock.

An ancient Slav town, it was important under Charlemagne. It was besieged by a German army in 1148, and captured by Henry the Lion in 1164. In the Thirty Years' War Demmin was the object of frequent conflicts, and even after the Peace of Westphalia was taken and retaken in the contest between the electoral prince and the Swedes. It passed to Prussia in 1720, and its fortifications were dismantled in 1759.

DEMOCHARES (c. 355–275 B.C.), nephew of Demos, honest Athenian orator and statesman, was one of the few distinguished Athenians in the period of decline. He is first heard of in 322, when he spoke in vain against the surrender of Demosthenes, and the other at a Macedonian oration demanded by Antipater. During the next fifteen years he probably lived in exile. On the restoration of the democracy by Demetrius Phloretides in 307 he occupied a prominent position but was banished in 301, for having ridiculed the decree of Statorides, which contained a fulsome eulogy of Demetrius. He was recalled in 298 and during the next four years for food and equipped the city with provisions and ammunition. In 296 (or 297) he was again banished for having concluded an alliance with the Boeotians, and did not return until 287 (or 286). According to Cicero (*Brutus*, 1.63) Demochares was the author of a history of his own time, written in an oratorical rather than a historical style. As a speaker he was noted for his freedom of language (*Parthenissus Seneca De ira*, iii. 23). He was violently attacked by Timotheus, but found a strenuous defender in Polybius (xiii. 131).

See also *Plutarch Demosthenes*, 30, *Demetrius*, 22, *Isocrates* 10, *Arrian* iii. 282, *J. G. Droysens Geschichte des Demochares*, in *Zeitschrift für die Klassische Altertumswissenschaft* (1896), Nov. 26, 27.

DEMOCRACY *Historical Development*—Democracy is a form of government based upon self rule of the people and in modern times upon freely elected representative institutions and an executive responsible to the people, and a way of life based upon the fundamental assumption of the equality of all individuals and of their equal right to life, liberty (including the liberty of thought and expression), and the pursuit of happiness. Democracy has a long and ancient history, and may be regarded as the modern fruit of western civilization and of its two component elements, the Athenian and Roman legacy and the Judeo-Christian tradition. The word is derived from the Greek *δημοκρατία* from *δῆμος*, the people, and *κράτος*, rule. In his *Politics* Aristotle, critical of the decaying Athenian democracy, regarded it in one passage (Bk. iii, chap. 4, 1279b) as a purer form of that state where the citizens at large govern, because democracy considers only the poor and not the common good. In Bk. iv, chap. 4 (1290b, 1291b), he expressed his opinion differently: "We should rather say, that a democracy is when the supreme power is in the hands of the freemen, . . . a democracy is a state where the freemen and the poor, being the majority, are invested with the power of the state." And "The most pure democracy is that which is so called principally from that equality which prevails in it for this is what the law in that state directs, that the poor shall be in no greater subjection than the rich, nor that the supreme power shall be lodged with either of these, but that both shall share it. For if liberty and equality, as some persons suppose, are chiefly to be found in a democracy, it must be so by every department of government being alike open to all, but as the people are the majority, and what they vote is law, it follows that such a state must be a democracy."

Democracy was widespread in ancient Greece. Greek history in its most developed period may be regarded as a struggle between democratic and oligarchic states, of which Athens and Sparta were the most representative examples. The Athenians were the first people to try, in their empire, to form a democratic empire, not merely one possessed by a sovereign people but one bound together by common democratic constitutions and institutions. This experiment failed because, as a result of the nature of the ancient city-state, the franchise of Athenian citizens was not extended, as later in Rome, to men of non-Athenian descent. But ancient democracy was in several ways fundamentally different from that of modern times. It was direct democracy in which the whole people formed the legislator and in which the representative system was unknown. That was made possible by the limited size of the ancient state which was generally confined to a city and its rural surroundings, and counted almost never more than 10,000 citizens. In the ancient democracies every citizen was entitled to attend the legislative meetings and to vote. A very large number of the citizens held one of the many elective offices in the course of the year. No division between the legislative and the executive branch existed, but it was in the hands of the whole active citizenry, there was no development of organization. The inability of the ancients to develop a representative system made it impossible for them to create a life on the states. On the other hand, the political life in the ancient democracies was most intense and all citizens were actively interested in and highly conversant with all details of administration. Direct democracy of this kind was the ideal first envisaged by Jean Jacques Rousseau in his *Contrat social*, and it may be found to a certain extent, in the New England town meetings and in some of the smaller Swiss cantons. The referendum and the popular initiative preserved in several modern democratic constitutions, as in that of Switzerland, can be regarded as elements of direct democracy surviving in the indirect or representative democracy, which is the generally accepted form of modern times.

Another very important difference between ancient Greek democracy and modern democracy does not concern the form of government but the fundamental assumption of the equality of all individuals. Ancient democracy was not compatible with slavery, it presupposed slavery, and it was not permitted the necessary leisure for the citizens to devote themselves to questions

of public interest. Modern democracy has tended more and more to abolish all differences and privileges of birth, class, race and sex, and to broaden its basis so as to become all inclusive. The ancients had a very low estimate of labour, even of highly skilled labour, which also was performed by slaves. This attitude prevailed for a long time and characterized many feudal and post-feudal societies. Only modern industrial civilization, which arose in countries where simultaneously modern democracy developed, produced the new concept of the dignity of labour which helped to break down the barriers of privilege. It should be noted, however, that in Athens slaves were very well treated, and that the main difference between their ways of life and those of other citizens of the poorer classes was the lack of political rights. The Stoic philosophy which dominated the Roman empire and pervaded Roman law, and the emphasis put by prophetic Judaism and early Christianity on the poor and the disinherited and on the equality of all men before God, created the fundamental assumptions on which democracy could develop its faith in the essential equality of all human beings.

The middle ages were not a favourable soil for the functioning of democracy, but toward the end of that period the growing power and wealth of the cities, especially in northern Italy, provided the opportunity for a more intense cultural and social life and with it the reappearance of the spirit of liberty. It is not worthy that Niccolò Machiavelli in his *Discorsi sopra la prima decada di Tito Livio* reached the value of liberty and the superiority of republics over monarchies or tyrannies. He emphasized the fact that the common weal is observed and promoted nowhere except in republics with a free citizenry (Bk. II, chap. 2, see also Bk. I, chap. 10). These discourses contain a remarkable plea for democracy, assert that the people are wiser and more constant than a prince, and reject the contrary opinion, adding that this contrary opinion has its origin in the fact that everyone can speak ill of the people, freely and without fear, even while the people rule, while everyone speaks of the princes only with a thousand fears and a thousand considerations (Bk. I, chap. 58). While the immediate effect of the Renaissance and the Reformation was to strengthen the power of the state and of kings, in the long run they helped to prepare the soil for the growth of democracy through their emphasis on the individual and individual conscience. A new spirit of inquiry grew up, spurred on by the new discoveries and inventions, it raised man's stature in his own eyes and opened before him vast and unknown possibilities. This new spirit found its expression in Francis Bacon's experimental philosophy as well as in René Descartes's rationalism which proclaimed in his "I think, therefore I am," the sovereignty and maturity of the thinking individual.

It was a long and hard struggle which from 1640 to 1918 carried democracy to world-wide victory. Through a number of great revolutions, but even more through the unceasing toil, the unsparring efforts and the spiritual devotion of countless individuals in many countries during these three centuries, the ideas of liberty and equality gained more and more concrete form. Seventeenth-century England may be regarded as the birthplace of modern democracy. Christian and classical traditions could grow

it being thus manifest that the power of kings and magistrates is nothing else, but what is only derivative, transferred and committed to them in trust from the people, to the common good of them all" (*Defense of the People of England*). Milton identified the English people and their cause with that of individual liberty, freedom of conscience, and the dignity of reason, but this new dispensation was to be universal, the English only preceding other nations, who were soon to follow. Macaulay in his *Essay on Milton* characterized the man and his epoch.

"He lived at one of the most memorable eras in the history of mankind, at the very crisis of the great conflict between liberty and despotism, reason and prejudice. That great battle was fought for no single generation, for no single land. The destinies of the human race were staked on the same issue with the freedom of the English people. Then were first proclaimed those mighty principles which have since worked their way into the depths of the American forests, which have aroused Greece from the slavers and degradation of two thousand years, and which have kindled an unquenchable fire in the hearts of the oppressed and loosed the knees of the oppressors with an unwonted fear."

The spirit of liberalism, rationalism and optimism pervading 17th century England found its lasting expression in John Locke's *Letters on Toleration* and *Two Treatises of Government*. Locke was greatly influenced by the writings of Thomas Hooker who, writing in the spirit of medieval scholasticism, carried over the basic political doctrines of Thomas Aquinas. Locke's works were dominated by the spirit of compromise, the "live and let live" attitude of mutual respect and toleration within the common frame, which characterized liberalism and democracy. Locke formulated and expounded two basic principles: that the individual, his liberty, dignity and happiness form the foundation of all social life, and that government is a moral trust dependent upon the free consent of the governed. As a result of the two revolutions of the 17th century, England was the only country in which the power of absolutism was definitely broken, and though democracy's growth was slow, its basis had been so firmly established that England never knew any retrogression. The control of national affairs had passed into the hands of a parliament with a steadily growing preponderance of the house of commons and a steadily enlarging electorate, the liberties of the community and of the individuals were protected by a Bill of Rights, judges had become independent from the executive power, the abolition of censorship and the recognition of tolerance became acknowledged principles.

From these roots the tree of democracy grew faster in the virgin soil of the American colonies than in the mother country. Locke became "America's philosopher par excellence." The colonists struggled with the mother country as Englishmen and on the basis of their freedom as Englishmen. What was a constitutional conflict within a common heritage of 17th century liberty became the starting point for a new surge of democracy, not only as a result of the peculiar social conditions of the colonies and the absence of the classes and institutions surviving from a feudal past, but also from the influence of the new ideas of natural rights, the rule of reason, and the freedom of man, which were expressed in the pamphlets "*Common Sense*" and "*The Crisis*" of an Englishman, Thomas Paine, and which were propagated in France by the Encyclopaedists and especially by Jean Jacques Rousseau. Their spokesman in America was Thomas Jefferson who had drafted the Declaration of Independence and whose life work in the later years was to convert the United States into a democracy under the influence of the 18th century ideas. This ideological foundation, started in the American Revolution, was carried on and expanded in the three following great conflicts through which the United States passed—in the Civil War under Abraham Lincoln, in World War I under Woodrow Wilson, and in World War II under Franklin Roosevelt.

Meanwhile the American Revolution, deeply influenced by the "French ideas," in turn acted upon developments in France. French society idealized the events across the Atlantic. It saw in them the first example of a people which in its eagerness for liberty and justice had thrown off the yoke of an unjust monarchy, and had established a government based upon the enlightened principles of reason. Soon the French people were to find them-

and to argue freely according to conscience, above all liberties, (*Araopagica*), was matched by his declaration that "no man who knows ought can be so stupid to deny that all men naturally were born free, being the image and resemblance of God himself

self involved in a similar effort. Years of unprecedented turmoil shook not only the foundations of French society, but also those of all Europe. The French Revolution introduced the symbols of a new cult of liberty and human rights and coined the three words which expressed the essence of the new faith of democracy: the liberty of every individual, the equality of all men, and the brotherhood of all human beings. In the immense enthusiasm of its beginnings, age old privileges were abandoned, the new feeling of the dignity of man, of his right to self expression and self-determination, not only created new political forms but manifested itself in all fields of public and private life. The armies of the French Revolution and of Napoleon carried the new spirit all over Europe, everywhere awakening the masses from their age-old lethargy and arousing in them the will to creative participation in the political, social and cultural fields.

Though the new ideas of liberalism and democracy seemed defeated in 1814 and Europe was apparently returning to the old order of authoritarian regime, of inequality and privilege, democracy was soon to resume its growth. In the century from 1820 to 1920 it gained both in depth and in breadth. The revolution of 1830, which started in Paris in July and ended in 1832 with the English Reform bill, re-established the trend toward constitutional government with guarantees for the rights and liberties of every citizen. Its invigorating influence made itself felt in 1848, the "spring of the peoples." The new ideas penetrated into central Europe and Russia, and finally, at the beginning of the 20th century started to transform traditional life even in the Ottoman empire and in Persia, in China and in Japan. World War I was really a democratic world revolution, in which the conservative monarchies of central and eastern Europe crumbled and gave way to democratic republics, suffrage became general everywhere, and the working class began for the first time to assume the responsibilities of government. So great was the impetus which World War I gave to the development of democracy that in most nations even women received the right to vote. This democratic wave did not stop at the confines of Europe. World War I had stirred the masses of the oriental and backward countries into previously unknown demands for national self determination and for individual rights. The victory of the democratic states of western Europe and of the United States of America over the military and conservative monarchies of central Europe, and the Russian revolution of March 1917 marked, up to that date, the highest points of development for democracy. At that time democracy for the first time seemed to fulfil its world wide mission of a liberating message to all classes and to all peoples.

For democracy is not only a form of government, but also carries definite implications in the economic field. In their rise, liberalism and democracy were connected with the ascendancy of the middle classes and with the growth of industrial civilization. As social phenomena, the English revolutions of the 17th century, the American and the French revolutions of the 18th century, and the revolutions of 1830 and 1848 were largely middle class movements. Economically they served the fight against a feudal and rural economy to provide the necessary liberty of development for the rising urban economy of traders and industrialists. This new economy was based on essential liberties removing all the restrictions of the past which had hindered the free development of the individual and had kept him in stations of life to which he had been assigned by birth or tradition. All these movements had also their more radical wings which insisted, beyond individual liberty and equality before the law, upon equality of opportunity and sometimes even equality of income. Though little was accomplished in the field of "economic democracy" in these revolutions, and in most cases the problem was neither seen nor understood, the rise of democracy with its emphasis upon equality and upon each individual's right to the pursuit of happiness awakened the masses to the realization of their situation, and brought many members of the upper and middle classes to the conviction that the benefits and blessings of democracy must be extended to the economic field to become real and effective for the masses. Complaints about the shortcomings of purely political democracy were frequent at the beginning of

the 19th century. Thus the *Mechanics Free Press* in Philadelphia declared in 1829: "There appear to exist two distinct classes, the rich and the poor, the oppressor and the oppressed, those that live by their own labors and they that live by the labor of others, the aristocratic and the democratic." The aspirations for a broadening of democracy to the economic field received a growing impetus throughout the 19th century with the progress of industrialization and of urbanization. The socialist movements in the 1830s and 1840s in France culminated in the formulation of socialist demands in the *Communist Manifesto* of Karl Marx and Friedrich Engels in 1848. It maintained that the "bourgeois" society could not develop a true democracy because it remained based on the exploitation of the wage earners by the capitalists. Some years before, the Chartists in England had tried to formulate a program of complete democracy without putting any emphasis, however, upon economic demands, confident that general and equal suffrage, annual elections to parliament, indemnities to parliamentarians and other means of making the elected representation correspond as closely as possible to the popular will, would result in economic democracy. Modern socialist movements, however, believed that political means alone were not sufficient and that economic measures were necessary. As such a measure, Henry George urged in his *Progress and Poverty* the introduction of the single tax to absorb the unearned increment in land values. Though important measures have been taken in most countries after the latter part of the 19th century to democratize the economic setup and to make the economically weaker classes participate more fully in social security and in the amenities of life, nevertheless economic democracy is still far from realization.

Ultimately, democracy in its political and economic expressions will always be determined by its strength as a moral and spiritual factor dominating the public mind. Great democratic statesmen like William Ewart Gladstone in England, or great democratic popular leaders like Giuseppe Mazzini in Italy have always understood how to instill some of their own democratic fervor and moral conviction in their people and thus to keep democracy as a live issue. For democracy does not exhaust itself in political techniques or in economic reforms. It is above all a fundamental attitude, a scale of values, a definite conception of man and his place in society. Though the institutions and forms of democracy may differ widely, and in fact do so in the various countries, there are central values which underlie all forms of democracy and determine what may be called the "democratic way of life." These values have been discussed above in the historical development. Here it is only necessary to point out what may be called the method of democracy. It is the method of discussion, of open-minded critical inquiry, and finally and frequently of compromise. Democracy presupposes the existence of opposition as a legitimate partner in the democratic process, it accepts a pluralistic view of values and associations, and it rejects any totalitarian or monolithic identification of the state with one party or with one dogma. But discussion and tolerance must always be held within the framework of the democratic faith, and that means the recognition of the fundamental values of individual liberty and of the equality of all men. Tolerance toward elements which deny the fundamental assumptions of democracy and even its right to existence, would not only be theoretically inadmissible, but also practically most dangerous to the existence of democracy. Democracy has many shortcomings, some of which are inherent in its nature, they can and must be improved and modified by constant criticism and vigilant opposition, they should not be allowed to foster a spirit of unproductive criticism which in its wish to put something "better" in the place of its "inefficiency" or "corruption" or "mediocrity" generally is not clear about the alternative which turns out to be some form of old authoritarianism or master-servant relation, however streamlined it may seem. By its own essence, democracy can never be perfect, because that would presuppose a perfect citizenry, highly educated and never swayed by blind emotion or by inertia. But with all its imperfections, democracy is so far the most human and humane form devised by the growth of western civilization which

increases the dignity and the creative faculties of every individual. Its intrinsic imperfections make it the most difficult, most daring and most promising form of human organization.

With the awakening of the masses from apathy to activity, from immaturity to full stature, democracy creates a number of complex problems which have sometimes been summed up in slogans like "the revolt of the masses" or, applied to former colonial peoples, "the revolt of the east." With the broadening of education, which only a comparatively short time ago was confined to a tiny minority and today practically everywhere tends to include everyone, the level of education necessarily had to be lowered, though the gain on the whole has been immense, not only in the breadth of education imparted but also in its quality. Since their awakening from traditional inertia, the masses have been more easily swayed by emotions, the democratic process of the formation of a collective will is cumbersome and allows the full play of demagoguery and may, in times of emergency, weaken or confuse the national resolve. All these difficulties offered to some an excuse for discarding democracy and for returning to the domination of a selected group, a self-appointed elite, convinced of its divine grace mission over the "eternally immature" people. Faced by the complexities of modern life, some wished to take refuge in an apparent "security" by scrapping 300 years of social and intellectual development. Since World War I a number of movements of this kind have arisen, motivated partly by a conscious return to what Oswald Spengler has called "age old barbarism," an attitude long believed obsolete, partly by a sense of defeatism, of frustration, of discouraged cynicism. Democracy had lost its vigour to a certain extent, had become softened by a preoccupation with material progress and economic considerations. The attacks to which it found itself exposed revealed democracy and brought about a rethinking of its fundamental values and implications. The difficulties inherent in democracy were realized, but they were understood as a challenge to which the right response was a deepening and broadening of a regenerating democracy.

The conditions of the 20th century, with its new means of communication and the fast-growing interdependence of all people on a shrinking earth, faced democracy with the problem which is inherent in its conception of human brotherhood that of establishing a democratic world order which would assure universal peace and the security of democracy in the different countries. The issue had been foreseen by Immanuel Kant in his essay on *Perpetual Peace*, published in 1795 under the influence of the first great democratic revolutionary wave.

A state of peace among men who live side by side is not the natural state, which is rather to be described as a state of war. That is to say, although there is not perpetual actual open hostility, yet there is a constant threatening that an outbreak may occur. Thus a state of peace must be established. Kant said that this peace was possible only if each state were what he called "republican," possessing representative institutions, and if the law of nations were founded on a federation of free states. "The intercourse, more or less close, which has been everywhere steadily increasing between the nations of the earth, has now extended so enormously that a violation of rights in one part of the world is felt all over it. Hence the idea of a cosmopolitan right is no fantastical, high-flown notion, but a complement of the unwritten code of law—constitutional as well as international law—necessary for the public rights of mankind in general and thus for the realization of perpetual peace." What Kant foresaw about 150 years ago, what was postulated by the democrats of 1848, became in the 20th century a matter for thoughtful consideration as a precondition for the survival of democracy anywhere. Woodrow Wilson, and with him many democrats in all democratic countries, felt the need and endeavoured to meet it by the creation of a League of Nations. Its close and fundamental connection with democracy was understood by Wilson. In his appeal for it he warned, "I think we all realize that the day has come when democracy is being put upon its final test." In the last address which he broadcast on Armistice Day, 1918, he repeated, "The faith of the world can be set straight only by the firmest and most determined exhibition of the will to lead and make the right prevail." The refusal of the democratic peoples to establish a firm international order, when the victory of 1918 gave them an opportunity, their unwillingness to shoulder responsibility for the common destiny of all nations, made possible World War II which began in 1939, in which democracy was faced with an unprecedented danger fraught with almost unimaginable consequences. This greatest and bloodiest of all wars came to a close in 1945 with the fall of Germany and Japan. Through the victory of Great Britain, Russia, the United States, and their allies, a second opportunity within the 20th century was given democratic and peace-loving nations to establish democracy more firmly in the other nations of the world and, through a new world organization, to render more secure the democratic order and international peace. A long period of post war unsettlement provided many obstacles to the realization of these ideals.

Millions of people throughout the world faced starvation, hundreds

of thousands of displaced peoples sought unsuccessfully to return to their homes or to establish new homes in more stable surroundings. Suspicion among the Allied nations prevented the ready settlement of territorial disputes. Within all nations economic problems aggravated by the war brought an overpowering sense of insecurity. Democracy was confronted by another long period of trial.

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Theory and Institutions—Considered as a form of government, democracy usually confronts modern thinkers under two separate aspects as democratic theory and as democratic institutions, and this division will be followed here. Even as a theory, however, it has undergone a series of developments from the earliest times. Philosophically, it has always suffered from the apparent paradox that under it the people are at the same time both the rulers and the ruled, and thus, to many of the ancients, was rather a form of anarchy than of government. Hence Aristotle placed it in the lowest degree of legitimate governments, and the most likely to degenerate into tyranny. The modern concept of democracy, on the other hand, finally emerged as a result of the perennial search for the best and most equitable form of government. Largely as a result of the rediscovery of Aristotle himself, the Middle Ages summed up the qualities of good government under three headings: it must be rule for the common good; it must be representative of the community; and it must, in its authority, be immediately derived from the community. Still under the influence of Aristotle, however, the Middle Ages, preoccupied with the idea of unity, considered the monarchy—the rule of one—to be the best form, the one most suited to secure this unity. It is clear to us now, however, that this concept was valid only so long as the monarch was himself ruled by an interior criterion of goodness, and then only in theory. For while the absolute monarchies did not always change into tyrannies, nevertheless, in practice, and in the 15th century, in theory, as a result of the re-introduction of the

Once, however, this point of reasoning had been reached, another, and graver, question had to be settled before a sound theory of democracy could be established. If the community was to govern itself, instead of being governed by some ruler or senate, then some justification would have to be found by which the community, or an agency set up by it, would possess the moral right to impose obligations upon the citizens as a whole. The writers of the Old and New Testaments, and the fathers of the church, assumed that the authority of the ruler was in fact the authority of God Himself. Those philosophers who followed Aristotle saw the origin of authority in the natural law

which amounted to the same thing, since the natural law was deemed to be merely the law of God as discovered in man's nature by human reason. On the other hand, the lawyers, following Ulpian, held that all authority is derived immediately from the people, while admitting that ultimately it came from God the Creator. In the early Middle Ages, following Chateaugay, the authority of the ruler arose as a result of a contract between the ruler and the people, signified by a mutual exchange of oaths. In the 13th century, a synthesis was made of these various opinions, and the community was said to possess the authority from God through the natural law and to have transferred it by a contract to the ruler. There was still no question of the community normally exercising its own authority, though democracy was always considered in theory to be a legitimate form of government. Soon, however, a distinction made between a political regime and a legal regime, one in which either the people or the king was the source of law, opened the way to the rise of the absolute monarchies. Sir John Fortescue tells us in the 15th century that in his time the political regime survived only in England, while on the continent generally it was the legal regime that held sway. The influence of Machiavelli, with his rigid concept of the absolute ruler, quite universally entered into political theory. In spite of the opposition of Richard Hooker, who looked to the older European tradition for his inspiration, England at last under the Tudors and then the Stuarts succumbed to the idea of the legal regime in an exaggerated form. It was Thomas Hobbes who made himself the philosophical protagonist of this theory. Meanwhile on the continent, a reaction against absolute rule had set in in Italy and Spain under Roberto Bellarmine and Francisco Suarez, and an attempt was made by these Jesuits to restore the mediaeval doctrine of a justification of political authority by seeking its immediate origin in the community itself. In England, in turn, the old Whigs, and the writers Algernon Sidney and John Locke (q.v.), both frankly basing their contentions on the older European tradition, sought the justification of authority in the compact by which a number of human wills concurred to seek the common good. The Scottish school of common sense, under Buchanan and Reid revived in Great Britain the older concept of the natural law, by which man,

bound by his own laws, and the *lex regia* of the old Roman law was interpreted in the Middle Ages to be the law by which the people set up a ruler and established the precise limits within which he could rule. We have here, moreover, the first germs of constitutional rule, which was later to become so important in democratic theory. This development, however, was temporarily retarded by the rise of the absolute monarchies, but as Lasca has observed, if it had been allowed to continue, it would have introduced democratic institutions much sooner in the history of western Europe. It remained for the American theorists to see the precise application of constitutionalism to self-government as the only external means to ensure that the ruler or government will be wholly devoted to the common good. According to these, it is the people who give the constitution, and the appointed ruling agency is held in its administration within the rigid limits of its letter, subject to the right of the people at any time, by appropriate means, to enlarge or restrict the powers which it has granted. In this theory, again, three things are done by a constitution: the requisite consent is granted by which a people constitutes a state, a form of government is chosen and set up, and to this government, the incumbents of which are later to be elected, certain rights are granted, and at the same time, definitely limited. Thus the ancient theory of the necessity of limitation of government within the consent of the people was made actually feasible by the democratic theory of a popular constitution. The example of the American colonists in adopting a constitution was followed in the French Revolution. On the other hand, in Great Britain, the claim is also made for a constitution, on the grounds that the commons, the ruling agency, is at any time restricted by the powers which, for the occasion, the people, through its representatives, are willing to grant. Thus, in that system, while the constitution is not written, it is nevertheless considered to exist as a definite limitation of power on the ruling agency.

Other limitations, however, had to be placed upon authority before a constitutional democracy could become possible. These, like the mediaeval one of justice in the ruler, are in the internal order, but, unlike the earlier limitations, they regard the community rather than the ruler. The principles of these are two: liberty and equality. Liberty, as a political idea, has always had to struggle between two opposing concepts of its meaning. The ancient idea, as expressed, for instance, by Aristotle, Augustine and Aquinas was that liberty is the right of the members of the community to be ruled in their own interest. This remained the controlling theoretical idea of liberty for many centuries, whatever the practice may have been at various times. Later, however, and especially after the Renaissance and Reformation, another idea came in to dispute this earlier concept. At

trained under the Scottish school, took the stand of an objective obligation to obey arising from man's own nature as a social and political animal, and the consequent placing of sovereignty in the people itself. In this they were abetted in England by Edmund Burke. It remained for George Washington, in his farewell address, to express this idea in a lapidary sentence: "The very idea of the right and power of the people to establish government presupposes the duty of every individual to obey the established government." This is the ancient doctrine of the essential correlation between rights and duties. It implies a mutual responsibility between state and individual in which man, by his nature as a social animal, seeks from the state perfection as a person, and the state in its turn seeks from the individual its co-operation by which it may contribute to the perfection of every other individual. It is this concept, as expressed by George Washington and others of his time, which give to the American its distinctive character for it solved once for all the problem of the moral right of the people as a sovereign to command the people subject.

Equally important in the development of democratic theory is the evolving notion of the necessary limitations on political authority which are required if government is to realize its essential function of caring for the common good. In the early days of western civilization this limitation was purely internal and spiritual. The ruler, the representative of God and should do nothing in his regime that contravenes the will of God, that is, nothing that God would not do if He were the direct ruler. This internal sanction was a powerful incentive as long as rulers voluntarily accepted the moral teaching of the church. It persisted, as a matter of history, only as long as the influence of churches on rulers. It was a mediaeval tradition that lasted even into the American colonies, particularly Massachusetts and Virginia. In the course of time it gradually became clear that some external sanction was necessary as well. Yet, while the need for limitation was clear, the visible means to this end were not so clearly discernible. The medieval contract between people and ruler was fairly efficient. In the hands of a man like Manselot or Lautenbach it became in fact a powerful instrument for holding the ruler to his duties as a servant of the people, for by his defying of the contract, the ruler became, in this theory, no longer a king but a tyrant, and hence the people were by that very fact absolved from their allegiance to him and to his government. One of the imperial factors, political writers quite generally held, with Isidore of Seville, that the ruler is

much-quoted dictum of Pope Gregory the Great (590-604), that "all men are by nature equal" was maintained as the universal teaching to many centuries. This equality, however, remained what may be called passive equality, it meant that originally all men without exception enjoyed liberty, the right to be ruled in their own interests. It was, therefore, essentially a conscientious limitation on the power of the ruler, and was observed only when he accepted the obligations which it laid upon him. It did not formally include the right of the individual to participation in government itself. The axiom laid down by Aquinas in the 13th century that "all should have some share in the government" was new for his time and did not bear fruit for many centuries. It took long thought before western man actually saw the implications of his own teaching, and it was a teaching, of

course, that was absolutely nonexistent in the east. For this reason, political equality, even under the enlightened English theory, remained only a partial right until the 19th century, it was an equal right shared by only a portion of the population. Once again, it remained for the republican theory originating on the American continent during the colonial period to perfect a system which would make it ultimately possible for an active equality of universal participation in government to become a reality. The equality practised by the French Revolution while more extreme, was in reality a historical development posterior to the American experiment, and undoubtedly influenced by it. Even then, however, as we shall see, in practice it took a generation before universal suffrage became the ultimate conclusion from the postulate of equality.

Intimately connected with the notion of political equality in a democracy is that of social equality. In a negative sense, this latter is usually taken to mean that hereditary or financial distinctions do not entitle individuals to special privileges in public life or before the law, and particularly that social inequalities do not constitute a title to political power. Such an equality in the social sense was an achievement of both the American and French Revolutions, though inequalities did not disappear in Britain until the liberal reforms of the early 20th century. Social equality in a positive sense rather pertains to a consideration of democracy as a way of life, and is treated below. On the other hand, in recent times, a more fundamental question has been raised whether a theory of political and social equality is sufficient to constitute a real democracy. It has been argued that economic equality as well is essential to the establishment of political equality, since a wide distribution of material goods is necessary to the stability of a democratic state. Those who defend this position, however, still show a broad gradation from those who look on economic equality as merely equal economic opportunity to acquire goods, all the way to those who advocate actual equal possession of goods through the medium of membership in the all-inclusive state. Actual economic inequality has persisted, even in theory, up to our day as the controlling doctrine in democratic countries, due to the quite general identification of democracy with the 19th century theory of laissez faire or economic liberalism, by which liberty is interpreted to mean that industrial entrepreneurs, owners and employers are exempt from their purely economic activities from governmental interference. This theory has necessarily resulted in the wide inequalities of possessions and even of opportunities which give one portion of the community a disproportionate share in political power. It is for this reason that many think that democracy ultimately will be based only on the one hand by divorcing its concept from that of economic liberalism, and on the other by finding a solution somewhere in the middle between the two extremes mentioned earlier in this paragraph, namely, by creating institutions within the democratic framework in which there would not only be equal economic opportunity for all, but in which it would be guaranteed.

A further question that has been raised on the question of equality concerns the extent to which it should be applied in a democracy. Should it be restricted only to the white populations which form the controlling groups in their respective countries, or should coloured populations, at home and in the colonies, also come under its protection? In the 19th century and the early 20th, there was no question but that the home white population considered that equality applied to it alone, so that democracy appeared as the sole monopoly of the original white democratic countries, while eastern and southern Asia and Africa were implicitly excluded from it, along with indigenous

restricted to property owners. It was only gradually that voting powers were extended to all citizens as by right, and even then under various restrictions. Also, nonnaturalized members of the state in all democratic countries are considered as not possessing the right to vote, though the United States has gone so far as to include the total number of inhabitants—citizens and noncitizens—in computing the size of a constituency.

Until the early 19th century the word "democracy" was usually restricted to what was properly called "pure democracy", that is, a government in which the whole people itself exercised the direct power of legislation when gathered together at one place for that purpose. It is the town-meeting idea on a national scale. It was always clear, however, that such a kind of democracy was possible only when the group was sufficiently small to meet all at one place. In a nation of any size, it was necessary to find another means by which the people could rule without taking part in every immediate step of the process of authority. It was thus that the idea was gradually developed of choosing a certain number of agents, or representatives, who were numerous enough to take the place of the whole people and few enough to meet at one place. The mediæval Spanish cortes, the French estates general, the English commons, were examples of this kind of representation, but ordinarily for a relatively limited purpose, the holding of moneys to the monarch for his wars or public works. When with the gradual overthrow of the English monarchy, the commons assumed a political function, the theory of representation took on an entirely different form. In the American constitutional convention, many speakers denounced what they called democracy, a dictatorship of the proletariat which they attributed to the Levellers. It was for this reason that the writers of the *Federalist*, who saw what they knew as democracy was an impossibility, due to the great extent of the Atlantic coast and to the many special interests prominent in the nascent states, chose rather to give their representative system the name of republic.

The final step in the evolution of the theory of democracy, therefore, involved the settlement of the nature of representation. The mediæval notion of the ruler as representative of the community was restricted to his internal obligation to look out for its interests, and did not include the continuing power of the people to operate through him. In other words, political equality was passive, not active, it implied the right to receive the benefits of government in an equitable way, but not the right to secure those benefits for themselves by direct action. It is true that Aquinas, in consequence of his axiom that all should have a share in government, held that both the supreme ruler in the ideal state and the subordinate systems should be elective, but his thought was not generally accepted in Europe until the 16th century. Also, while it was generally held that the ruler merely exercised the authority which was the community's, there was, as Carlyle has shown, considerable debate as to whether the community actually handed over its power to the ruler, or could, under certain circumstances, recall it from him. It was not until Bellarmine and Suarez adopted the doctrine of the power of recall that continental thought generally gave hospitality to the notion, in spite of severe opposition in conservative quarters. In England, opinion was equally divided, with James I and his followers holding that power was not even derived from the people and hence could not be recalled by it, while Hooker, Coke, Sidney, Locke and the old Whigs generally held to the ancient tradition. Later, the theorists of the French Revolution, with their inherent hesitation as to whether any political authority was legitimate, except as an artificial and necessary expedient, logically extended political power to a democracy.

On the American constitution, especially the latter writing in the 1780's, in theory, as to whether "for good behaviour," that "constitution guaranteed" it was the latter theory that of the representative to his of American democratic open, for if democracy really is not sufficient that the people, even by universal enough apart to be consulted to account for their ac-

I could not be said that the hly settled. There remained that representation was it majority will of the constit- representative elected on the own best judgment as to the only accepted and it was Burke in the Bristol speech, an system, as it had been adopted by the nation. It was the theory of the lawyer, as agent for his principal, who, in his superior knowledge, experience and opportunity, is expected to take the best means to achieve the end which his client desires. Thus, in the political field, it is the constituency which adopts the end to be achieved, while the representative is expected to choose the means which he deems the best suited for that

the subject of the right of the ballot was re- vote as a privilege extended by those who already have that right to those whom it chooses to include in the right. Thus, while we usually look on the government of Britain as a democracy after the great revolution, and also consider the United States as a democracy after the adoption of the constitution, if not before, nevertheless in both countries for many generations the right of the ballot was re-

free discretion as to whom they might choose, and hence he was not the immediate choice of the people. The senate also was not immediately chosen by the general electorate of the various states, but by the state legislatures, to whom, therefore, the senators were directly responsible. Only the lower house in the American system was to be elected by popular vote. In the case of the president, and largely as a result of rigid party control, the constitutional provision has been nullified, the electors have lost their discretionary powers, and hence for all practical purposes, he is elected by a direct popular vote. Popular election of the senate was introduced by the 17th amendment (adopted 1913). Only the federal judiciary, in the American system, is theoretically independent of the will of the community, though the popular philosopher, Dooley, has expressed the current opinion, that "the supreme court follows the election returns." Due to the fact also that the supreme court justices have been ordinarily appointed at a relatively advanced age, the president who is elected for two terms or more is in a position to appoint incumbents who more or less adhere to the policy of the contemporary majority party. The United States supreme court, however, has been noted for maintaining the civil rights of individual citizens, no matter what general social or economic philosophy its members profess.

Electoral systems in a democracy have also varied in different circumstances and lands, and at different times in the same land, in accord with varying theories of the nature and extent of representation itself. No electoral system, apparently, has included the whole population. At different times, the electorate has been considered either as an attribute of citizenship, a vested privilege, an abstract right, a function of government or a means of expressing human personality, but in general it can be said that the modern tendency has been to include as far as possible all the adult population in the number of those who are entitled to express their preference for their representatives. Moreover, with the abandonment of the earlier idea that the family is the essential unit of society, it was quite in accord with this tendency that the head of the family, the husband, should lose his unique prerogative, and so women suffrage was introduced in the United States by the 19th amendment (adopted 1920) and in its complete form by Great Britain in 1928. All electoral systems in early days, including the British and American, restricted the ballot to property owners and it was only gradually that universal adult suffrage has been adopted. Meanwhile, also, constant attempts at restriction have been practised. For many years, the "grandfather clause," excluding from the polls those whose grandfathers had been slaves, was a disqualification in southern states in the U.S.A., and at present writing (1942) the poll-tax disqualification, by which the poor (mostly Negroes) are excluded from voting and jury duty in a dozen states, is a matter of intense controversy. Other restrictions have to do with registration, with extended periods of domicile in the respective voting precincts, and other similar forms of exclusion through legal means. Intimidation of rural or industrial employees has also been widely resorted to. It has always been assumed that the electoral system should be free of all special influences, and hence that the free ballot necessarily means a secret ballot. In those countries in Europe and elsewhere with democratic regimes in which the political parties themselves supply the ballot outside the polling places, this secrecy has been necessarily absent. The United States system, in which local government itself prints and supplies the ballot or a voting machine, is probably the best way to secure secrecy. Many so called plebiscites which in totalitarian countries the ruling regimes have designed to give a colour of legitimacy to their revolutionary movements have lacked secrecy, and hence freedom

third parties would give the working classes a strong balance of power, since they would draw off to themselves the influence of both main parties. As has been said, in democratic countries only those parties can in theory be tolerated which accept the democratic regime, or if they wish to change it fundamentally, aim at doing so by constitutional means. There has, however, by tacit consent been no concerted movement to test this theory, probably because such parties (Action Française in France, Communist parties in Britain and America), have never reached such proportions at the polls as to constitute a serious menace to the existing status.

A final institutional characteristic of most democracies is equal educational opportunity. While universal popular education is a relatively new institution, even in democratic countries, including the United States, it is now generally admitted that at least elementary education should keep pace with the extension of the franchise. Since theoretically the ultimate source of political power in a democracy lies in public opinion, the ability to read has always been considered a necessary qualification of the citizen of a democracy. It has usually been held, therefore, that popular education in a democracy, at least of an elementary kind, should be made compulsory by law. The democracies, however, unlike the totalitarian states, have never presumed to dictate the content of the education to be given, and so under them the schools are free.

Democracy as a Way of Life—Considered as a way of life, democracy is a subjective attitude by which the members of the community are led to secure to every one his rights, to look upon all fellow citizens without distinction of colour or race as brethren in a common enterprise, and to give spontaneous support to projects which enhance civic excellence and promote the general welfare. In this sense democracy approaches the "virtue" which the old philosophers and the Founding Fathers of America considered the principal characteristic of citizenship, and is akin to the medieval "justice" by which all members of the community were to co-operate by joint action to give each one his due. In this sense, therefore, democracy is not necessarily allied either with democratic theory or democratic institutions, but could exist under any form of government. It is, however, one of the more valid claims of democracy that only under it can these civic virtues flourish to their full extent, because only under democracy do these exist those institutions through which those virtues may exercise themselves. These institutions are a popular constitution, a parliament of some kind, universal suffrage and a disciplined party system. Through these an active equality of persons exists by which the individual citizen is associated with the process of authority. This equality places upon the individual that responsibility which in absolute systems is laid upon the ruler. The individual, therefore, as ruler, must himself possess and exercise all those virtues with which the ideal rules in all political literature has been endowed. In a sense, therefore, democracy professes a philosophy of life in somewhat the same way that the totalitarian systems of modern days profess one. However, in this philosophy is a personal freedom, freedom from the dictatorship of intellect by which the total systems maintain themselves. In other words, freedom of conscience and freedom of expression are its necessary components. Along with these freedoms, is also included economic freedom, at least if by that term is understood freedom from dictation to the political process by purely economic forces, and a more nearly equal opportunity to the members of the community to acquire the goods of the earth. (W. P. A. S., X.)

DEMOCRATIC PARTY, founded by Thomas Jefferson, the third president, is the oldest continuously existing political instrumentality in the United States. Its original name was the Republican party and the day of its birth has been fixed as May 13, 1792. A letter of that date from Jefferson to George Washington made the first authoritative claim of a name for the party, of which Jefferson had become the recognized leader. Actually the seeds were sown in the Constitutional Convention of 1787, when the first battles were fought between Hamiltonian advocates of a strong, centralized federal government and Jeffersonians who wanted the least possible federal government consistent with national security and welfare. In accord with Jeffersonian philosophy there was eventually established a party which adopted the following political principles: direct popular control of government, wide extension of suffrage and the fullest measure of personal liberty consistent with law and order, opposition to sumptuary laws, strict interpretation of the constitution and preservation of the rights of the states, opposition to centralized power in the federal government, equal rights for all, religious liberty, free speech and a free press.

Although the new party was a strong opposition force in congress, it did not obtain control of the government until Jefferson became president in 1801. For 40 years thereafter, except in 1825-29, the Democratic party was in almost continuous control. After serving two terms, Jefferson was able to obtain the nominations and elections of James Madison and James Monroe, re-

has been customary in the United States. In some countries, for instance in Great Britain, the party secretaries in preparing lists of candidates to be presented, take care that in the total number of them are contained specific representatives of the various professions and branches of industry and commerce. Another type of functional representation has been proposed by some socialist groups in which regional constituencies would be abolished, and only professional and industrial groups would be represented in legislative bodies. In Great Britain for many years, and in the United States in some localities in recent years, labour parties have been created on the theory that such

spectively, as president Madison and Monroe, both close friends and disciples of Jefferson served a total of 16 years. This 40-year Democratic rule, which included the so-called "Era of Good Feeling," was interrupted only by the election of John Quincy Adams in 1824. Adams, who served one term, was in neither the Hamilton nor the Jefferson tradition but fought bitterly with both groups in congress. He was succeeded by Andrew Jackson in 1829. In 1840 the Democrats lost to the Whigs, but on the death of Pres. William Henry Harrison in 1841, John Tyler succeeded, and he became more of a Democrat than a Whig.

The Democrats regained control in 1844, lost in 1848, came back to power in 1852 and remained in office until the historic split on the problem of slavery in 1860, followed by the Civil War.

Although Jefferson had founded the party on the principle of popular and self government, as against the Hamilton idea of control by an economic and industrial oligarchy, the so-called Virginia school of presidents were aristocrats in birth, breeding, education and environment. It was not until the election in 1828 of Andrew Jackson, a backwoodsman and warrior from Tennessee, that a man of the people entered the White House as a Democrat, to become the second great figure in the party's annals. More than 70 years later, the Democrats' most important annual celebrations became known as Jefferson-Jackson day dinners.

The Jeffersonians in effect held the party in trust for the people, whereas Jackson turned it over to them. Under him the people and the local politicians participated in public affairs and political councils. He organized the country's first political machine. One effect was introduction of the spoils system, under which federal office became a reward for activity on behalf of the party.

Jackson, a dominant and tempestuous figure, also brought the party back to Jefferson's original principles of strict interpretation of the constitution, a position which the sage of Monticello had found it necessary to abandon, notably in the purchase of Louisiana. Jackson's two great battles, which he won, were to abolish the second United States bank and to crush the defiance of the federal government by South Carolina. That state, under the leadership of Jackson's archrival, John C. Calhoun, showed its resentment against the 1828 "tariff of abominations" and a slightly modified 1832 version of the same bill by threatening to nullify this legislation and, if necessary, to secede. Jackson's Nullification proclamation, which ranks as a great state paper, proclaimed that no state had a right to withdraw from the federal union, and was a forerunner of Abraham Lincoln's similar declaration in 1861. It was during Jackson's campaigns that his followers began to call themselves Democrats, and the name was in general use in his second term.

Between 1837, when Jackson retired as an enfeebled but heroic figure, and 1860, there were four Democratic presidents whose history generally regards as mediocre—Martin Van Buren, James K. Polk, the first "dark horse" in US politics, Franklin Pierce and James Buchanan. But the real party history concerns the politicians and statesmen's futile struggle to ignore and compromise the slavery issue, and the inevitability of the north-south split. In 1850, which divided the Democrats so decisively that they did not elect a president again until 1884.

After the Van Buren administration (1837-41), the party came ever more completely under the domination of the south, which has undubitably convinced that its economic, social and political interests were bound up in the preservation and extension of slavery. The south demanded the right to extend slavery into new territories and states as the only way to prevent the great industrial state of the north and the opening way to becoming too strong in the federal government. To further this end, the Democratic party repudiated its basic principles under pressure from the south. It insisted upon the broadest possible construction of the constitution in order to force slavery on the new states or territories, and then applied to them the most rigid states rights doctrine in order to preserve slavery from constitutional and federal interference.

By 1850 the slavery question had assumed such aggravated form that it was impossible to ignore or compromise it, as had been

done in the Missouri Compromise of 1820. A final effort, however, was made in the Compromise of 1850, which was proposed by Henry Clay and accepted by both the Whigs and Democrats. On the basis of this arrangement, the Democratic conventions of 1852 and 1856 assumed that the issue had been settled. Such an assumption was proved erroneous by subsequent events. No matter how the politicians side-stepped the question in their speeches and platforms, the absorbing, popular issue was slavery. They did not recognize or reckon with such political propaganda as Harriet Beecher Stowe's *Uncle Tom's Cabin*. The final crack up came in 1860, when the highly emotional delegates assembled for the Democratic convention in Charleston, S.C. on April 23 of that year. With the fight centring about the platform, the majority report of the resolutions committee set forth the viewpoint of the south.

The majority plank declared that each new state or territory must have the right to enter the federal union on its own terms, as expressed in a constitution adopted by vote of its residents, whether it prohibited or recognized slavery. Pending adoption of a constitution, the platform declared for free settlement in new states and territories, which meant that southerners could establish themselves there with their "property," including slaves. This was a deliberate defiance of the movement to prevent an increase in the number of slave states.

When the convention rejected this resolution and adopted a minority report ignoring any specific slavery declaration, half the southern delegates walked out. The northern wing adjourned to Baltimore, Md. and nominated Stephen A. Douglas of Illinois as its presidential candidate and Herschel V. Johnson of Georgia for vice president. The southern faction met in Richmond, Va., adopted the rejected majority report on slavery and nominated John C. Breckinridge of Kentucky and Joseph Lane of Oregon by unanimous vote.

Thus stood the Democratic party, rumed and divided over a great moral issue and destined to defeat. The newly formed Republican party, which had been organized in 1854 at Jackson, Mich., won its first national victory because of its clear cut stand on the slavery question. Although Abraham Lincoln did not obtain a majority of the popular vote, he received a great majority in the electoral college because of the Democratic split.

From 1860 to 1932 the Democratic party became such a minority force that it was in executive power for only 16 years. Its defeat in 1876, however, when Samuel J. Tilden of New York, an anti-Tammany reformer, was the nominee, was questioned by those who believed that he defeated Rutherford B. Hayes. The enfranchisement of the Negro after the Civil War had two important political effects. It made the south almost unshakably Democratic, although there were defections in 1928 and 1948. It gave the Republicans a ballot box advantage in many key electoral states with a large Negro population, an advantage which persisted until the advent of Franklin D. Roosevelt in 1932.

It was not until 1884 that the Democrats won a presidential election with Grover Cleveland of New York. They lost with him in 1888, but elected him again in 1892. In 1896 the party once more split disastrously this time on the question of free silver as advocated by its candidate William Jennings Bryan of Nebraska. Through their addition to economic radicalism under the Bryan leadership the Democrats after 1896 again became a minority group for the large business, industrial and financial interests preferred the party of William McKinley and Marcus Hanna, and even looked kindly at first upon Theodore Roosevelt. The Democrats returned to power in 1913 with Woodrow Wilson, former governor of New Jersey and president of Princeton University, only because of the William Howard Taft-Theodore Roosevelt feud.

Woodrow Wilson rallied behind him the nation's idealistic youth and elderly reformers many of whom enrolled in his official family. Under the banner of the New Freedom, he urged and obtained legislation for greater federal regulation of banking and industry, including the Federal Reserve System, the Federal Trade Commission and strengthening of the antitrust statutes. Women became voters during his term in

Democratic Presidential Candidates, 1796-1952

| Elec tion date | Democratic candidate* | Popular vote | | Electoral [†] | |
|----------------------|--------------------------|--------------|------------|------------------------|-----------------|
| | | Democrat | Opponent | Dem | Opp |
| 1796 | Thomas Jefferson | (†) | (†) | 68 | 71 |
| 1800 | Thomas Jefferson | (†) | (†) | 73 [‡] | 73 [‡] |
| 1804 | Thomas Jefferson | (†) | (†) | 122 | 14 |
| 1808 | James Madison | (†) | (†) | 162 | 47 |
| 1812 | James Madison | (†) | (†) | 128 | 89 |
| 1816 | James Monroe | (†) | (†) | 183 | 34 |
| 1820 | James Monroe | (†) | (†) | 231 | 1 |
| 1824 | John Quincy Adams | 108,740 | 153,544 | 84 [‡] | 99 [‡] |
| 1828 | Andrew Jackson | 647,286 | 508,064 | 178 | 83 |
| 1832 | Andrew Jackson | 687,502 | 530,189 | 219 | 49 |
| 1836 | Martin Van Buren | 762,678 | 735,651 | 170 | 73 |
| 1840 | Martin Van Buren | 1,129,102 | 1,275,016 | 60 | 234 |
| 1844 | James K. Polk | 1,337,243 | 1,299,062 | 170 | 105 |
| 1848 | Lewis Cass | 1,220,544 | 1,360,090 | 127 | 163 |
| 1852 | Franklin B. Pierce | 1,601,274 | 1,806,580 | 254 | 42 |
| 1856 | James Buchanan | 1,838,109 | 1,341,264 | 174 | 114 |
| 1860 | Stephen A. Douglas | 1,375,157 | 1,866,452 | 12 | 180 |
| 1864 | George B. McClellan | 1,805,237 | 2,213,605 | 21 | 212 |
| 1868 | Horatio Seymour | 2,703,449 | 3,012,833 | 80 | 214 |
| 1872 | Horace Greeley | 2,834,125 | 3,597,132 | 66 [§] | 286 |
| 1876 | Samuel J. Tilden | 4,300,500 | 4,036,298 | 184 | 185 |
| 1880 | Winfield S. Hancock | 4,444,952 | 4,454,416 | 155 | 214 |
| 1884 | Grover Cleveland | 4,874,986 | 4,851,981 | 219 | 182 |
| 1888 | Grover Cleveland | 5,549,309 | 5,439,853 | 168 | 133 |
| 1892 | Grover Cleveland | 5,536,918 | 5,176,108 | 277 | 145 |
| 1896 | William J. Bryan | 6,529,095 | 7,104,779 | 176 | 271 |
| 1900 | William J. Bryan | 6,358,133 | 7,207,993 | 155 | 292 |
| 1904 | Alton B. Parker | 5,077,911 | 7,623,486 | 140 | 336 |
| 1908 | William J. Bryan | 6,409,104 | 7,678,908 | 162 | 321 |
| 1912 | Woodrow Wilson | 6,293,454 | 4,110,938 | 435 | 88 |
| 1916 | Woodrow Wilson | 9,129,660 | 8,538,221 | 277 | 254 |
| 1920 | James M. Cox | 9,147,353 | 16,152,200 | 127 | 404 |
| 1924 | John W. Davis | 8,386,593 | 15,725,016 | 136 | 382 |
| 1928 | Alfred F. Smith | 15,016,443 | 21,793,381 | 87 | 444 |
| 1932 | Franklin D. Roosevelt | 22,821,857 | 15,761,847 | 472 | 59 |
| 1936 | Franklin D. Roosevelt | 27,751,597 | 16,670,583 | 523 | 8 |
| 1940 | Franklin D. Roosevelt | 27,244,160 | 22,305,198 | 449 | 82 |
| 1944 | Franklin D. Roosevelt | 25,604,504 | 20,266,285 | 432 | 99 |
| 1948 | Harry S. Truman | 24,105,695 | 21,969,170 | 303 | 189 |
| 1952 | Adlai E. Stevenson | 27,311,316 | 33,027,549 | 89 | 442 |

*Popularly called "Republicans" up to the time of Andrew Jackson. †Electors chosen by legislatures in many states. ‡Contest decided in house of representatives. §Greeley died before electoral vote was cast. †Electors

the White House. In his second four years he mobilized the country's resources for the defeat of Germany in World War I, and was hailed throughout the world as the "saviour of democracy." He inspired creation of the well-meant but ill-fated League of Nations.

Another Democratic night descended in 1920 with the election of the Republican nominee, Warren G. Harding, over the James M. Cox-Franklin Roosevelt ticket. The voters had become disillusioned with the war's sacrifices and division among the victorious Allies. The Democrats had no inspiring leadership, and no unity on any national problem. The question of prohibition split urban and rural factions. The backwash of war and the temporary and artificial but spectacular prosperity of the 1920s kept the party out of power from 1920 to 1932.

In 1932, however, the Democrats rode to victory with Franklin D. Roosevelt, governor of New York. Hard times under Herbert Hoover contributed to a triumph in which Roosevelt carried all but six states. In 1936 the party's achievement was overwhelming, only Maine and Vermont voting Republican. Roosevelt established a precedent in 1940 when he ran for and won a third term. He carried all but ten states and received a plurality of 4,900,000 votes over Wendell L. Willkie. He won a fourth time in 1944, defeating Gov. Thomas E. Dewey of New York. Roosevelt had 432 electoral votes to Dewey's 99, but his plurality of 3,600,000 over Dewey was the smallest of his four campaigns.

Roosevelt died on April 12, 1945, at Warm Springs, Ga., and was succeeded by Vice Pres. Harry S. Truman, former senator from Missouri. Truman served out the balance of the unfinished term, and was elected on Nov. 2, 1948, defeating the Republican candidate, Thomas E. Dewey, by 303 electoral votes to 189. The

popular vote was 24,105,695 to 21,969,170, the smallest given to the Democratic nominee since the party returned to power in 1932.

Roosevelt's program, known as the New Deal, provided for collective bargaining for labour unions under federal protection, subsidy payments to farmers in return for control of production, strict regulation of banking and investment, government ownership and operation of utilities, a social security and unemployment insurance system, guarantee of bank deposits, federal loans for home building and ownership. These "reforms" were denounced as "socialism," "centralization" and "federal dictatorship." But their general popularity was reflected in his four easy victories. A great factor in these Democratic successes was that, through heavy relief and war expenditures, the depression years of 1929-37 were succeeded by a period of apparent prosperity.

Domestic reform, however, was forgotten when the Japanese bombardment of Pearl Harbor embroiled the United States in World War II on Dec. 7, 1941. Roosevelt transformed the U.S. into an "arsenal of democracy," and became the leader of the Allied forces which crushed Germany, Japan and Italy in 1945.

On his accession in April 1945, President Truman tried to expand his predecessor's New Deal into what he described as a Fair Deal. He proposed to congress such innovations as compulsory health insurance, a farm plan that would subsidize both producers and retail purchasers with public funds, a broad civil rights program, federal aid to education and numerous other expansions and controls. On all these issues he was thwarted by a coalition of Republicans and "Jeffersonian" Democrats, principally from southern states, in congress. Revelations of corruption in several executive agencies, especially the bureau of internal revenue and the Reconstruction Finance Corporation, were reminiscent of the U.S. Grant and Harding scandals. Foreign problems, especially soviet expansion and aggression, occupied Truman from 1947 on. Accepting the soviet challenge in what was then described as a "cold war," he sponsored huge loans and grants for restoration of Europe's economy, shattered by World War II, and for rearming the North Atlantic Treaty organization members. In June 1950 he ordered U.S. forces in Japan to resist a Communist invasion of South Korea.

The Democratic party's long rule of 20 years came to an end with the election of Dwight D. Eisenhower on Nov. 4, 1952, as the first Republican president since Hoover. The Democratic candidate, Adlai E. Stevenson, although strongly supported by Truman in a bitter campaign, carried only 9 states and 89 electoral votes to 442 for Eisenhower. The Democrats' unsuccessful vice presidential candidate was Sen. John Sparkman of Alabama.

(R. T. V. X)

DEMOCRITUS, probably the greatest of the Greek physical philosophers, was a native of Abdera in Thrace, or as some say—probably wrongly—of Miletus (Diog. Laert. ix. 34). Our knowledge of his life is based almost entirely on tradition of an untrustworthy kind. He seems to have been born about 470 or 460 B.C. and was, therefore, an older contemporary of Socrates. He inherited considerable property, which enabled him to travel widely in the east in search of information. In Egypt he settled for seven years, during which he studied the mathematical and physical systems of the ancient schools. The extent to which he was influenced by the Magi and the eastern astrologists is a matter of pure conjecture. He returned from his travels impoverished, one tradition says that he received 500 talents from his fellow citizens and that a public funeral was decreed him. Another tradition states that he was regarded as insane by the Abderitans and that Hippocrates was summoned to cure him. Diodorus Siculus tells us that he died at the age of 90, others make him as much as 20 years older. His works, according to Diogenes Laertius, numbered 72 and were characterized by a purity of style which compares favourably with that of Plato. In the variety of his knowledge and in the importance of his influence on both Greek and modern speculation, Democritus was the Aristotle of the 5th century, while the sanity of his metaphysical theory has led many to regard him as the equal, if not the superior, of Plato.

His views may be treated under the following heads:

1. *The Atoms and Cosmology* (adopted in part at least from the doctrines of Leucippus). While agreeing with the Eleatics on the eternal sameness of Being (nothing can arise out of nothing; nothing can be reduced to nothing), Democritus followed the physicists in denying its oneness and immobility. Movement and

plurality being necessary to explain the phenomena of the universe and impossible without space (not-Being) he asserted that the latter had an equal right with Being to be considered existent. Being is the Full (*πλήρες, plenum*), not-Being is the Void (*κενόν, vacuum*), the infinite space in which moved the infinite number of atoms into which the single Being of the Eleatics was broken up. These atoms are eternal and invisible, absolutely small, so small that their size cannot be diminished (hence the name *άτομος*, 'indivisible'), absolutely full and incompressible, they are without pores and entirely fill the space they occupy, homogeneous, differing only in figure (as A from N), arrangement (as N from NA), position (as N is Z on its side), magnitude (and consequently in weight, although some authorities dispute this). But while the atoms thus differ in quantity, their differences of quality are only apparent, due to the impressions caused on our senses by different configurations and combinations of atoms. A thing is only hot or cold, sweet or bitter, hard or soft by convention (*νόμος*), the only things that exist in reality (*εἶδος*) are the atoms and the void. Locke's distinction between primary and secondary qualities is here anticipated. Thus, the atoms of water and iron are the same, but those of the former, being smooth and round, and therefore unable to hook on to one another, roll over and over like small globes, whereas the atoms of iron, being rough jagged and uneven, cling together and form a solid body. Since all phenomena are composed of the same eternal atoms (just as a tragedy and a comedy contain the same letters) it may be said that nothing comes into being or perishes in the absolute sense of the words (*εἰ*) the modern "indestructibility of matter" and "conservation of energy"), although the compounds of the atoms are liable to increase and decrease, appearance and disappearance—in other words, to birth and death. As the atoms are eternal and uncaused, so is motion, it has its origin in a preceding motion, and so on *ad infinitum*. For the love and hate of Empedocles and the *nous* (intelligence) of Anaxagoras, Democritus substituted fixed and necessary laws (not chance, that is a misrepresentation due chiefly to Cicero). Everything can be explained by a purely mechanical (but not fortuitous) system, in which there is no room for the idea of a providence or an intelligent cause working with a view to an end. The origin of the universe was explained as follows. An infinite number of atoms was carried downwards through infinite space. The larger (and heavier), falling with greater velocity, overtook and collided with the smaller (and lighter), which were thereby forced upwards. This caused various

atoms being intercalated between two corporeal atoms. Although, in accordance with his principles, Democritus was bound to regard the soul as material (composed of round, smooth, specially mobile atoms, identified with the fire atoms floating in the air), he admitted a distinction between it and the body, and is even said to have looked upon it as something divine. These all-perceiving soul atoms exercise different functions in different organs, the head is the seat of reason, the liver of passion, the liver of desire. Life is maintained by the introduction of fresh atoms to replace those lost by exhalation and when respiration, and consequently the supply of atoms, ceases the result is death. It follows that the soul perishes with, and in the same sense as, the body.

3 Perception—Sensations are the changes produced in the soul by external impressions, and are the result of contact, since every action of one body (and all representations are corporeal phenomena) upon another is of the nature of a shock. Certain emanations (*άττοροαί, άπόρροαί*) or images (*εἰδωλά*), consisting of subtle atoms, thrown off from the surface of an object, pene-

trate the body through the pores and pass into the soul. At the same time Democritus distinguished between obscure (*ασκορία*) cognition, resting on sensation alone, and genuine (*γνησιολη*), which is the result of inquiry by reason, and is concerned with atoms and void, the only real existences. This knowledge, however, he confessed was exceedingly difficult to attain.

It is in Democritus first that we find a real attempt to explain colour. He regards black, red, white and green as primary. White is characteristically smooth, *εἰ*, casting no shadow, even, flat, black is uneven, rough, shadowy and so on. The other colours result from various mixtures of these four, and are infinite in number. Colour itself is not objective, it is found not in the ultimate *plenum* and *vacuum*, but only in derived objects according to their physical qualities and relations.

4 Theology—Democritus rejected the notion of a deity taking part in the creation or government of the universe, but yielded to popular prejudice so far as to admit the existence of a class of beings, of the same form as men, grander, composed of very subtle atoms, less liable to dissolution, but still mortal, dwelling in the upper regions of air. However, according to Plutarch, Democritus recognized one god under the form of a fiery sphere, the soul of the world, but this idea is probably of later origin. The popular belief in gods was attributed by Democritus to the desire to explain extraordinary phenomena (thunder, lightning, earthquakes) by reference to superhuman agency.

5 Ethics—Democritus's moral system—the first collection of ethical precepts which deserves the name—strongly resembles the negative side of the system of Epicurus. The *summum bonum* is the maximum of pleasure with the minimum of pain. But true pleasure is not sensual enjoyment, it has its principle in the soul. It consists not in the possession of wealth or flocks and herds, but in good humour, in the just disposition and constant tranquility of the soul. Hence the necessity of avoiding extremes, too much and too little are alike evils. (See ETHICS, HISTORY of.)

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DEMOGRAPHY, the science which deals with the statistics of health and disease, of the physical, intellectual, physiological and economical aspects of births, marriages and mortality (from Gr. *δημος*, people, and *γράφειν*, to write). The first to employ the word was Achille Guillard in his *Elements de statistique humaine ou démographie comparée* (1855), but the meaning which he attached to it was merely that of the science which treats of the condition, general movement and progress of population in civilized countries, *i.e.*, little more than what is comprised in the ordinary vital statistics, gleaned from census and registration reports. The word has come to have a much wider meaning and may now be defined as that branch of statistics which deals with the life-conditions of peoples.

DE MOIVRE, ABRAHAM (1667-1754), English mathematician of French Huguenot extraction, was born at Vitry, Champagne, on May 26, 1667. His eminence as a mathematician secured his admission into the Royal society in 1697, and also led to his being appointed by the Royal society to consider the famous dispute between Newton and Leibnitz. He was an intimate personal friend of Newton. De Moivre lived a quiet and uneventful life and died in London on Nov. 27, 1754. Two important theorems in trigonometry bear his name (See TRIGONOMETRY). The majority of his papers appeared in *Philosophical Transactions*. Among his separately published works the most important are *The Doctrine of Chances* (1716), in which he formulated the theory of recurring series, completed the theory of partial fractions, and laid down the rule for the probability of a

compound event *Miscellanea Analytica* (1730) contains his trigonometrical theorems

DEMONETIZATION, a term employed in monetary science in two different senses (a) The depriving or divesting of a metal of its standard monetary value From 1663 to 1717 silver was the standard of value in England and gold coins passed at their market value The debasement and underrating of the silver coinage insensibly brought about the demonetization of silver in England as a standard of value, and the substitution of gold During the latter half of the 19th century a great depreciation occurred in the value of silver, owing to increasing production, and, consequently, it was impossible to preserve any ratio of stability between it and gold This led to the abandonment or demonetization of the metal as a standard and to its use merely as token money (b) The withdrawal of coin from circulation, as, for example, in England that of all pre Victorian gold coins under the provisions of the Coinage Act 1889, and the royal proclamation of Nov 22, 1890

DEMONOLOGY, the branch of the science of religions which relates to superhuman beings which are not gods (*Daluvor*, demon, genius, spirit) Demons, when regarded as spirits, may either be human, or non human, separable souls, or disemate spirits which have never inhabited a body, a sharp distinction is often drawn between these two classes which are frequently conceived as producing identical results, e.g., diseases

The term includes (1) human souls regarded as genui or familiars, (2) such as receive a cult (for which see ANCESTOR WORSHIP), and (3) ghosts or other malevolent revenants, excluded are souls conceived as inhabiting another world Demons may be regarded as corporeal, since primitive peoples do not distinguish clearly between material and immaterial beings

Prevalence of Demons—All the affairs of life are supposed to be under the control of spirits, each ruling a certain element or even object, and themselves in subjection to a greater spirit A rise in culture often results in an increase in the number of spiritual beings with whom man surrounds himself

Character of Spiritual World—The ascription of malevolence to the world of spirits is by no means universal Local spirits are often regarded as inoffensive in the main, true, the passer-by must make some trifling offering as he nears their place of abode, but it is only occasionally that mischievous acts, such as the throwing down of a tree on a passer by, are, in the view of the natives, perpetrated by the spirits So, too, many of the

body of the victim (see Possession), and either dominate his mind as well as his body, inflict specific diseases, or cause pains of various sorts The demon theory of disease is still attested by some of our medical terms, epilepsy (*Gr. ἐπιδῆμις*, seizure) points to the belief that the patient is possessed As a logical consequence of this view of disease the mode of treatment among peoples in the lower stages of culture is marked by an endeavour



FROM SEKAT MALAY MAGIC (MACILLAN & CO.)
MODELS OF PENANGALAN AND LANGUIR TWO MALAY BIRTH SPIRITS (VAMPIRES)

to propitiate the evil spirits by sacrifice, to expel them by spells, etc. (see Exorcism), to drive them away by blowing, etc., and conversely to keep away small-pox by placing thorns and brushwood in the paths leading to places afflicted by that disease, in the hope of making the disease demon retrace his steps Another way in which a demon is held to cause disease is by introducing itself into the patient's body and sucking his blood (*Rivers, Medicine, Magic and Religion*)

(b) One of the primary meanings of *daemón* is that of genius (*gr.*) or familiar, tutelary spirit The animal guardian appears in the *magical* of Central America, the *yumbas* of some Australian tribes, the *manitous* of the Red Indian and the bush soul of some West African tribes All the world over it is held that the familiars of the wizard or wizard can assume the form of animals (see WITCHCRAFT)

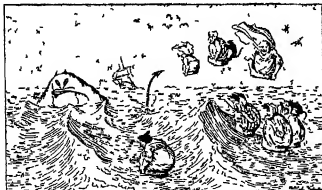
(c) The familiar is sometimes an ancestral spirit, and here we touch the fringe of the cult of the dead (see also ANCESTOR WORSHIP) Especially feared among many peoples are the souls of those who have committed suicide or died a violent death, the woman who dies in childbirth is held to become a demon of the most dangerous kind, even the unburied, as restless, dissatisfied spirits, are more feared than ordinary ghosts These are they who cannot be reborn and are permanently severed from their community They are therefore hostile Funeral rites (see DEAD DISPOSAL OF) exhibit marked variations due to this cultural attitude All spirits have power Those who are or become permanent spirits have more power and more permanency than those who are due to return The evocation of spirits, especially in the form of necromancy is an important branch of the demonology of many peoples

(d) The vampire is a particular form of demon which calls for some notice In Europe the Slavonic area is the principal seat of vampire beliefs, and as a natural development, means of preventing the dead from injuring the living have been evolved The corpse of the vampire, which may often be recognized by its unnaturally ruddy and fresh appearance, should be staked down in the grave or its head should be cut off, it is interesting to note that the cutting off of heads of the dead was a neolithic burial rite

(e) The vampire is frequently blended in popular idea with the *Poltergeist* (see PSYCHICAL RESEARCH) or knocking spirit and also with the wer-wolf (see LYCANTHROPY)

(f) Dream demons are very common, in fact the word "nightmare" (*AS. mæc*, spirit, elf) preserves this form of belief, which is found right down to the lowest culture Horses too are said to be subject to the persecutions of demons, which ride them at night Another class of nocturnal demons, the incubi and succubi, are said to consort with human beings in their sleep

(g) Corresponding to the personal tutelary spirit (*supra*, b) we have the genus of buildings and places, and a snake was a frequent form for this kind of demon The South African belief that the snakes which are in the neighbourhood of the kraal are the incarnations of the ancestors of the residents, suggests that some similar idea lay at the bottom of the Roman belief. To



FROM AN ET. INK BY GEORGE CHIFFRANK 1870 BY DUTY OF THE BUREAU OF THE BUREAU
A WITCHES FROLIC SHOWING THE DEVIL AND A PARTY OF WITCHES RIDING IN TUBS OVER A STORMY SEA ON THEIR WAY TO WRECK A SHIP

spirits especially concerned with the operations of nature are conceived as neutral or even benevolent

Classification—Besides the distinctions of human and non human, hostile and friendly, the demons in which the lower races believe are classified by them according to function, each class with a distinctive name, with extraordinary minuteness

(a) Natural causes, either of death or of disease, are hardly, if at all, recognized by the uncivilized, everything is attributed to spirits or magical influence of some sort The spirits which cause disease may be human or non human, they may enter the

this day in European folklore the house snake or toad, which lives in the cellar, is regarded as the "life index" or other self of the father of the house, the death of one involves the death of the other, according to popular belief. The assignment of genius to buildings and gates is connected with the custom of sacrificing a human being or an animal at the foundation of a building. Sometimes a similar guardian is provided for the frontier of a country or of a tribe.

(b) The animistic creed postulates the existence of all kinds of local spirits, which are sometimes tied to their habitats, sometimes free to wander. Especially prominent in Europe—classical, mediæval and modern—and in East Asia is the spirit of the lake, river, spring, or well, often conceived as human, but also in the form of a bull or horse. Less specialized in their functions are many of the figures of modern folklore, some of whom have perhaps replaced some ancient goddesses.

(c) Certain aspects of the belief in plant souls demand more detailed treatment. Outside the European area vegetation spirits of all kinds seem to be conceived, as a rule, as anthropomorphic, in classical Europe, and parts of the Slavonic area at the present day, the tree spirit was believed to have the form of a goat, or to have goats' feet.

Of special importance in Europe is the conception of the so-called "corn spirit," by which the life of the corn is supposed to exist apart from the corn itself and to take the form, sometimes of an animal, sometimes of a man or woman, sometimes of a child. The animal identified with the corn demon is sometimes killed in the spring in order to mingle its blood or bones with the seed, at harvest-time it is supposed to sit in the last corn and the animals driven out from it are sometimes killed. In other cases the reaper who cuts the last ear is said to have killed the "wolf" or the "dog," and sometimes receives the name of "wolf" or "dog" and retains it till the next harvest. The corn spirit is also said to be hiding in the barn till the corn is threshed, or it may reappear at midwinter, when the farmer begins to think of his new year of labour and harvest. Side by side with the conception of the corn spirit as an animal is the anthropomorphic view of it; and at the same time the association of gods and goddesses of corn with animal embodiments of the corn spirit is found.

(d) In many parts of the world is found the conception termed the "otiose creator," that is to say, the belief in a great

tom of expelling ghosts, spirits or evils generally. Primitive peoples from the Australians upwards celebrate, usually at fixed intervals, a driving out of hurtful influences. Sometimes it is merely the ghosts of those who have died in the year which are thus driven out, from this custom must be distinguished that of dismissing the souls of the dead at the close of the year and sending them on their journey to the other world, this latter custom seems to have an entirely different origin and is an essential part of the funerary ritual. In other cases it is believed that evil spirits generally or even non personal evils such as sins are believed to be expelled. In these customs originated perhaps the scapegoat, some forms of sacrifice (*q v*) and other cathartic ceremonies.

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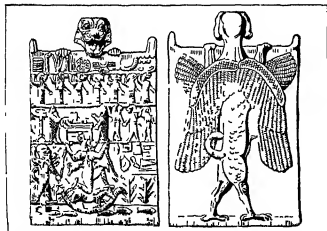
DEMONSTRATION is commonly used as the equivalent of "proof" or of "exact proof," such as is met with in mathematics or in the "exact sciences." Locke confined the possibility of demonstration to relations among abstract ideas (such as those of mathematics) and denied it to matters of fact (such as the ordinary physical events or human actions). Originally the term demonstration (or rather its Greek equivalent, *arabêstis*) was confined to propositions (whether inferential or not), the subject and predicate of which were seen to be intimately interconnected.

See H. W. B. Joseph, *Introduction to Logic* (1916).

DE MORGAN, AUGUSTUS (1806–1871), English mathematician and logician, was born at Madura in the Madras presidency. He received his early education in private schools, and before the age of 14 had learned Latin, Greek and some Hebrew, in addition to acquiring much general knowledge. At the age of 16 he entered Trinity college, Cambridge, and studied mathematics, partly under the tuition of Sir G. B. Airy. In 1825 he gained a Trinity scholarship. He was prevented from taking his M.A. degree, or from obtaining a fellowship, by his conscientious objection to signing the theological tests then required from masters of arts and fellows at Cambridge.

A career in his own university being closed against him, he entered Lincoln's Inn, but, almost at the same time, the establishment in 1828, of the University of London, in Gower street, afterwards known as University college, gave him an opportunity of continuing his mathematical pursuits. At the early age of 22 he gave his first lecture as professor of mathematics in the college which he served with the utmost zeal and success for a third of a century. His connection with the college, indeed, was interrupted in 1831 when a disagreement with the governing body caused De Morgan and some other professors to resign their chairs simultaneously. When, in 1836, his successor was accidentally drowned De Morgan was requested to resume the professorship. In 1837 he married Sophia Elizabeth, daughter of William Fred. They settled in Chelsea, where in later years Mrs. De Morgan had a large circle of intellectual and artistic friends.

As a teacher of mathematics De Morgan was unrivalled. He gave instruction in the form of continuous lectures delivered *extempore* from brief notes. His writings, however excellent, gave little idea of the perspicuity and elegance of his *viva voce* expositions. Many of his pupils distinguished themselves, and, although Isaac Todhunter and E. J. Routh, he had an important influence on the later Cambridge school. For 30 years he took an active part in the business of the Royal Astronomical Society, editing its publications, supplying obituary notices of members and for 18 years acting as one of the honorary secretaries.



FROM THE BRONZE TABLET OF THE DEATH OF THE KING OF ASSYRIA
CONVERSE AND REVERSE OF AN ANCIENT ASSYRIAN BRONZE TABLET REPRESENTING THE WORLD IN THE CLUTCHES OF AN EVIL DEMON

entity who is the author of all that exists but is too remote from the world and too high above terrestrial things to concern himself with the details of the universe. The operations of nature are conducted by a multitude of more or less obedient subordinate deities, who shade off into demons or the usual type from whom they are hardly distinguishable.

Sometimes the gods of an older religion degenerate into the demons of the belief which succeeds it. (See WITCHAMENTS.)

Expulsion of Demons—Mention must be made of the cus-

De Morgan's mathematical writings contributed powerfully towards the progress of the science. His memoirs on the "Foundations of Algebra," in the 7th and 8th volumes of the *Cambridge Philosophical Transactions*, contain important contributions to the philosophy of mathematical method. The work on *Trigonometry and Double Algebra* (1849) contains in the latter part a most luminous and philosophical view of existing and possible systems of symbolic calculus. De Morgan's long series of publications began in 1828 with a translation of part of Bourdon's *Elements of Algebra*. In 1830 appeared the first edition of his well known *Elements of Arithmetic*, which is distinguished by a simple yet thoroughly philosophical treatment of the ideas of number and magnitude, and by the introduction of new abbreviated processes of computation, to which De Morgan always attributed much practical importance. His other principal mathematical works were *The Elements of Algebra* (1835), a valuable but somewhat dry elementary treatise, *the Essay on Probabilities* (1838), forming the 107th volume of *Lardner's Cyclopaedia*, which forms a useful introduction to the subject, and *The Elements of Trigonometry and Trigonometrical Analysis, preliminary to the Differential Calculus* (1837). Two of his most elaborate treatises are to be found in the *Encyclopaedia metropolitana*, namely, the articles on the "Calculus of Functions" and the "Theory of Probabilities." De Morgan's minor mathematical writings were scattered over various periodicals. A list of these and other papers will be found in the *Royal Society's Catalogue*, which contains 42 entries under the name of De Morgan.

But it is probably as a logical reformer that De Morgan will be best remembered. In this respect he stands alongside of his great contemporaries, Sir W. R. Hamilton and George Boole, as one of several independent discoverers who enounced the principle of the quantification of the predicate. De Morgan always laid much stress upon the importance of logical training. In his admirable papers upon the modes of teaching arithmetic and geometry, originally published in the *Quarterly Journal of Education* (reprinted in *The Schoolmaster*, vol. 11), he remonstrated against the neglect of logical doctrine. In 1839 he produced a small work called *First Notions of Logic*, giving what he had found by experience to be much wanted by students commencing with Euclid. In Oct. 1846 he completed the first of his investigations, in the form of a paper printed in the *Transactions of the Cambridge Philosophical Society* (vol. viii, No. 29), which gave rise to a controversy with Sir W. R. Hamilton regarding the independence of De Morgan's discovery. The eight forms of proposition adopted by De Morgan as the basis of his system partially differ from those which Hamilton derived from the quantified predicate. The general character of De Morgan's development of logical forms was wholly peculiar and original on his part.

Late in 1847 De Morgan published his principal logical treatise, *Formal Logic, or The Calculus of Inference, Necessary and Probable*. This contains a reprint of the *First Notions*, an elaborate development of his doctrine of the syllogism, and of the numerical definite syllogism, together with chapters on probability, induction, old logical terms and fallacies. There followed at intervals, in the years 1850, 1858, 1860 and 1863, a series of four elaborate memoirs on the "Syllogism" printed in volumes ix and x of the *Cambridge Philosophical Transactions*. These papers

led him to leave University college. The refusal of the council to accept the recommendation of the senate, that they should appoint an eminent Unitarian minister to the professorship of logic and mental philosophy, revived all De Morgan's sensitiveness on the subject of sectarian freedom. In 1867 he lost his son George Campbell De Morgan, a young man of the highest scientific promise, whose name, as De Morgan expressly wished, will long be connected with the London Mathematical Society, of which he was one of the founders. From this time De Morgan rapidly fell into ill health (previously almost unknown to him), dying on March 18, 1871. An interesting and truthful sketch of his life will be found in the *Monthly Notices of the Royal Astronomical Society* for Feb. 9 1872, vol. xxii, p. 112, written by A. C. Ranby, who says, "He was the kindest as well as the most learned of men—benignant to everyone who approached him, never forgetting the claims which weakness has on strength."

It is impossible to omit a reference to his witty sayings, some specimens of which are preserved in the *Diary of Henry Crabb Robinson* (1869), which also contains a humorous account of H. C. R. by De Morgan.

A very large part of De Morgan's work is contained in periodical publications, and in encyclopaedias and works of reference. His correspondence with contemporary scientific men was very extensive, and full of interest. It remains unpublished, as does also a large mass of mathematical tracts which he prepared for the use of his students, treating all parts of mathematical science and embodying some of the matter of his lectures. De Morgan's library was purchased by Lord Overstone, and presented to the University of London.

See S. de Morgan, *Memoir of Augustus de Morgan* (1882).

DE MORGAN, WILLIAM FREND (1839-1917), artist and novelist, son of Augustus de Morgan, born in London on Nov. 16, 1839, and educated at University college and the Academy schools. He became a member of the circle which gathered round Rossetti, William Morris and Burne Jones, and experimented in various forms of decorative art. After his father's death the family settled at 30 Cheyne row, and there, in the back garden, De Morgan set up a kiln and began to make pottery. He rediscovered the secret of the brilliant blue and green glazes of the old potters, and presently formed a firm to develop the manufacture of tiles and other pottery on a commercial scale. He had an inventive genius, and nearly all the appliances of the factory were designed by him. The De Morgan ware became famous, the tiles were used for the decoration of some of the great liners, and in some cases for exterior decoration of houses. There are many fine examples of his work in the ceramic galleries of the Victoria and Albert museum, London, which also possesses a collection of his sketches. In 1905, when he was over 65, he retired from business, and began his extremely successful career as a novelist. He had written stories for recreation, and *Joseph Vance*, fragments of which had been rescued from destruction by his wife, appeared in 1906. In Charles Heath of *Alce for Short* (1907) he put, he said, "a good deal of himself." Other novels, which had a large circulation, followed. He died in London of trench fever on Jan. 15, 1917.

See Mrs A. W. M. Stirling, *William de Morgan and his Wife* (1922).

DEMOSTHENES (d. 413 B.C.), Athenian general, first appeared in 426 B.C. In this year Demosthenes and Procles led of 30 ships on a cruise round the Peloponnese first made on Leucas, but this was abandoned for want of the Aetolians, which was the first step in a race through central Greece to Phocis and Boeotia, where, who knew the country, failed him, but he arrived with 20

Hamilton aptly described it, is often to exhibit the least analogy between quantitative and qualitative reasoning, which is rather to be sought in the logical works of Boole.

In 1866 his life became clouded by the circumstances which led

then made a compact with Menedaeus to allow the Spartans to withdraw, and wiped out the remainder of the Ambraciots at Aedonenes. The result of this campaign was the complete destruction of the Corinthian sphere of influence in north-west Greece, and Demosthenes, having redeemed his early failure, could now return to Athens. In 425 he went with Eurymedon and Sophocles on an expedition towards Sicily. He was delayed at Pylos, which was fortified by the soldiers to beguile their idleness, and Demosthenes stayed there with five ships and successfully defended it against attacks from Sparta and Corcyra. The arrival of an Athenian fleet turned the besiegers into the besieged, the Spartans were blockaded in Spacetrinum, and their eventual defeat and capture was really the work of Demosthenes, though Cleon had nominally superseded him. The feature of these operations was the successful use of light infantry, a lesson which Demosthenes had learned from his early campaigns, but which no other commander during the war seems to have grasped. The year 424 saw him engaged in the abortive attack on Megara, and the equally unsuccessful invasion of Boeotia, which resulted in the battle of Delium. In 413 he was sent with Eurymedon to reinforce Nicias before Syracuse. As soon as he arrived he conducted a night attack on Epipolae. When this failed he advised immediate retreat, but was overruled by Nicias. When at last the retreat began, the division under Demosthenes fell behind, was cornered in an orchard and surrendered. Demosthenes was put to death. We know practically nothing of his political views, but Aristophanes (Eq. 423) suggests that he was leader of the party opposed to Cleon.

Βιολογία—Thucydides, ii. iv, vii, Diodorus, xi. xi, Aristophanes, Eq. 423, see the Histories of Greece, and Grundy, in *Jour. Hell. Stud.* (1896), A. W. Gomme, in *Class. Quart.*, xvi. 36 (1923).

DEMOSTHENES, the great Attic orator and statesman, was born in 384 (or 383) B.C. His father, who bore the same name, was an Athenian citizen belonging to the deme of Paeania. His mother, Cleobule, was the daughter of Gylon, a citizen who had been active in procuring the protection of the kings of Bosphorus for the Athenian colony of Nymphaeum in the Crimea, and whose wife was a native of that region. On these grounds the adversaries of Demosthenes, in after-days, used absurdly to taunt him with a traitorous or barbarian ancestry. The boy had a bitter-fore-taste of life. He was seven years old when his father died, leaving property (in a manufactory of swords, and another of upholstery) worth about £3,500, which, invested as it seems to have been (20% was not thought exorbitant), would have yielded rather more than £600 a year—a handsome, though not a great fortune. But his guardians—two nephews of his father, Aphobus and Demophon, and one Therippides—abused their trust, and handed over to Demosthenes, when he came of age, rather less than one-seventh of his patrimony, perhaps between £50 and £60 a year. Demosthenes, after studying with Isaeus (q.v.), brought an action against Aphobus, and gained a verdict for about £2,400. But it does not appear that he got the money, and, after some more fruitless proceedings against Oenoter, the brother-in-law of Aphobus, the matter was dropped, not, however, before his relatives had managed to throw a public burden (the equipment of a ship of war) on their late ward, whereby his resources were yet further straitened. He now became a professional writer of speeches or pleas (*λογισγράφοι*) for the law courts, sometimes speaking himself. Biographers have delighted to relate how, painfully, Demosthenes made himself a tolerable speaker, how, with pebbles in his mouth, he tried his lungs against the winds, how he declaimed as he ran up hill, how he shut himself up in a cell, having first guarded himself against a longing for the haunts of men by shaving one side of his head, how he wrote out Thucydides eight times, how he was deterred by the Assembly and encouraged by a judicious actor who met him moping about the Paeaeus. He certainly seems to have met him moping about the Paeaeus. He certainly seems to have been the reverse of all this. (The stalwart Achilles upbraids him with never having been a sportsman), and he probably had some sort of defect or imperfection in his speech as a boy. Perhaps the most interesting fact about his work for the law courts is that he seems to have continued it, in some measure, through the most exciting parts of

his great political career. The speech for Phormion belongs to the same year as the plea for Megalopolis. The speech against Boeotus "Concerning the Name" comes between the First Philippic and the First Olynthic.

Political Career and Creed—The political career of Demosthenes, from his first direct contact with public affairs in 355 B.C. to his death in 322, has an essential unity. It is the assertion, in successive forms adapted to successive moments, of unchanging principles. Externally, it is divided into the chapter which precedes and the chapter which follows Chaeronea. But its inner meaning, the secret of its indomitable vigour, the law which harmonizes its apparent contrasts, cannot be understood unless it is regarded as a whole. Still less can it be appreciated in all its large wisdom and sustained self-mastery if it is viewed merely as a duel between the ablest champion and the craftiest enemy of Greek freedom. The time indeed came when Demosthenes and Philip stood face to face as representative antagonists in a mortal conflict. But, for Demosthenes, the special peril represented by Philip, the peril of subjugation to Macedonia, was merely a disastrous accident. Philip happened to become the most prominent and most formidable type of a danger which was already threatening Greece before his baleful star arose. As Demosthenes said to the Athenians, if the Macedonian had not existed they would have made another Philip for themselves. Until Athens recovered something of its old spirit, there must ever be a great standing danger, not for Athens only, but for Greece—the danger that sooner or later, in some shape from some quarter, barbarian violence would break up the tradition of separate Hellenic life.

What was the true relation of Athens to Greece? The answer which he gave to this question is the key to the life of Demosthenes. Athens, so Demosthenes held, was the natural head of Greece. Not, however, as an empress holding subject or subordinate cities in a dependence more or less compulsory. Rather as that city which most nobly expressed the noblest attributes of Greek political existence. Wherever the cry of the oppressed goes up from Greece against Greece, it was the voice of Athens which should first remind the oppressor that Hellene differed from barbarian in postponing the use of force to the persuasions of equal law. Wherever a barbarian hand offered wrong to any city of the Hellenic sisterhood, it was the arm of Athens which should first be stretched forth in the holy strength of Apollo the Averter. Athens must never again seek "empire" in the sense which became odious under the influence of Cleon and Hyperboulus. Athens must aim at leading a free confederacy, of which the members should be bound to her by their own truest interests.

Such, in the belief of Demosthenes, was the part which Athens must perform if Greece was to be safe. But reforms must be effected before Athens could be capable of such a part. Athens had long been suffering from the profound decay of public spirit. Since the early years of the Peloponnesian War, the separation of Athenian society from the State had been growing more and more marked. Politics were now managed by a small circle of politicians. Wars were conducted by professional soldiers whose troops were chiefly mercenaries. The mass of the citizens took no active interest in public affairs. But, though indifferent to principles, they had quickly sensitive partialities for men, and it was necessary to keep them in good humour. Pericles had introduced the practice of giving a small bounty from the Treasury to the poorer citizens, for the purpose of enabling them to attend the theatre at the great festivals,—in other words, for the purpose of bringing them under the concentrated influence of the best Attic culture. A provision eminently wise for the age of Pericles easily became a mischief when the once honourable name of "demagogue" began to mean a flatterer of the mob. Before the end of the Peloponnesian War the festival-money (*theorikon*) was abolished. A few years after the restoration of the democracy it was again introduced. But until 354 B.C. it had never been more than a gratuity, of which the payment depended on the Treasury having a surplus. In 354 B.C. Eubulius became steward of the Treasury. His first measure was to make the festival-money a permanent item in the budget. Thenceforth this bounty was in reality very much what Demades afterwards

called it,—the cement (κόλλα) of the democracy

Forensic Speeches in Public Causes—Years before the danger from Macedon was urgent, Demosthenes had begun the work of his life—the effort to lift the spirit of Athens, to revive the old civic loyalty, to rouse the city into taking that place and performing that part which her own welfare as well as the safety of Greece prescribed. His formally political speeches must never be considered apart from his forensic speeches in public causes. The Athenian procedure against the proposer of an unconstitutional law—*νόμος*, of a law incompatible with existing laws—had a direct tendency to make the law court, in such cases, a political arena. The same tendency was indirectly exerted by the tolerance of Athenian juries (in the absence of a presiding expert like a judge) for irrelevant matter, since it was usually easy for a speaker to make capital out of the adversary's political antecedents. But the forensic speeches of Demosthenes for public causes are not only political in this general sense. They are documents, as indispensable as the Olynthiacs or Philippics, for his own political career. Only by taking them along with the formally political speeches, and regarding the whole as one unbroken series, can we see clearly the full scope of the task which he set before him,—a task in which his long resistance to Philip was only the most dramatic incident, and in which his real achievement is to be measured by the event of Chaeroneia.

A forensic speech, composed for a public cause, opens the political career of Demosthenes with a protest against a signal abuse. In 355 B.C., at the age of 20, he wrote the speech "Against Androtion." This combats on legal grounds a proposal that the out-going *Boule* should receive the honour of a golden crown. In its larger aspect, it is a denunciation of the corrupt system which that *Boule* represented, and especially of the manner in which the Treasury had been administered by Aristophon. In 354 B.C. Demosthenes composed and spoke the oration "Against Leptines," who had effected a slender saving for the State by the expedient of revoking those hereditary exemptions from taxation which had at various times been conferred in recognition of distinguished merit. He answers the advocates of the retrenchment by pointing out that the public interest will not ultimately be served by a wholesale violation of the public faith. In the same year he delivered his first strictly political speech, "On the Navy Boards" (*Symmetries*). The Athenians, irritated by the support which Artaxerxes had lately given to the revolt of their allies, and excited by rumours of his hostile preparations, were feverishly eager for a war with Persia. Demosthenes urges that such an enterprise would at present be useless, that it would fail to unite Greece, that the energies of the city should be reserved for a real emergency, but that, before the city can successfully cope with any war, there must be a better organization of resources, and, first of all, a reform of the navy.

Two years later (352 B.C.) he is found dealing with a more definite question of foreign policy. Sparta, favoured by the depression of Thebes in the Phocian War, was threatening Megalopolis. Both Sparta and Megalopolis sent embassies to Athens. Demosthenes supported Megalopolis. The rumour of Megalopolis would mean, he argued, the return of Spartan domination in the Peloponnese. Athenians must not favour the tyranny of any one city. They must respect the rights of all the cities, and thus promote unity based on mutual confidence. In the same year Demosthenes wrote the speech "Against Timocrates" to be

as it is fulsome. Athens can secure the permanence of her foreign possessions only by being strong enough to hold them.

Thus, between 355 and 352, Demosthenes had laid down the main lines of his policy. Domestic administration must be purified. Statesmen must be made to feel that they are responsible to the State. They must not be allowed to anticipate judgment on their deserts by voting each other golden crowns. They must not think to screen misappropriation of public money by getting partisans to pass new laws about State debtors. Foreign policy must be guided by a larger and more provident conception of Athenian interests. When public excitement demands a foreign war, Athens must not rush into it without asking whether it is necessary, whether it will have Greek support, and whether she herself is ready for it. When a strong Greek city threatens a weak one, and seeks to purchase Athenian connivance with the bribe of a border town, Athens must remember that duty and prudence alike command her to respect the independence of all Greeks. When it is proposed, by way of insurance on Athenian possessions abroad, to flatter the favourite of a doubtful ally, Athens must remember that such devices will not avail. Power which has no army except on paper, and no ships fit to leave their moorings.

Athens and Philip—But the time had gone by when Athenians could have tranquil leisure for domestic reform. A danger, calling for prompt action, had at last come very near. For six years Athens had been at war with Philip on account of his seizure of Amphipolis. Meanwhile he had destroyed Potidaea and founded Philippi. On the Thracian coasts he had become master of Abdera and Maroneia. On the Thessalian coast he had acquired Methone. In a second invasion of Thessaly, he had overthrown the Phocians under Onomarchus, and had advanced to Thermopylae, to find the gates of Greece closed against him by an Athenian force. He had then marched to Heraeum on the Propontis, and had dictated a peace to Cersobleptes. He had formed an alliance with Cardia, Fenestus and Byzantium. Lastly, he had begun to show designs on the great Confederacy of Olynthus, the more warlike Miletus of the North. The First Philippic of Demosthenes was spoken in 351 B.C. The Third Philippic—the latest of the extant political speeches—was spoken in 347 B.C. Between these he delivered eight political orations, of which seven are directly concerned with Philip. The whole series falls into two great divisions. The first division comprises those speeches which were spoken against Philip while he was still a foreign Power threatening Greece from without. Such are the First Philippic and the three orations for Olynthus. The second division comprises the speeches spoken against Philip when, by admission to the Amphictyonic Council, he had now won his way within the circle of the Greek States, and when the issue was no longer between Greece and Macedonia, but between the Greek and Macedonian parties in Greece. Such are the speech "On the Peace," the speech "On the Embassy," the speech "On the Chersonese," the Second and Third Philippics.

The First Philippic, spoken early in 351 B.C., was no sudden note of alarm drawing attention to an unnoticed peril. On the contrary, the assembly was weary of the subject. For six years the war with Philip had been a theme of barren talk. Demosthenes urges that it is time to do something, and to do it with a plan. Athens fighting Philip has fared, he says, like an amateur boxer opposed to a skilled pugilist. The helpless hands have only followed blows which a trained eye should have taught them to parry. An Athenian force must be stationed in the north, at Lemnos or Thasos. Of 2,000 infantry and 200 cavalry at least one quarter must be Athenian citizens capable of directing the mercenaries.

Later in the same year Demosthenes did another service to the cause of national freedom. Rhodes, severed by its own act from the Athenian Confederacy, had since 355 been virtually subject to Mausolus, prince (βασιλεύς) of Caria, himself a tributary of Persia. Mausolus died in 351, and was succeeded by his widow Artemisia. The democratic party in Rhodes now appealed to Athens for help in throwing off the Carian yoke. Demosthenes supported their application in his speech "For the Rhodians."

Athens Demosthenes points out that such adulation is as futile

No act of his life was a truer proof of statesmanship. He failed. But at least he had once more warned Athens that the cause of political freedom was everywhere her own and that, wherever that cause was forsaken, there a new danger was created both for Athens and for Greece.

Next year (350) an Athenian force under Phocion was sent to Euboea, in support of Plutarchus, tyrant of Eretria, against the faction of Cleitarchus. Demosthenes protested against spending strength, needed for greater objects, on the local quarrels of a despot. Phocion won a victory at Tamyne. But the "inglorious and costly war" entailed an outlay of more than £12,000 on the ransom of captives alone, and ended in the total destruction of Athenian influence throughout Euboea. That island was now left an open field for the intrigues of Philip. Worst of all, the party of Eubulus not only defeated a proposal, arising from this campaign, for applying the festival money to the war fund, but actually carried a law making it high treason to renew the proposal. The degree to which political enmity was exasperated by the Euboean War may be judged from the incident of Medias, an adherent of Eubulus, and a type of opulent rowdism. Demosthenes was choragus of his tribe, and was wearing the robe of that sacred office at the great festival in the theatre of Dionysus, when Medias struck him on the face. The affair was eventually compromised. The speech "Against Medias" written by Demosthenes for the trial (in 349) was neither spoken nor completed, and remains, as few will regret, a sketch.

Olynthiaics—It was now three years since, in 352, the Olynthians had made peace with Athens. In 350 a second Olynthian embassy had obtained Athenian help. In 349 Philip opened war against the Chalcidic towns of the Olynthian League. The First and Second Olynthiaics of Demosthenes were spoken in that year in support of sending one force to defend Olynthus and another to attack Philip. "Better now than later," is the thought of the First Olynthiac. The Second argues that Philip's strength is overrated. The Third—spoken in 348—carries us into the midst of action! It deals with practical details. The festival-fund must be used for the war. The citizens must serve in person. A few months later, Olynthus and the 32 towns of the confederacy were swept from the earth. Men could walk over their sites, Demosthenes said seven years afterwards, without knowing that such cities had existed. It was now certain that Philip could not be stopped outside of Greece. The question was, What point within Greece shall he be allowed to reach?

Demosthenes saw that Athens must have time to collect strength. Nothing could be gained, meanwhile, by going on with the war. Macedonian sympathizers at Athens, of whom Philocrates was the chief, also favoured peace. Eleatic envoys, including Phocion, Aeschines, and Demosthenes, were sent to Philip in February 348 B.C. After a debate at Athens, peace was concluded with Philip in April. Philip on the one hand, Athens and her allies on the other, were to keep what they respectively held at the time when the peace was ratified. But here the Athenians made a fatal error. Philip was now at war with the people of Halus in Thessaly. Thebes had for ten years been at war with Phocis. Here were two distinct chances for Philip's armed intervention in Greece. But if the Halians and the Phocians were included in the peace, Philip could not help arms against them without violating the peace. Accordingly Philip insisted that they should not be included. Demosthenes insisted they should be included. They were not included. The result followed swiftly. The same envoys were sent a second time to Philip at the end of April 346 for the purpose of renewing his oath in ratification of the peace. It was late in June when he returned from Thrace to Pella—thus gaining, under the terms, all the towns that he had taken meanwhile. He next took the envoys with him through Thessaly to Thermopylae. There—at the invitation of Thessalians and Thebans—he intervened in the Phocian

War. Phalaecus, surrendered. Phocis was crushed. Philip took its place in the Amphictyonic Council, and was thus established as a Greek power in the very centre, at the sacred hearth, of Greece. The right of precedence in consultation of the oracle (*προμαντεία*) was transferred from Athens to Philip. While indignant Athenians were clamouring for the revocation of the peace, Demosthenes upheld it in his speech "On the Peace" in September. It ought never to have been made on such terms, he said. But, having been made, it had better be kept. "If we went to war now, where should we find allies? And after losing Oropus, Amphipolis, Cardia, Chios, Cos, Rhodes, Byzantium, shall we fight about the shadow of Delphi?"

Second and Third Philippic—During the eight years between the peace of Philocrates and the battle of Chaeroneia, the authority of Demosthenes steadily grew, until it became first predominant and then paramount. He had, indeed, a melancholy advantage. Each year his argument was more and more cogently enforced by the logic of facts. In 344 he visited the Peloponnese for the purpose of countering Macedonian intrigue. Mistrust, he told the Peloponnesian cities, is the safeguard of free communities against tyrants. Philip lodged a formal complaint at Athens. Demosthenes replied in the Second Philippic. "If," he said, "Philip is the friend of Greece, we are doing wrong. If he is the enemy of Greece, we are doing right. Which is he? I hold him to be our enemy, because everything that he has hitherto done has benefited himself and hurt us." The prosecution of Aeschines for malversation on the embassy (commonly known as *De falsa legatione*), which was brought to an issue in the following year, marks the moral strength of the position now held by Demosthenes. When the gravity of the charge and the complexity of the evidence are considered, the acquittal of Aeschines by a narrow majority must be deemed his condemnation. The speech "On the Affairs of the Chersonese" and the Third Philippic were the crowning efforts of Demosthenes. Spoken in the same year, 341 B.C., and within a short space of each other, they must be taken together. The speech "On the Affairs of the Chersonese" regards the situation chiefly from an Athenian point of view. "If the peace means," argues Demosthenes, "that Philip can seize with impunity one Athenian possession after another, but that Athenians shall not on their peril touch aught that belongs to Philip, where is the line to be drawn? We shall go to war, I am told, when it is necessary. If the necessity has not come yet, when will it come?" The Third Philippic ascends from the Athenian to the Hellenic view. Philip has annihilated Olynthus and the Chalcidic towns. He has ruined Phocis. He has frightened Thebes. He has divided Thessaly. Euboea and the Peloponnese are his. His power stretches from the Adriatic to the Hellespont. Where shall be the end? Athens is the last hope of Greece. And, in this final crisis, Demosthenes was the embodied energy of Athens. It was Demosthenes who went to Byzantium, brought the estranged city back to the Athenian Alliance, and snatched it from the hands of Philip. It was Demosthenes who, when Philip had already seized Elatea, hurried to Thebes, and by his passionate appeal gained one last chance, the only possible chance, for Greek freedom, who broke down the barrier of an inveterate jealousy, who brought Thebans to fight beside Athenians, and who thus won at the eleventh hour a victory for the spirit of loyal union which took away at least one bitterness from the unspeakable calamity of Chaeroneia.

After Chaeroneia—But the work of Demosthenes was not closed by the ruin of his cause. During the last 16 years of his life (338–322) he rendered services to Athens not less important, and perhaps more difficult, than those which he had rendered before. He was now, as a matter of course, foremost in the public affairs of Athens. In Jan. 337, he spoke the funeral oration over those who had fallen at Chaeroneia. He was member of a commission for strengthening the fortifications of the city (*τειχοποιοί*). He administered the festival-fund. During a dearth which visited Athens between 330 and 326 he was charged with the organization of public relief. In 324 he was chief (*ἀρχιθεσπας*) of the sacred embassy to Olympia. Already, in 336, Ctesiphon had proposed that Demosthenes should receive a golden crown from the

¹It is generally agreed that the Third Olynthiac is the latest, but the question of the order of the First and Second has been much discussed. See Grote (*History of Greece*, chap. 38, appendix), who prefers the arrangement II., I., III.; and Blass (*Die attische Beredsamkeit*), II., p. 310.

State, and that his extraordinary merits should be proclaimed in the theatre at the Great Dionysia. The proposal was adopted by the senate as a bill (*πρόβουλευμα*), but it must be passed by the Assembly before it could become an act (*νόμος*). To prevent this, Aeschines gave notice, in 336, that he intended to proceed against Ctesiphon for having proposed an unconstitutional measure. For six years Aeschines avoided action on this notice. At last, in 330, the patriotic party felt strong enough to force him to an issue. Aeschines spoke the speech "Against Ctesiphon," an attack on the whole public life of Demosthenes. Demosthenes gained an overwhelming victory for himself and for the honour of Athens in the most finished, the most splendid and the most pathetic work of ancient eloquence "On the Crown."

In the winter of 325-324 Harpalus, the receiver general of Alexander in Asia, fled to Greece, taking with him 8,000 mercenaries, and treasure equivalent to about a million and a quarter sterling. On the motion of Demosthenes he was warned from the harbours of Attica. Having left his troops and part of his treasure at Taurunum, he again presented himself at the Pirææus, and was now admitted. He spoke fervently of the opportunity which offered itself to those who loved the freedom of Greece. All Asia would rise with Athens to throw off the hated yoke. Fiery patriots like Hyperides were in raptures. For zeal which could be bought Harpalus had other persuasions. But Demosthenes stood firm. War with Alexander would, he saw, be madness. It could have but one result—some indefinitely worse doom for Athens. Antipater and Olympias presently demanded the surrender of Harpalus. Demosthenes opposed this. But he reconciled the dignity with the loyalty of Athens by carrying a decree that Harpalus should be arrested, and that his treasure should be deposited in the Parthenon, to be held in trust for Alexander. Harpalus escaped from prison. The amount of the treasure, which Harpalus had stated as 700 talents, proved to be no more than 350. Demosthenes proposed that the Areopagus should inquire what had become of the other 350. Six months spent in party intrigues, passed before the Areopagus gave in their report (*ἀπόφασις*). The report implicated nine persons. Demosthenes headed the list of the accused. Hyperides was among the ten public prosecutors. Demosthenes was condemned, fined fifty talents, and, in default of payment, imprisoned. After a few days he escaped from prison to Aegina, and thence to Troezen. Two things in this obscure affair are beyond reasonable doubt. First, that Demosthenes was not bribed by Harpalus. The hatred of the Macedonian party towards Demosthenes, and the fury of those vehement patriots who cried out that he had betrayed their best opportunity, combined to procure his condemnation, with the help, probably, of some appearances which were against him. Secondly, it can scarcely be questioned that, by withstanding the hot-headed patriots at this juncture, Demosthenes did heroic service to Athens.

Next year (323 B.C.) Alexander died. Then the voice of Demosthenes, calling Greece to arms, rang out like a trumpet. Early in Aug. 322 the battle of Crannon decided the Laman War against Greece. Antipater demanded, as the condition on which he would refrain from besieging Athens, the surrender of the leading patriots. Demades moved the decree of the assembly by which Demosthenes, Hyperides, and some others were condemned to death as traitors. A Macedonian garrison occupied Munychia, on the 20th of Boedromion (Sept. 16) 322, the day on which, 13 years before, Alexander had punished the rebellion of Thebes with annihilation.

Death.—The condemned men had fled to Aegina. Parting there from Hyperides and the rest, Demosthenes went on to Calauria, a small island off the coast of Argolis. He sought asylum in an ancient sanctuary, the temple of Poseidon. Archias of Thuri, a man who, like Aeschines, had begun life as a tragic actor, and who was now in the pay of Antipater, soon traced the fugitive, landed in Calauria, and appeared before the temple of Poseidon with a body of Thracian spearmen. Archias was not the man to stick at sacrilege. In Aegina, Hyperides and the others had been taken from the shrine of Aæcus. But he hesitated to violate an asylum so peculiarly sacred as the Calau-

rian temple. Standing before its open door, with his Thracian soldiers around him, he endeavoured to prevail on Demosthenes to quit the holy precinct. Antipater would be certain to pardon him. Demosthenes sat silent, with his eyes fixed on the ground. At last, as the emissary persisted in his bland persuasions, he looked up and said "Archias, you never moved me by your acting, and you will not move me now by your promises." Archias lost his temper, and began to threaten. "Now," rejoined Demosthenes, "you speak like a real Macedonian oracle, before you were acting. Wait a moment, then, till I write to my friends." With these words, Demosthenes withdrew into the inner part of the temple—still visible, however, from the entrance. He took out a roll of paper, as if he were going to write, put the pen to his mouth, and bit it, as was his habit in composing. Then he threw his head back, and drew his cloak over it. The Thracian spearmen, who were watching him from the door, began to gibe at his cowardice. Archias went in to him, encouraged him to rise, repeated his old arguments, talked to him of reconciliation with Antipater. By this time Demosthenes felt that the poison which he had sucked from the pen was beginning to work. He drew the cloak from his face, and looked steadily at Archias. "Now you can play the part of Creon in the tragedy as soon as you like," he said, "and cast forth my body unburied. But I, O gracious Poseidon, quit thy temple while I yet live, Antipater and his Macedonians have done what they could to pollute it." He moved towards the door, calling to them to support his tottering steps. He had just passed the altar of the god, when he fell, and with a groan gave up the ghost (Oct. 322 B.C.).

Political Character and Oratory.—As a statesman, Demosthenes needs no epitaph but his own words in the speech "On the Crown,"—*"I say that, if the event had been manifest to the whole world beforehand, not even then ought Athens to have forsaken this course, if Athens had any regard for her glory, or for her past, or for the ages to come."* The Persian soldier in Herodotus, following Xerxes to foreseen ruin, confides to his fellow guest at the banquet that the bitterest pain which man can know is *πολλὰ φρονεῖντα μὲνός κρατέειν*,—complete, but helpless, prescience. In the grasp of a more inexorable necessity, the champion of Greek freedom was borne onward to a more tremendous catastrophe than that which strewn the waters of Salamis with Persian wrecks and the field of Plataea with Persian dead, but to him, at least, it was given to proclaim aloud the clear and sure foreboding that filled his soul, to do all that true heart and free hand could do for his cause, and, though not to save, yet to encourage, to console and to ennoble. As the inspiration of his life was larger and higher than the mere courage of resistance, so his merit must be regarded as standing altogether outside and above the struggle with Macedon. The great purpose which he set before him was to revive the public spirit, to restore the political vigour, and to reestablish the Panhellenic influence of Athens—never for her own advantage merely, but always in the interest of Greece. His glory is, that while he lived he helped Athens to live a higher life. Wherever the noblest expressions of her mind are honoured, wherever the large conceptions of Pericles command the admiration of statesmen, wherever the architect and the sculptor love to dwell on the masterpieces of Ictinus and Pheidias, wherever the spell of ideal beauty or of lofty contemplation is exercised by the creations of Sophocles or of Plato, there it will be remembered that the spirit which wrought in all these would have passed sooner from among men, if it had not been recalled from a trance by the passionate breath of Demosthenes.

The orator in whom artistic genius was united, more perfectly than in any other man, with moral enthusiasm and with intellectual grasp, has held in the modern world the same rank which was accorded to him in the old, but he cannot enjoy the same appreciation. Sincerity and intensity are, to the modern reader, the most obvious characteristics of Demosthenes. His style is, on the whole, singularly free from what we are accustomed to regard as rhetorical embellishment. Where the modern orator would employ a wealth of imagery, or elaborate a picture in exquisite detail, Demosthenes is content with a phrase or a word

Burke uses, in reference to Hyder Ali, the same image which Demosthenes uses in reference to Philip "Compounding all the materials of fury, havoc, desolation, into one black cloud, he hung for a while on the declivity of the mountains. Whilst the authors of all these evils were idly and stupidly gazing on this menacing meteor, which darkened all their horizon, it suddenly burst, and poured down the whole of its contents upon the plains of the Carnatic." Demosthenes forbears to amplify "The people gave their voice, and the danger which hung upon our borders went by like a cloud." To our modern feeling, the eloquence of Demosthenes exhibits everywhere a general stamp of earnest and simple strength. But it is well to remember the charge made against the style of Demosthenes by a contemporary Greek orator, and the defence offered by the best Greek critic of oratory. Aeschines reproached the diction of Demosthenes with excess of elaboration and adornment (*περίεργια*). Dionysius, in reply, admits that Demosthenes does at times depart from simplicity,—that his style is sometimes elaborately ornate and remote from the ordinary usage. But, he adds, Demosthenes adopts this manner where it is justified by the elevation of his theme. The remark may serve to remind us of our modern disadvantage for a full appreciation of Demosthenes. The old world, as we do, his moral and mental greatness, his fire, his self devotion, his insight. But it felt also, as we can never feel, the versatile perfection of his skill. Thus it was that made Demosthenes unique to the ancients. The ardent patriot, the far-seeing statesman, were united in his person with the consummate and unapproachable artist. Dionysius devoted two special treatises to Demosthenes,—one on his language and style (*λεκτικός τόπος*), the other on his treatment of subject-matter (*πραγματικός τόπος*). The latter is lost. The former is one of the best essays in literary criticism which antiquity has bequeathed to us. The idea which it works out is that Demosthenes has perfected Greek prose by fusing in a glorious harmony the elements which had hitherto belonged to separate types. The austere dignity of Antiphon, the plain elegance of Lysias, the smooth and balanced finish of that middle or normal character which is represented by Isocrates, have come together in Demosthenes. Nor is this all. In each species he excels the specialists. He surpasses the school of Antiphon in perspicuity, the school of Lysias in verve, the school of Isocrates in variety, in felicity, in symmetry, in pathos, in power.

Literary History of Demosthenes.—The ancient fame of Demosthenes as an orator can be compared only with the fame of Homer as a poet. Cicero, with generous appreciation, recognizes Demosthenes as the standard of perfection. Dionysius, the closest and most penetrating of his ancient critics, exhausts the language of admiration in showing how Demosthenes united and elevated whatever had been best in earlier masters of the Greek idiom. Hermogenes, in his works on rhetoric, refers to Demosthenes as *ὁ ῥήτωρ*, the orator. The writer of the treatise On Sublimity knows no heights loftier than those to which Demosthenes has risen. From his own younger contemporaries, Aristotle and Theophrastus, who founded their theory of rhetoric in large part on his practice, down to the latest Byzantines, the consent of theorists, orators, antiquarians, antiquologists and lexicographers offered the same unvarying homage to Demosthenes. His work bustled commentators such as Xenon, Minucian, Basiliscus, Aelius, Theon, Zosimus of Gaza. Arguments to his speeches were drawn up by rhetoricians so distinguished as Numenius and Libanius.

tempt was made to separate the authentic works from those spurious works which had even then become mingled with them. Philosophical schools which, like the Stoic, felt the ethical interest of Demosthenes, cared little for his language. The rhetoricians who imitated or analysed his style cared little for the criticism of his text. Their treatment of it had, indeed, a direct tendency to falsify it. It was customary to indicate by marks those passages which were especially useful for study or imitation. It then became a rhetorical exercise to recast, adapt or interweave such passages. Sopater, the commentator on Hermogenes, wrote on *μεταβολαὶ καὶ μεταρρυθνίσεις τῶν Δημοσθένους λόγων*, "adaptations or transcripts of passages in Demosthenes." Such manipulation could not but lead to interpolations or confusions in the original text. Great, too, as was the attention bestowed on the thought, sentiment and style of Demosthenes, comparatively little care was bestowed on his subject-matter. He was studied more on the moral and the formal side than on the real side. An incorrect substitution of one name for another, a reading which gave an impossible date, insertions of spurious laws or decrees, were points which few readers would stop to notice. Hence it resulted that, while Plato, Thucydides and Demosthenes were the most universally popular of the classical prose writers, the text of Demosthenes, the most widely used perhaps of all, was also the least pure. His more careful students at length made an effort to arrest the process of corruption. Editions of Demosthenes based on a critical recension, and called *Ἀττικὰν* (*αὐτὴ γραφή*), came to be distinguished from the vulgates, or *δημοδαίει εκδόσεις*.

Among the extant manuscripts of Demosthenes—upwards of 170 in number—one is far superior, as a whole, to the rest. This is *Parisinus* 2034, of the 10th century. A comparison of this ms with the extracts of Aelius Aristides and Harpocration from the Third Philippic favours the view that it is derived from an *Ἀττικαῖον*, whereas the *δημοδαίει εκδόσεις*, used by Hermogenes and by the rhetoricians generally, have been the chief sources of our other manuscripts. The collation of this manuscript by Immanuel Bekker first placed the textual criticism of Demosthenes on a sound footing. Not only is this manuscript nearly free from interpolations, but it is the sole voucher for many excellent readings. Among the other mss, some of the more important are—*Marcianus* 416 F, of the 10th (or 11th) century, the basis of the Aldine edition, *Augustanus* I (N 85), derived from the last, and containing scholia to the speeches on the Crown and the Embassy, by Ulpian, with some by a younger writer, who was perhaps Moschopolus, *Parisinus*, *Antuerpiensis*—the last two comparatively free from additions. The fullest authority on the ms is J. T. Vömel, *Notitia codicum Demosthenis*, and *Prolegomena Critica* to his edition published at Halle (1856-57), pp. 175-178.

The extant scholia on Demosthenes are for the most part poor. Their staple consists of Byzantine erudition, and their value depends chiefly on what they have preserved of older criticism. They are better than usual for the *Περὶ στέφανου*, *Κατὰ Τυμοκράτους*, best for the *Περὶ παραπρεσβείας*. The Greek commentaries ascribed to Ulpian are especially defective on the historical side, and give little essential aid. Editions.—C. W. Müller, in *Orat. Att.* i (1847-58), *Scholia Graeca in Demosthenem ex cod. aucta et emendata* (Oxon, 1851, in W. Dindorf's ed.)

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1643, was made commander in chief of the Parliamentary Army in the Midlands and lord lieutenant of Warwickshire. He resigned his command after the passing of the self-denying ordinance in April 1645. At Uxbridge (1645) and at Carisbrooke (1647) Denbigh was one of the commissioners appointed to treat with the king. He supported the army in its dispute with the parliament, but he would take no part in the trial of Charles I. Under the Commonwealth Denbigh was a member of the council of state, but later he came to be regarded as a royalist. He died without issue on Nov. 28, 1675.

His titles devolved on his nephew WILLIAM FEILDING (1640–85), son and heir of his brother George (created Baron Feilding of Lecghe, Viscount Callan and earl of Desmond), and the earldom of Desmond has been held by his descendants to the present day in conjunction with the earldom of Denbigh.

DENBIGH (*Dmbych*), municipal borough, market and county town of Denbighshire, Wales, on a branch of the L.M.S.R. Pop. (est. 1938) 7,663. Area 14.2 sq. mi. The name suggests an early fortification, *Dm* in *Dmbych* means a fort and the pre-Norman fort was called *Castell caled fryn yn Rhos*, or "the castle of the hard hill in Rhos." Denbigh castle was built in 1282 by Henry de Lacy, earl of Lincoln, from whom the town received its first charter. The outer wall is nearly a mile round. The castle was given to the Mortimers and to Leicester under Edward III and Elizabeth respectively. In 1645, after the defeat of Rowton Moor, Charles I. found shelter there. The castle long resisted the Parliamentarians. There are ruins of a Carmelite priory dating from the 13th century, a Bluecoat school (1514), a free grammar school (1527), an orphan girl school (funds left by Thomas Howell to the Drapers' Co. in Henry VII's reign), the town hall (built in 1572 by Robert Dudley, earl of Leicester, enlarged and restored in 1780), an unfinished church (begun by Leicester), and the old parish church of St. Marcella. The industries are mainly agricultural with a little quarrying. The borough of Denbigh has a separate commission of the peace, but no separate court of quarter sessions. Near Denbigh, at Bodewyddan, etc., coal is worked.

DENBIGHSHIRE (*Dmbych*), a county of the north coast of Wales, made up of two linked regions, north-west and south-east. Area 668.7 sq. mi. The north-west region is bounded west by the Conwy, along the line of which the Ordovician rocks with volcanic elements to the west (see CAERNARVONSHIRE) give place to the sharp-edged plateau of Silurian rocks, a part of the general Welsh plateau (see WALES). This region stretches east to the trough of the Vale of Clwyd, the west side of which is in Denbighshire, while the county has extensions up the Bodfari gap in the eastern wall of the vale (the Moel Famau range, with Moel Famau 1,820 ft.) and across the Clwyd farther up the valley. Flintshire borders it here on the east. The nucleus of Merionethshire is the fault valley through Corwen, Bala and Dolgellay, and consequently valleys opening into the main fault-valley are for the most part in the latter county. The north-west region of Denbighshire is thus mainly a dissected plateau draining eastward to the Clwyd, but with small portions draining to the Conwy on the west or to the upper Dee on the south. On the north coast between Old Colwyn and Llandulas is a detached fragment of Caernarvonshire, a fact related to a change in the course of the Conwy stream.

series, crops up along the Vale of Clwyd and in Eglwysseg. Resting upon this the Carboniferous limestone extends from Llanymynich, its extreme southern point, to the Cynrybrain fault, and there forks into two divisions that terminate respectively in the Great Orme's Head and in Talargoch, and are separated from each other by the denuded shales of the Moel Famau range. In the Vale of Clwyd the limestone underlies the new red sandstone, and in the eastern division it is itself overlaid by the millstone grit of Ruabon and Minera, and by a long reach of the coal measures which, near Wrexham, are $\frac{1}{2}$ m. in breadth. Eastward of these a broad strip of the red marly beds succeeds, and between this and the Dee the ground is occupied—as in the Vale of Clwyd—by the new red rocks. The red sandstone areas form the best agricultural land. The eastern flank of the county is less sharp as it grades down to the coalfield west of the Dee. These coal measures have been extensively worked, with Rhos, Wrexham and Ruabon as centres. From the limestone below, lead, with silver and zinc ores, have been obtained. Valuable fireclays and terra-cotta marls are also taken from the coal measures about Wrexham. As in other northern counties of Wales, the whole of the lower ground is covered more or less thickly with glacial drift. On the western side of the Vale of Clwyd, at Cefn and Plas Heaton, the caves, a common feature in such limestone districts, have yielded the remains of the rhinoceros, mammoth, hippopotamus and other mammals now extinct in Britain.

Archaeology.—The period of earliest occupation of the region by man is still very doubtful. The high ground is dotted by tumuli, but only one beaker pot has been recorded. Finds of early gold and socketed axes dating from the late Bronze age are more numerous, indicating that the upper Dee valley and the Vale of Clwyd had become important lines of movement by this time. The native hill fortresses and Roman statues of later times show the importance of the North Wales coastal route. A great native hill-fortress was Dinorben (see Willoughby Gardner, "The Native Hill-forts of North Wales and their Defences," *Archaeologia Cambrensis*, vol. lxxxi, part 2, Dec. 1926). It seems clear that these native fortresses protected routes, and, whatever their original date, they received much attention during the Roman period. Roman roads ran from Chester via Flint through the north of the county to St. Asaph, and thence on to Kanovum and Segontium (Caernarvon). Another line was via Ffrith and the south of the county to the Bala cleft and the Caergrai station. Clawdd Coch has traces of the Romans, so also has Penygae and Penbarras. To their period belong the inscribed Gwyntherin and Pentreolaes (near Bettws-y-coed) stones. The Valle Crucis, "Elise's pillar," tells of Brochmael and the Carlegion (Chester) struggle against Aethelfrith's invading Northumbrians, A.D. 613, while Offa's dike goes back to the Merican advance. The south-east of the county includes a considerable section of this dike as well as of the smaller and parallel Watt's dike (see Fox, *Archaeologia Cambrensis*, vol. lxxxi, part 1, June, 1926).

History.—After the Edwardian conquest Denbigh castle was built by Henry de Lacy, earl of Lincoln, and Ruthin castle probably by Hugh, earl of Chester. The rolls of the Court of Ruthin are complete from 1294, and are now in the National Library of Wales, Aberystwyth. Owen Glendower failed to take Ruthin in 1400. In the south-east of the county Chirk castle was founded

the great families were features of the county, which developed considerably under the Nonconformist influences of the 18th century.

Oak wood lofts and screens, a feature of southwest England, the Welsh border and Montgomeryshire, are found at Llanrwst, Grestford and Derwen Gresford and Llanrhaadr (Dyffryn Llanrwst Clwyd) have stained glass.

Industries and Occupations.—The great extent of moorland area has confined the agricultural output of the county. A little wheat is grown in the lowlands but 12 times as much oats (1939). Turnips and swedes are also important crops. Large flocks of sheep are pastured on the hillsides, and many black cattle are reared for fattening in the midlands of England and for sale in London. Large numbers of pigs are also kept. Other industries formerly of greater importance than at present include slate quarrying, lead mining and woollen manufacture. Nantglyn prepares paving flags, Rhiwfelen (near Llangollen), slabs and slates, while good slates are also obtained at Glyn Cernog. There is plenty of limestone with china stone at Brymbo. Cefn Rhiwabon yields sandstone (for hones) and millstone grit. The great Minera mine has produced great quantities of lead ore. Woollen manufactures centre around Llangollen and Llanystumdaf (St. Bridget's). The extensive development of coal mining in the south-east of the county in the latter half of the 19th century transformed the old world market towns of Chirk, Ruabon and Wrexham into coal mining and industrial centres. The proximity of the Lancashire and Staffordshire industrial areas ensures a market for the coal.

The development of the industrial area (south east) with its new populations and new ideas, provided a social and political contrast against the other section of Denbighshire (north-west) which remained rural and agricultural. These distinct geographical and social units illustrate the difficulty of the county as an administrative unit. The Denbighshire technical college is open to students resident in Flint and Merioneth.

Communications.—The Holyhead road to London, a one-time famous coaching route, runs down the Llangollen valley. The LMS railway (Holyhead line), with the Conway and Clwyd valleys branches, together with the lines connecting Denbigh with Ruabon (Rhiwabon), via Ruthin and Corwen, Wrexham with Connah's Quay (LNE railway) and Rhosllanerchrugog with Glyn Cernog (for the Great Western and LNE railways) opened up the county.

The area of the administrative county is 668.7 sq mi., with a population (est. 1938) of 156,840. Wartime movements caused an increase of 11% in the county between Sept. 1939 and Feb. 1941. The chief towns are Colwyn Bay, Denbigh, Ruthin and Wrexham, the municipal boroughs, and Abergele, Llangollen and Llanrwst, the urban districts. There are five rural districts. The county has two parliamentary divisions. Denbighshire is in the north Wales circuit, assizes being held at Ruthin. Denbigh and Wrexham boroughs have separate commissions of the peace, but no separate quarter session courts. There are ten petty sessional divisions. The county is in the diocese of St. Asaph.

DENDERA, a village in Upper Egypt, situated in the angle of the great westward bend of the Nile opposite Kena. Here was the ancient city of Tentyra, capital of the Tentyrite nome, the sixth of Upper Egypt and the principal seat of the worship of Hathor (Aphrodite), the cow-goddess of love and joy. The temple of Hathor was built in the 1st century B.C., being begun under the later Ptolemies and finished by Augustus, but much of the decoration is later. A great rectangular enclosure of crude bricks, measuring about 900x80 ft., contains the sacred buildings, it was entered by two stone gateways, in the north and the east sides, built by Domitian. Another smaller enclosure lies to the east with a gateway, also of the Roman period.

The temple building, which is of sandstone, measures about 300 ft. from front to back, and consists of two oblong rectangles, the foremost, placed transversely to the other, is the great hypostyle hall or pronaos, the broadest and loftiest part of the temple, measuring 135 ft. in width, and comprising about one third of the whole structure, the façade has six columns with heads of

Hathor, and the ceiling is supported by 18 great columns. The second rectangle contains a small hypostyle hall with six columns, and the sanctuary, with their subsidiary chambers. The sanctuary is surrounded by a corridor into which the chambers open, on the west side is an apartment forming a court and kiosk for the celebration of the feast of the New Year, the principal festival of Dendera. On the roof of the temple, reached by two staircases, are a pavilion and several chambers dedicated to the worship of Osiris. Inside and out the whole of the temple is covered with scenes and inscriptions in crowded characters, of ceremonial and religious import, the decoration is even carried into a remarkable series of hidden passages and chambers or crypts made in the solid walls for the reception of its most valuable treasures. North-east of the entrance is a "Birth House" for the cult of the child Harsemteu, and behind the temple a small temple of Isis, dating from the reign of Augustus. Petrie's excavation of the cemetery behind the temple enclosures revealed burials dating from the fourth dynasty onwards, the most important being *mastabas* of the period from the sixth to the 11th dynasties, many of these exhibited a peculiar degradation of the contemporary style of sculpture.

One of the zodiacs of the temple, from a chamber on the roof, was removed in 1820 to the Bibliothèque Nationale in Paris. Figures of the celebrated Cleopatra VI. occur amongst the sculptures on the exterior of the temple, but they are purely conventional, without a trace of portraiture. Horus of Edfu, the enemy of the crocodiles and hippopotami of Set, appears sometimes as the consort of Hathor of Dendera. Juvenal, in his 17th satire, takes as his text a religious riot between the Tentyrites and the neighbouring Ombites, and Sir Flinders Petrie has shown that the Ombos in question was opposite Cosme, only about 15 m. from Tentyra, where the hippopotamus sacred to Set was venerated.

DENDERMONDE *see* TERMONDE

DENDRITE The fibrous process of a nerve-cell or neuron which conducts impulses toward the cell body. The dendrites of a given neuron differ in several ways from the axon, which is the fibrous process conducting away from the cell body. There may be several dendrites, whereas ordinarily there is but a single axon fibre, and the dendrites are usually arranged in branching form (hence the derivation of the term from the Greek word, *δένδρον*, meaning "tree").

See also NERVOUS SYSTEM, C. J. Herrick, *Neurological Foundations of Animal Behavior*.

DENE-HOLES, the name given to certain caves or excavations in England, popularly but incorrectly attributed to the Danes. The word however is probably derived from the Anglo-Saxon *den*, a hole or valley. There are many underground excavations in the chalk districts of the south of England, but true deneholes are found chiefly in those parts of Kent and Essex along the lower banks of the Thames.

The general outline is invariably the same. The entrance is a vertical shaft, some 3 ft. in diameter, falling sometimes to a depth of 60 ft. The depth is regulated by the depth of the chalk from the surface, but although chalk could have been obtained close at hand within a few feet, or even inches, from the surface, a depth of from 45 to 80 ft., or more, is a characteristic feature. The shaft, when the chalk is reached, widens out into a domed chamber with a roof of chalk some 3 ft. thick. The walls frequently contract somewhat as they approach the floor. As a rule there is only one chamber, from 16 to 18 ft. in height, beneath each shaft. From this excessive height it has been inferred that the caves were not primarily intended for habitations or even hiding places. In some cases the chamber is extended, the roof being supported by pillars of chalk left standing. In a rare specimen of a twin chamber discovered at Gravesend, the one entrance served for both caves, although a separate aperture connected them on the floor level. Where galleries are found connecting the chambers, forming a bewildering labyrinth, they are usually the work of a people of a much later period than that of the chambers.

Isolated specimens have been discovered in various parts of Kent, Essex, Hants and Berks, but the most important groups are at Grays Thurrock, in the districts of Woolwich, Abbey Wood and

Bexley and Gravesend. Some of the Chislehurst caves may have been begun as dene holes, but if so, they have been so enlarged and altered that their original character has been obliterated.

The tool work on the roof or ceiling is generally rougher than that on the walls, where an upright position could be maintained. Casts taken of some of the pick holes near the roof show that, in all probability they were made by bone or horn picks. And numerous bone picks have been discovered in Essex and Kent. These pick holes have assisted in fixing the date of their formation to pre-Roman times. Very few relics of archaeological value have been discovered in any of the known dene holes, to assist in fixing the date or determining their uses. Pliny mentions pits sunk to a depth of a hundred feet, "where they branched out like the veins of mines." This has been used in support of the explanation that dene holes were wells sunk for the extraction of chalk. Chretien de Troyes has a passage on underground caves in Britain which may refer to dene holes, and tradition of the 14th century treated the dene-holes of Grays as the fabled gold mines of Cunobeline (or Cymbeline) of the 1st century. Vortigern's caves at Margate are possibly dene holes adapted by later peoples to other purposes, and excellent examples of various pick holes may be seen on different parts of the walls. Local tradition associates these caves with smugglers, and since illicit trade was common both on the coast and in the Thames up to Barking Creek, the theory is tenable.

There are three purposes for which dene-holes may originally have been excavated, (a) as hiding places or dwellings, (b) as draw-wells for the extraction of chalk for agricultural uses, and (c) as store houses for grain. It is unlikely that they were used as habitations, although they may have been used occasionally as hiding-places. Against the theory that they were primarily designed for the extraction of chalk, it may be urged that chalk could have been obtained on the surface close by, and that known examples of chalk draw wells do not descend to so great a depth. The discovery of a shallow dene-hole, about 14 ft below the surface, at Stone, negates this theory still further. The view that these prehistoric excavations were designed as silos is usually accepted as the most probable. Silos, or underground storehouses, are well known in the south of Europe and Morocco. It is supposed that the grain was stored in the ear and carefully protected from damp by straw. A curious smoothness of the roof of one of the chambers of the Gravesend twin-chamber dene hole supports this theory. The theory that the excavations were made in order to get flints for implements is quite impossible, as a careful examination of a few examples will show.

See F. C. J. Spurrell, "Deneholes and Artificial Caves" in the *Archaeological Journal* (1882), T. V. Holmes, "Deneholes" (1881) and many other references in the *Essex Naturalist*, *Archaeologia Cantiana* (vol. xviii, 1886), F. W. Reader, "Deneholes" in *Old Essex*, ed. A. C. Kelway (1908), W. Johnston, *Folk Memory* (1908) with bibliography.

DENHAM, DIXON (1786-1828), English traveller in central Africa, was born in London. He served in the campaigns in Portugal, Spain, France and Belgium, and received the Waterloo medal. In 1821 he volunteered to join Dr. Oudney and Hugh Clapperton (q.v.), who had been sent by the British government via Tripoli to the central Sudan. He joined the expedition at Murzuk in Fezzan. The pasha of Tripoli did not at first provide the promised escort, but the expedition eventually left Murzuk at the end of 1822. Thence it made its way across the Sahara to Bornu, reached in Feb. 1823. Here Denham, against the wish of Oudney and Clapperton, accompanied a slave raiding expedition into the Mandara highlands south of Bornu. The raiders were defeated, and Denham barely escaped with his life. When Oudney and Clapperton set out, Dec. 1823, for the Hausa states, Denham remained behind. He explored the western, south and southeastern shores of Lake Chad, and the lower courses of the rivers Waube, Logone and Shari. In Aug. 1824 he returned to England. He had just been appointed governor of Sierra Leone when he died of fever at Freetown on May 8, 1828.

See *Narrative of Travels and Discoveries in Northern and Central Africa in the Years 1822-24* (1826), the greater part of which is written by Denham, Dr. Robert Brown, *The Story of Africa*, vol. 1, chap. xiii (1829).

DENHAM, SIR JOHN (1615-1669), English poet, only son of Sir John Denham, lord chief baron of the exchequer in Ireland, was born in Dublin, entered at Trinity College, Oxford, in 1631, and at Lincoln's Inn in 1634. His first work was *The Destruction of Troy*, a verse paraphrase, written in 1636, of the second book of the *Aeneid*, but he made his reputation with *The Sophy*, a tragedy acted at Blackfriars in 1641, and printed in 1642. In the latter year appeared the famous descriptive poem of "Cooper's Hill," which Dryden called "the exact standard of good writing," and Pope used as a model for *Windsor Forest*. Denham fought on the king's side in the Civil War, and in 1648 had to leave England when it was suspected that he was concerned in forwarding Charles's correspondence. He remained abroad in the service of the exiled court until 1652, when he returned to England. He was for some time the guest of the earl of Pembroke at Wilton, and then obtained leave to settle at Bury St. Edmunds. At the Restoration he was rewarded with the office of surveyor-general of works. A scandal, caused by the behaviour of his second wife, who became the duke of York's mistress, is said to have driven him mad, but he recovered and survived her for two years. Some satires on the conduct of the Dutch wars, *Directions to a Painter*, and *Fresh Directions* are also attributed to him. His beautiful elegy on Abraham Cowley dates from 1667.

BIBLIOGRAPHY—His *Poems and Translations*, with a dedicatory epistle to Charles II, appeared in 1668. Other editions followed, and they are reprinted in Chalmers' (1810) and other collections of the English poets. His political satires were printed with some of Rochester's and Marvell's in *Bibliotheca curiosa*, vol. 1 (Edinburgh, 1885). See *Cambridge History of English Literature*, vol. vii, ch. iii, by A. Hamilton, *Writers of the Couplet*.

DENHARDT, KLEMENS (1852-1929) and his brother GUSTAV (1856-1917), German explorers, were born at Zeitz. In 1878 they explored the Tana river, and six years later were able to negotiate a friendly treaty with the sultan of Witu. Part of the territory acquired was sold to the German Witu-Gesellschaft and was later given to England in exchange for Heligoland.

DENIA, a town in east Spain in Alicante province, on the Mediterranean sea and on the coast-railway from Carcagente to Alicante. Pop. (1940) 7,637 (mun. 12,323). Denia, built on the seaward slopes of a small hill surmounted by a ruined castle, lies between the limestone ridge of Mongo on the south and a fertile plain on the north.

Denia makes soap, jam, nails, bicycles and woollen, linen and esparto fabrics but is above all a fruit port. It exports grapes, raisins, melons and oranges, tomatoes, onions and almonds, usually to Great Britain and north Europe and imports wheat, flour, guano, sulphur, from Italy, Baltic timber, and coal and tin-piles from South Wales. The harbour, sheltered by a breakwater, contains only a small area of deep anchorage and quay accommodation is limited to boats of under 12 ft draught. Vessels therefore

load and discharge chiefly into lighters, the larger boats anchoring in the open roadstead about 1 mi from the shore. Throughout the civil war of 1936-39, the port remained in loyalist control.

Denia was colonized by Greek merchants from Emporiae (Ampurias in Catalonia), or Massilia (Marseille), at a very early date, the Romans named the town *Dianum*, after its temple of Diana, built, in imitation of that at Ephesus, at the foot of the castle hill. Denia was captured by the Moors in 713, and according to an ancient but questionable tradition, under them became so prosperous a trading centre that its population rose to 50,000. Many characteristic Moorish houses survive in the town though it has been largely modernized. After the city was retaken by the Christians in 1253, its prosperity dwindled, and only began to revive in the 19th century. During the War of the Spanish Succession (1701-14), Denia was thrice besieged, and in 1813 the French withstood an allied British and Spanish siege of the citadel for five months before surrendering, on honourable terms.

DENIFLE, HEINRICH SEUSE (1844-1905), Austrian historian and priest, was born on Jan 16, 1844, at Imst. After becoming a Dominican in 1861, he studied at Graz, Rome and Marseille, and then from 1870 to 1880 taught philosophy and theology at Graz. Ten years after his first important work, *Das geistliche Leben. Eine Blumenlese aus den deutschen Mystikern des 14. Jahr.*, Denifle became in 1883 subarchivist of the Vatican. Then came a series of erudite works which have revolutionized our knowledge of the middle ages. In 1885 appeared *Die Unversitäten des Mittelalters* 1, 1900, in 1889-97 the edition (together with Chatelain) of *Chartularium Univ. Paris*, in 1894-97 *Liber Procuratorum Nationis Anglicanae* 1333-46, in 1898 *Specimina palaeographica Regestorum Pontificum ab Innocentio III. ab Urbano VIII.*, in 1899 *La guerre de cent ans et la désolation des églises, monastères, et hôpitaux, t. I jusqu'à la mort de Chas. V* (1385), in 1897 *La désolation des églises, monastères, hôpitaux, en France vers le milieu du XIV^e siècle* (based on some 1,300 documents). The publication in 1904 of *Luther u. Luthertum*, based on original documents, was followed in the same year by *Luther u. rationalistischer u. christlicher Beleuchtung*, a reply to the defense of Luther by Harnack and Seeberg, and by a second volume posthumously in 1909. Besides short articles on various mediaeval mystics, in 1885 Denifle together with Ehrle founded the invaluable *Archiv f. Lit. u. Kirchengeschichte des Mittelalters*.

DENIKER, JOSEPH (1852-1918), French naturalist and anthropologist, was born at Astrakhan, Russia. He studied at St Petersburg (Leningrad) and, as an engineer, travelled extensively in the petroleum districts of the Caucasus, in central Europe, Italy and Dalmatia. In 1888 he was appointed chief librarian of the Natural History museum, Paris. His valuable ethnological works include *Recherches anatomiques et embryologiques sur les singes anthropoïdes* (1885), *Étude sur les Kalmouks* (1883), *Les Ghilaks* (1883), and *Races et peuples de la terre* (1900, Eng. trans. 1900, 2nd ed. 1926). He was one of the editors of the *Dictionnaire de géographie universelle*. He died in Paris on March 18, 1918.

DENIKIN, ANTON IVANOVICH (1872-1947), Russian general, was born in humble circumstances on Dec. 4, 1872. During the Russo-Japanese War he rose from captain to colonel, and in World War I became commander in chief of the southwestern front. After the Revolution he followed Lavr G. Kornilov and was arrested and imprisoned with him in Bykov. They escaped together and joined Mikhail Alexeyev, who was forming in Rostov and Novocherkassk on the Don a small army of volunteers to fight the bolsheviks. After Kornilov's death on March 31, 1918, Denikin became military commander of the army, while Alexeyev retained the political and financial leadership. They established contact with the Don Cossacks under Peter Krasnov, and were further strengthened by the forces of Gen. Pokrovsky and Col. Drozdovsky. In June 1918 Denikin initiated a campaign in the northern Caucasus, by September his army had grown from 9,000 to 40,000, and by Feb. 1919 he had driven a bolshevist army of 150,000 from the northern Caucasus. Alexeyev died on Sept. 25, 1918, and early in 1919 Denikin took the name of commander in chief of the armed forces of South Russia.

In the autumn of 1919 Denikin came within measurable distance of complete victory. His forces had grown to 150,000, Kharkov, Poltava, Odessa, Kiev, and Orel were in his hands, his right wing had, through a force of Ural Cossacks, established connection with Alexander V. Kolchak's left wing about 400,000 sq. mi. of territory had been wrested from the bolsheviks, and a South Russian government was in being, with a "special council" of 24 members. But his great military ability was not alone enough to ensure the fulfilment of Denikin's aims. The rapid turn in his fortunes from victory to defeat was due to a complexity of causes, prominent among which were the general political bewilderment and diversity of purpose manifested by his supporters both within and without the boundaries of the former Russian empire, and the consequent difficulty of maintaining the effective morale of his armies. Meanwhile, largely owing to the relentless discipline introduced by Lev D. Trotsky, the bolshevist resistance had stiffened. At the beginning of Nov. 1919 Simeon M. Budennyi's cavalry broke through the "white" lines at Kupiansk and a general retreat set in. By promising a new government on federal lines Denikin made a final, but fruitless, attempt to weld the various Cossack units into cohesion.

Early in 1920 the bolshevist army retook Rostov and Ekaterinodar. Denikin, in face of great difficulties, transferred his army from Novorossiysk to the Crimea, and shortly afterwards resigned his command to Gen. Peter Wrangel and retired to England. He died on Aug. 8, 1947, at Ann Arbor, Mich.

DENIM, the name originally given to a kind of serge. It is now applied to a stout twilled cloth made in various colours usually of cotton, and used for overalls, etc.

DENINA, CARLO GIOVANNI MARIA (1731-1813). Italian historian, was born at Revello, Piedmont, in 1731, and was educated at Saluzzo and Turin. He was professor of human history and rhetoric in the college of Turin. His most important work is *Delle rivoluzioni d'Italia* (1769-72). In 1782, at Frederick the Great's invitation, he went to Berlin, where he published his *Vie et règne de Frédéric II* (1788) and *La Prusse littéraire sous Frédéric II*, 3 vols. (1790-91). His *Delle rivoluzioni della Germania* was published at Florence in 1804, in the same year he went to Paris as the imperial librarian, on the invitation of Napoleon. He died in Paris on Dec. 5, 1813.

DENIS (DIONYSIUS), SAINT, first bishop of Paris, patron saint of France, whose feast is celebrated on Oct. 9. According to Gregory of Tours (*Hist. Franc.*, i, 30), he was sent into Gaul at the time of the emperor Decius. He suffered martyrdom at the village of Catulliacus, the modern St. Denis. His tomb was situated by the side of the Roman road, where rose the priory of St. Denis de l'Estree, which existed until the 18th century. In the 5th century a basilica was built over the tomb. About 625 Dagobert, son of Clotilde II, founded a monastery in honour of St. Denis near by where the greater number of the kings of France have been buried. A false interpretation of Gregory of Tours, apparently dating from 724, represented St. Denis as receiving his mission from Pope Clement, and as having suffered martyrdom under Domitian (81-96). Hilduin, abbot of St. Denis in the first half of the 9th century, wrongly identified Denis of Paris with Denis (Dionysius) the Areopagite. St. Denis is generally represented carrying his head in his hands.

See *Acta Sanctorum*, Octobris, iv, 696-697, Chevliher, *Bio-bibliog.*, J. Havet, *Les Origines de Saint-Denis*, in his collected works, i, 191-246 (Paris, 1896).

DENIS, MAURICE (1870-1943), French painter, born at Granville, France, on Nov. 25, 1870. The guiding influence in his artistic development was the work of Gauguin, and he joined with some fellow students, all admirers of Gauguin, to form the group known as "Symbolists." Among them were Serusier, Vuillard, Bonnard and X. Roussel. Denis was also attracted to the pointillism of Seurat, as is shown by his use of pure pigments and of the juxtaposition of complementary colours in his pictures. He then devoted himself to decorative painting, following the example of the great Italian fresco painters of the 15th century. His most remarkable works are in the sphere of religious art, and mural decorations of this kind are to be seen in the churches of Le

Vésinet and of St Paul at Geneva and in the priory chapel at St Germain en Laye. Denis decorated the ceiling of the Champs Elysées theatre Paris and also illustrated numerous works including a translation of the *Little Flowers of St Francis*. He published *Theories*, 1896-1910, *Du Symbolisme et de Ganguin, vers un nouveau ordre classique* (1912), *Nouvelles theories sur l'art moderne, sur l'art sacré* (1914-21), *Aristide Maillol* (1925), *Charmes et leçons de l'Italie* (1935), and *L'Histoire de l'Art Religieux* (1939). He died in Paris, Nov. 13, 1943.

DENIS, MICHAEL (1729-1800), Austrian poet, was born at Scharding, on the Inn on Sept. 7, 1729. He was brought up by the Jesuits, entered their order, and in 1759 was appointed professor in the Theresianum in Vienna. In 1784, after the suppression of the college, he was made second custodian of the court library, and seven years later became chief librarian. He died on Sept. 29, 1800. Denis is best remembered as the translator of *Ossian* (1768-69), also published with his own poems in 5 vols. as *Ossians and Sineses Lieder*, 1, 84). His *Sammlung kurzer Gedichte aus den neuern Dichtern Deutschlands*, 3 vols. (1765-66), introduced current North German literature to Austrian readers.

A selection of his poetry edited by R. Hamel will be found in vol. 48 of *Kürschner's Deutsche Nationalbibliothek* (1884). His *Literarischer Nachlass* was published by J. F. von Retzer in 1802 (2 vols.) See P. von Hofmann-Wellenhof, *Michael Denis* (1881).

DENISON, GEORGE TAYLOR (1839-1925), Canadian soldier and publicist was born in Toronto on Aug. 31, 1839, and died there on June 6, 1925. In 1861 he was called to the bar. He saw active service during the Fenian raid of 1866, and during the rebellion of 1885. In 1877 he was appointed police magistrate of Toronto. Col. Denison was one of the founders of the "Canada First" party. He was a member of the Royal Society of Canada and was president of the section dealing with English history and literature. His best known military work is the *History of Modern Cavalry* (1877) which was awarded first prize by the Russian government in an open competition and has been translated into German, Russian and Japanese. In 1900 he published his reminiscences under the title of *Soldiering in Canada*.

DENISON, a city of Grayson county, Tex., U.S., 75 mi N.E. of Dallas and 4 mi from the Red river. It is on federal highways 75 and 69 and is served by the Frisco, the Kansas, Oklahoma and Gulf, the Missouri-Kansas Texas, the Southern Pacific and the Texas and Pacific railways. Pop. (1950) 17,444. It is an important railway centre.

The manufacturing industries include freight-car construction shops, paper mills, planing mills, cotton textile mills, a large peanut plant, a wood preserving plant, and plants manufacturing food products, machinery, clothing, boats, furniture, livestock feed etc.

The \$60,000,000 Denison dam on the Red river forms a large artificial lake, Lake Texoma. Denison was settled by northerners in 1872 when the Missouri, Kansas and Texas railway reached this point, and was named after George Denison, a director of the railway. It was incorporated as a city in 1891.

DENIZEN, a dweller, a stranger admitted to certain rights in a foreign country, in England an alien who obtains by letters patent (*ex donatione regis*) privileges of a British subject. By 22 and 3, Will. 3 Cl. 2 a denizen unless born of English parents (אזרח) is not a member of the privy council or of parliament or holds any civil or military office or trust or takes an oath of allegiance to the crown. The British Nationality Act, 1948 provides that nothing therein contained shall affect the right of any alien to denizenship by the crown.

DENİZLİ, chief town of a district of the same name of Turkey (anc. *Ladik* or *Ἰλδίκ*) latitude 36° 16' N. Pop. (1950) 21,049. It is beautifully situated at the foot of Bithynian (Mt. S. bacus) on a tributary of the Çaruk Su (Lycus) and is connected by a branch line with the station of Gemlik on the Smyrna-Izmir railway. It took the place of Iudaea when this town was deserted during the wars between the Byzantines and Seljuk Turk, probably between 1158 and 1174. It had become the Muslim city in the 13th century and was the so-called *Ladik* being famous for the so-called embroidered products of

its Greek inhabitants. The delightful gardens of Denizli have obtained for it the name of the "Damascus of Anatolia".

DENMAN, THOMAS, 1st BARON (1779-1854) English judge, was born in London, the son of a well known physician on July 23, 1779. He was educated at Eton and St John's college, Cambridge, where he graduated in 1800. He then married, and in 1806 he was called to the bar at Lincoln's Inn. In a few years he attained a position at the bar second only to that of Brougham and Scarlett (Lord Abinger). He distinguished himself by his eloquent defence of the Luddites, but his most brilliant appearance was one of the counsel for Queen Caroline for whom he made a great speech before the lords which gained him the enmity of the king and retarded his career. At the general election of 1818 he was returned M.P. for Wareham in the Whig interest. In the following year he was returned for Nottingham for which place he continued to sit till his elevation to the bench in 1832. In 1832 he was appointed common sergeant by the corporation of London. In 1830 he was made attorney general under Lord Grey's administration. Two years later he was made lord chief justice, and in 1834 he was raised to the peerage. As a judge he is most celebrated for his decision in the important privilege case of *Stockdale v. Hansard* (9 Ad. and El. 1, 11 Ad. and El. 253), but he was never ranked as a profound lawyer. In 1830 he resigned his chief justiceship and retired into private life.

The Hon. GEORGE DENMAN (1819-96), his fourth son, was also a distinguished lawyer and a judge of the Queen's bench from 1872 till his death in 1896.

See *Memoir of Thomas, first Lord Denman*, by Sir Joseph Arnould (1873), E. Manson, *Builders of our Law* (1904).

DENMARK (DANMARK), a kingdom of Europe, occupying part of the peninsula of Jutland (Jylland) and a group of islands dividing the Baltic and North seas and lying, except for the island of Bornholm, between lat. 54° 33' and 57° 45' N. and between long. 8° 5' and 12° 47' E. The southern part of the peninsula (Schleswig-Holstein) belongs to Germany. The northern extremity of the Danish part is actually insular, being separated from the mainland by the narrow and shallow Limfjord, which connects the North sea with the Kattegat (though broadest in the west, its connection with the North sea dates from 1825 only). The Skagerrak bounds Jutland on the north and northwest. Between the Kattegat and the Baltic and between the base of the peninsula and southwestern Sweden lie the Danish islands. Of the total area of the kingdom (16,575 sq mi.), Jutland covers 11,411 and the islands in the Baltic 5,136 sq mi. The latter comprise the two large islands, Fyn (Funen) and Zealand with smaller islands, chiefly on their south sides, and Bornholm far to the east in the Baltic.

Physiography—The solid geology is almost everywhere obscured by deposits of boulder clay lying generally on Cretaceous rocks, of which there are outcrops for example in Moen and Aalborg. Much of the Danish chalk, including the well known limestone of Faxø, belongs to the highest or "Danian" subdivision of the Cretaceous period. In the southwest a succession of strata, including lignite formations, intervenes between the chalk and the boulder clay. It is on the island of Bornholm only that older formations come to light. This island compares rather with southern Sweden and forms in fact the southernmost portion of the Scandinavian system, boulder clay is absent in the southwest of the island where Cimbrian, Silurian, Jurassic and Cretaceous formations appear. Some parts of Denmark are supposed to have been raised out of the sea toward the end of the Cretaceous period and may have been above water in various subsequent periods, but the final emergence was during the formation of the Ancylus lake toward the close of the Ice Age. Research greatly enlarged knowledge of the Pleistocene glaciation in its relation to early man, and its phases in the Baltic area were correlated with the stages observed in the Alps. Successive layers of trees preserved among peat in certain small depressions found in many of the forests of Denmark show that the flora has undergone remarkable variations to be connected with changes of climate during and since the glacial epoch. The first pine forests replaced a tundra flora during the period of the Ancylus lake, a fresh water inland

sex caused by a phase of elevation in the area now occupied by the Baltic. Before the disappearance of the lake there followed a still milder climate with oak forests, and a later cooler and moister phase is represented by the beech forests so widely distributed in modern Denmark, which apparently spread in the late Bronze and early Iron Age. It is to the Gothi-glacial and to the preceding Daniglacial retreats (equated by many respectively with the Achen and Laufer oscillations in the Alps), that the country owes its covering of moraine deposits.

The surface of the country is uniformly low, the highest ground culminating in Yding Skov høj in southeastern Jutland, which is but 565 ft above the sea. There are however, numerous hills between 300 and 500 ft in height. Undulating moraine formations of fertile clay, the legacy of the Pleistocene glaciation, are commonest in Zealand, Fyn and east Jutland, where they form the basis of Denmark's most characteristic landscapes of rich cornfields, meadows and beech woods. Extensive plains are in the west, consisting of poor sandy soils washed from the western edge of an ice sheet which lay from north to south down the peninsula. These wide expanses of heather covered sands are broken here and there by moraine formations of an earlier glacial phase. They were reclaimed for forest or arable land to the extent of nearly 5,000 sq km. The dune islands and dunes form an almost continuous line along the west coast of Jutland from Blaaivands Huk to the Skaw. The dunes did great damage up to the end of the 19th century by drifting in over the cultivated areas and even destroying settlements, but later they were largely planted and secured by means of groynes.

Jutland and Fyn—Bordered by these sparsely peopled dunes with a coast dangerous to shipping the peninsula of Jutland (Jylland) may be said to turn its back on the North Sea; its life has tended to orientate itself toward the islands where Copenhagen provides a metropolitan centre that contains, with Fredriksherg and Gentofte, 21% of the total population of the country. Esbjerg, which has a large fleet of fishing vessels and daily steamship services to England and France, is the only harbour on the western coast, but new harbours were constructed in the north at Hirtshals and Hanstholm. The drainage of the peninsula is typical of a low glaciated region. The Varde, Omme, Skjerne, Stor and Karup, sluggish and tortuous streams, flow through marshy tracts into the lagoons of the western coast, while the eastern Limfjord is flanked by the swamps known as Vildmose. The country's largest river, the Gudenaa, 80 mi in length, rises near the eastern coast and drains the Silkeborg series of lakes, following a winding course into Randers fjord (Cattegat). Off South Jutland (North Schleswig) is the island of Als in the Little Belt. Fyn, the main western island, is separated from the peninsula by the Little Belt, varying in width from ten miles to the one half mile strait which lies between the resort of Middelfart and the port of Fredericia, in Jutland. In form roughly oval, with a length from northwest to southeast of 53 mi, and an area of 1,149 sq mi, Fyn is closely allied to the mainland, and its fertile meadows among patches of woodland and boulder strewn hills are typically Danish. An archipelago, which includes Taastrup, Avernako and Dreio, lies to the south, enclosed by the narrow islands of Aero (16 mi in length) and Langeland (32 mi).

Zealand (Sjælland)—The largest island in the kingdom, Zealand lies east of Fyn, from which it is separated by the Great Belt, 11 mi wide in its narrowest part. It is 82 mi from north to south and 68 mi from east to west, but the outline is very irregular. The area is 2,708 sq mi. On the north lies the Cattegat, on the east the Sound, narrowing to 3 mi off Elsinore, and on the south the straits beyond which come the islands of Moen, Falster and Laaland. The undulating surface is little above sea level, save that the Cretaceous hills of the southeast, especially in Moen, reach heights of more than 300 ft. Of numerous coastal indentations the most important is the Ise fjord on the north, with its eastern and western branches, the Roskilde and the Lammø fjords, penetrating about 25 mi inland. Small lakes among the glacial debris are common here as elsewhere in Denmark, those of Arre and Esrom in the northeast attaining notable dimensions.

Climate—The climate is milder than that of most countries in

the same latitude for it is profoundly modified by maritime influences. No part of the land is more than 10 mi from the open sea, while numerous indentations carry equable conditions, and their effect is noticeable on the monthly weather maps. The mean annual temperature is 45° 2', the average for July is about 61° and for January about 32°. Frost occurs on an average on 20 days in each of the months from December to March. The eastern coasts are ice fringed for some time, and both the Sound and the Great Belt are very occasionally impassable on account of ice. Variable winds (mainly west and southwest) of cyclonic origin lead to considerable variations from day to day especially in the winter months. The average annual rainfall is about 24 in., showing a tendency toward a maximum from July to November. The wettest month is August (3.12 in.) and February (3.34 in.) is the driest. Thunderstorms are frequent in summer. At that season rainfall is greatest in central Jutland where the higher ground produces an increase throughout the year, more rain falls in the east of the kingdom than in the west. The reverse is true of the distribution of winter rain. The most equable climate occurs on the North Sea coast, wider temperature ranges marking the higher ground of central Jutland and the interior of Zealand. For the most part, climate combines with location and soil conditions in making Denmark an essentially agricultural and pastoral land.

Flora and Fauna—The flora of Denmark is surprisingly varied. The ordinary forms of northern Europe grow freely in the islands and on the eastern coast, while the heaths and sand hills of the Atlantic side have a number of distinctive species. The native Danish forest is almost exclusively made up of beech, but it comprises only one third of the whole timbered area, extensive coniferous plantations having been made. The latter, however, are confined for the most part to Jutland, so that the beech remains characteristic of the landscape in the islands. The oak and ash are now rare, in the first half of the 17th century the oak was still the characteristic Danish tree. Large oak forests have been planted. Abundant traces of ancient extensive forests of fir and pine are found. Numerous peat bogs with remains of trees supply a large proportion of the fuel locally used. In Bornholm the flora is more like that of Sweden, not the beech, but the pine, birch and ash are the most abundant trees.

The wild animals and birds of Denmark are those of the rest of central Europe. The larger quadrupeds are all extinct. The sea fisheries are important. Oysters are found, but have disappeared from many localities where their abundance in ancient times is proved by their shell mounds on the coast. Salmon are found in some rivers of Jutland. (E. E. E., H. L. N.)

HISTORY

The first trustworthy written evidence of a kingdom of Denmark belongs to the beginning of the Viking period. Everything before that is prehistory. Roman knowledge of this remote country was fragmentary and unreliable, and the traditional accounts in *Widsith* and *Beowulf* and by later Scandinavian writers notably Sveno Grammaticus (c. 1200), are so many mythological and legendary to serve as history. Archaeology and the study of place names, however, provide a certain amount of information about the earliest settlements.

After the first nomadic hunters, before 10,000 B.C., a Stone Age culture developed which culminated in the megalithic culture c. 2000 B.C. There was then a cultural break so violent that we must suppose the settled agriculturalists to have been displaced by newcomers, that is by the Single Grave people who eventually took possession of central Denmark. Apart from minor immigrations later the country seems at this time to have received its permanent population, though not to have been finally settled. The reigned culture of the ruling class in the Bronze Age (c. 1500-400 B.C.) and the poor peasant culture of the earliest Iron Age were developed mainly in the old settlements, but in the centuries around the beginning of the Christian era of colonization seems to have been completely reorganized. The old habitations round the small primitive field systems (dikes) were abandoned for the earliest of existing villages with the characteristic round endings

unge, løse, stød and un

The open field system with its long ridged strips was probably introduced at the same time. The period of the great migrations, the dimmest in Danish history, was a period of war and unrest, probably at this time the whole country was conquered by Danes from the east. There are glimpses of a tribal organization as associated with local things (arbitrating assemblies) but no trace of comprehensive government. Place names indicate belief in the pagan gods, e.g., Njord and Freyja. Tyr and Odin.

The Viking Period (800-1050)—The northward extension of Charlemagne's dominion brought Denmark into close connection with Europe. The Frankish conquests were halted by the Danish king Gudfred and a solemn treaty on the Eider in 811 made this river the frontier, and it remained the southern frontier of Denmark until 1864. Gudfred may have ruled over all Denmark, but the centre of gravity, was in the extreme south of the Jutland peninsula here Hedeby, on the Schlei, became an important station on the new Frankish trade route to the Arabs via Friesland, the Baltic sea and the Russian rivers. To protect this vital border land a great rampart, the Dannevirke, was erected, but it failed to prevent temporary Swedish and German conquests. The Danes took an active part in this trade together with the Frisians, at the same time Danish and other Scandinavian Vikings began the expeditions of plunder and conquest (see **VIKING**) that resulted in the Viking kingdoms in Friesland, England, France and Russia. Immediately after Gudfred's death in 810 the kingdom was dissolved. Various dynasties contended for power and appealed one after another to the Frankish rulers, who sought moreover to bring about a Frankish infiltration into Scandinavia by mission aries—notably Ansgar, the "apostle of the North"—though with out lasting result.

In the 10th century a new royal line, centred at Jelling (North Jutland), succeeded at last in uniting the kingdom. The name of the kingdom occurs for the first time on Danish soil in runic inscriptions on the Jelling stones. The self glorifying phrase "Denmark's repair" (*Danmarks bød*) used by King Gorm may refer to the reconquest of the Hedeby region, while Gorm's son Harald Bluetooth (Harald Blaatand) boasts of having completed the country's unification, converted the Danes to Christianity and conquered Norway.

The words correspond to reality. After Harald's baptism his father's pagan tomb was turned into a Christian construction with a church between two great mounds, and the newly appointed Jutland bishops, under the archbishop of Hamburg, organized the country's Christianization. The expansion begun by Harald in Norway was continued by his son the Viking king Sweyn I Forkbeard (Svend Tveskæg), who conquered England in 1013. Under Sweyn's son Canute the Great (Knud) there grew up a great Anglo-Scandinavian kingdom that included parts of Sweden.

Numerous runic inscriptions show that, over the broad peasant population there was a class of chieftains (*thegner* and *drenge*), which sought fame through warlike exploits and foreign expeditions. Wealth and power distinguished this aristocratic Viking community, the circular encampments of Trelleborg, Aggersborg and Fyrkat (excavated from 1934), astonishing in size and in mathematical construction, testify to high technical culture and great organizational talent.

The Kingdom of the Valdemars (1050-1241)—Shortly after the death of Canute (1035) his great kingdom was dissolved. Denmark again became a purely Scandinavian power, for a time under Norwegian rule, until Canute's nephew Sweyn II Estrithson (Svend Estridsen) founded a new Danish kingdom on European lines and in close association with the Roman Church. His five sons who followed him in turn (1074-1134), ruled according to varying principles some adhered to the traditional constitutional practice of a weak monarchy in sympathy with the aristocracy, others, opposing the aristocracy but in close association with the church, sought to create a powerful and centralized monarchy. At this time the church which for a period had been under strong Anglo-Saxon influence, passed once more under the leadership of Hamburg and, undergoing its final process of organization became (c. 1104) a separate national church with an archbishopric

at Lund in Skane. Canon law made slow progress and never became absolute in Danish ecclesiastical law. The partial introduction of tithes soon caused kings and nobles to vie with the peasants in building Romanesque stone churches in nearly every parish, some of them new ones and some replacements of wooden buildings.

The reigns of Sweyn's sons were followed by disintegration and internal strife among their many heirs. For a time the country was split up into minor kingdoms, weak kings took their land in fief from the Holy Roman emperor, and the new Scandinavian church was reverting to the primacy of Hamburg. But unity and independence were restored, first in the ecclesiastical field under Archbishop Eskil a great founder of monasteries and persistent champion of Gregorian ideas and later (1157) in the national, when Valdemar I (96) had defeated his rivals. In close association with Absalon (bishop of Roskilde, 1158, archbishop 1177-1201), who was inspired by French monarchical ideas, King Valdemar built up a powerful and expansive monarchy. Archbishop Eskil, seeing a threat to the church's freedom, went into exile, but later, after an agreement with the king he inaugurated in a double celebration at Ringsted in 1170 the theocratic and hereditary monarchy of the Valdemars, canonizing the king's father, the duke Canute Lavard, and crowning and anointing the king's young son Canute. Soon after, he yielded the archbishopric to Absalon. Regardless of the oath of fealty to the emperor the country's military power was reorganized and in rivalry with the Germans the Danes began, after their conquest of Rugen (1169 ff.) to dominate the Slav countries of the Baltic.

After Valdemar's death (1182) Absalon rejected by force of arms the German demand for supremacy and consolidated the monarchy internally and externally. Under Valdemar II (1202-41) Baltic expansion gained impetus, and in 1214 the emperor acknowledged Danish suzerainty over the German-Slav lands north of the Elbe and the Elde, Estonia was conquered in 1219. Thus culminated Danish dominion of the Baltic. Soon after, the king having been taken prisoner by one of his German vassals, it collapsed. An attempt at reconquest of the German Baltic lands failed when the Danish army that had invaded Holstein was defeated at Bornhöved in 1227. Only Rugen and Estonia were left.

The successful establishment of a great Danish kingdom was due in part to German weakness, in part, however, to internal reasons. A rapid growth in population since the Viking period had led to vigorous internal colonization, successions of new villages had occupied the space between the old ones, new towns had grown up and rising exports of agricultural goods and herring from Skane gave increased prosperity. The Valdemars rose above particularism and gained the allegiance of fresh social groups—not only that of the clergy but also that of the class of the powerful landed lords (*herremænd*) that had arisen by a fusion of the king's retainers (*hird*) with the old nobility. From this were recruited the court officials who, together with the greatly expanded chancery, were responsible for the central government, and the local officials (*ombudsmand*), who also administered the royal demesnes. The landed nobility formed a new and better equipped regular army, which increasingly took the place of the old peasant levies (*leding*). In return, the people's military obligations and services for maintaining the king were converted into fixed property taxes. Intellectual life flourished through a clergy educated at French and Italian schools. Denmark was drawing abreast of the civilized nations of Europe.

Dissolution and Consolidation (1241-1375)—The policy of conquest had overruled the country's resources, and when the population ceased to grow there was a lack of energy with which to colonize what had been conquered. The breakdown of the expansionist policy was therefore inevitable. But the powerful monarchy had also sown the seed of internal disruption and national dismemberment. In order to hold the royal patrimony together Valdemar II had distributed large areas as feudal appanages to his younger and illegitimate sons and the extensive privileges which the autocratic monarchy had paid for the loyal support of clergy and landlords had created a huge aristocracy that soon became a dangerous rival to the throne. The eldest son,

Eric IV Plovpenning, who had long since been crowned as consort, was soon in dispute with the church and with his brothers about royal prerogatives. His brother, Duke Abel of Schleswig, proclaimed himself king and had Eric murdered (1250). He was then elected king, but when he fell fighting against rebel Frisians (1252) his sons were passed over and his brother was elected as Christopher I. Thus not only was the hereditary principle broken, but the older Abel line which continued to hold the duchy of Schleswig, became a permanent source of unrest and by its close association with Holstein, began the germination of Schleswig. A number of archbishops persisted in the church's struggle against the crown. In this nationally destructive contest the king held the upper hand. He had been forced, however, to accede to the constitutional demands of the aristocracy. In the 1250s an aristocratic national assembly (*parlamentum*) was formed, which imposed legal limits to the arbitrary rule of the monarchy. After a long constitutional struggle in which the king turned for support to a narrow privy council and to some extent to German princes and mercenaries, Eric V Glipping (1259-86) was forced to yield. The first charter (*haandfæstning*) of 1282 legalized the assembly's authority and limited the king's powers, during the next few years the nobles carried out a policy of radical reforms and reorganization. When Eric V was murdered in mysterious circumstances, the royalists seized the opportunity to regain control and had the leaders of the reform party convicted of the murder and exiled.

Eric VI Menved (1286-1320) tried to restore the power of the throne and revive expansion into German territories. But progress was only apparent. Government finances broke down, and the kingdom began to disintegrate, especially when large territories were mortgaged to raise capital.

At subsequent royal elections the discontented nobles tried to control the monarchy by strict charters, but the result was more mortgages and increasing disintegration. From the death of Eric VI's brother Christopher II (1332) to 1340 the country was without a king. Holsteiner counts ruled over and impoverished Jutland and the islands as mortgagées, while Skåne subjected itself to the Swedish king. From 1241 the tendency had been toward increasing feudalization; officials and nobles freed themselves from government bonds, and free peasants in large numbers abandoned their property rights and sought protection from the strong, which seemed to them more effective than the inefficient legal protection afforded by the monarchy.

Through the mediation of German princes and the Hanseatic league Valdemar IV (1340-75) succeeded in reaching a settlement with the Holsteiner mortgagées and obtaining recognition as king. He succeeded in reunifying the country bit by bit by alternate redemption and force of arms and crowned national recovery by reconquering Skåne in 1360. Laying great stress on national unity and fellowship, he built up a new antifeudal state. A national army was established in which burghers and peasants gained a place beside the nobles. The king's military power rested chiefly, however, on a chain of castles, under strict supervision, their officers became the leaders of local administration. The crown's finances were restored with a severe hand: the old land taxes were given a fixed money value, and new taxes and labour services were levied, but meanwhile the nucleus formed by the royal demesnes was continually increased as a royal court of law (*retsterting*) awarded to the crown all lands lost during the period

a condition of his return to the throne.

The Scandinavian Union (1375-1523)—The male line of the dynasty having died out with Valdemar IV, the privy council took control and elected as king young Olaf (1375-87), son of Valdemar's daughter Margaret by her marriage with King Haakon VI of Norway and heir also to the succession of Sweden (where Albert of Mecklenburg, Haakon VI's cousin, was at that time reigning). The power of the throne was limited by charter, but the real ruler was Margaret who, when first her husband and then her son died, was acknowledged in 1387 as "lady and husband" of Denmark and Norway. With wisdom and moderation she gained control over the privy council (which had taken over authority of the *parlamentum*) and ruled with the aid of private court officials. She kept a close watch over the conduct of her stewards and zealously carried out the legal restitution of the lost demesnes.

Called in by discontented Swedish nobles, Margaret expelled the Mecklenburgers from Sweden in 1389 and thus became the actual ruler of all Scandinavia (see MARGARET, queen of Denmark, Norway and Sweden). Everywhere she enforced allegiance to her elder sister's grandson, Eric, duke of Pomerania, who was crowned king of all three countries in a solemn joint act at Kalmar in 1397. An attempt was made at this assembly to establish a more permanent connection between the respective countries, but because of disagreement as to whether the government of the union should be aristocratic and constitutional or strictly monarchical the meeting seems to have been dissolved without result. The famous charter of the union of Kalmar was probably never adopted, the aristocratic constitution at least never became effective. The monarchy remained powerful and was strengthened after Margaret's death in 1412. Being childless, Eric of Pomerania (Eric VII of Denmark) arranged for a Pomeranian cousin to be designated his successor and gained acceptance of the principle that the royal castles after his death should pass to his successor directly, not via the privy council. In foreign policy Eric evidently planned to create a great Baltic state centred on Scandinavia and Pomerania, but despite the best intentions he lacked the ability to accomplish even limited Danish tasks. He wanted to recover Schleswig, which after the expiry of the male line of the Abel dynasty had in 1386 been enfeoffed to the counts of Holstein, for the crown, and he sought to weaken the commercial power of the Hanseatic league by such means as encouraging a Danish urban middle class—a policy that found expression in his edict of 1422, which reserved trades and crafts for Danish citizens. This caused the Hanseatic league to ally itself with the Holsteiners and, although the Danish navy defeated the league repeatedly in the Sound (where from c. 1429 Denmark exacted dues), Denmark was inferior on land. The burdens of war converted Swedish discontent with royal rule into open revolt, and the Danish privy council enforced a tolerable peace with the Hanseatic league and the Holsteiners in 1435 in order to apply every energy to perpetuating the union. But at a meeting at Kalmar in 1436 the Danish councillors deserted the king's union policy and supported the constitutional program of the Swedish nobles, disavowing the Pomeranian succession, the result was an open breach. Eric withdrew to Gotland, and the nobles established a federative union in 1438. In 1439 Eric was also deposed in Denmark in favour of his sister's son, Christopher of Bavaria.

For Christopher III's brief reign (1439-48), during which the privy council predominated, the three Scandinavian countries remained united. After his death the union was dissolved. The Swedes elected the former regent, Karl Knutsson, king as Charles VIII, Denmark and later Norway took a descendant of the royal house, Count Christian of Oldenburg, founder of the Oldenburg dynasty (1448-1863). The union policy remained an issue under Christian I (1448-81) and his successors John (Hans, 1481-1513) and Christian II (1513-23), mostly in internal Swedish party politics, but it was only for brief periods that the Oldenburgs reigned nominally over Sweden. Christian I was more successful in his policy toward Schleswig when the dual line died out (1459) he managed—despite the provision in the *Constitutio Waldemariana* of 1326 that Schleswig and Denmark must not be united under the same ruler—to become both duke of Schleswig and

the Holsteiners and the Jutland nobles. Riesenau on all sides, the king left the country, the privy council then assumed control and, in 1370, concluded the peace of Stralsund, which granted the Hanseatic towns great commercial privileges but left the kingdom intact. Reluctantly Valdemar acquiesced in the treaty, which was

count of Holsten. He did so only by getting elected in 1460 by the combined Schleswig-Holstein knighthood on severe economic terms and on condition that the two lands remain 'for ever undivided'. Internal relations with the aristocracy were tense as the kings strove to free themselves from the privy council's increasingly severe charter demands while supporting vigorous Danish trades and crafts and resisting the economic pressure of the Hanseatic league. The farsighted but violent and two-minded Christian II strained this policy to breaking point. Setting the privy council and the nobles aside, he took commoners as his advisers and passed radical laws in favour of burgher and peasant. Sweden he subdued by force of arms. But the decimation of the Swedish nobility in the Stockholm Bloodbath (1520) brought about the revolt and the liberation of Sweden under Gustavus Vasa and the increasingly violent policy directed against the Danish nobility and church led to final disaster. In 1523 a group of the country's most powerful men withdrew their allegiance. Despondently the king abandoned the struggle and left the country. The privy council called in his uncle, Duke Frederenik (See below) (A. E. C. N.).

The 15th Century State—In the 15th century there had come into full development the differences which for two centuries were to characterize the Danish political situation. The constitutional problem was, to whom should belong the chief power in the country, the king or the landowners represented in the *rigsraad*, which at that time was made up of the country's 7 bishops and about 20 noble landowners, whom the king indeed chose but whom he had to take from the leading families and who thus corresponded in some degree to a privy council. This *rigsraad* possessed in theory the highest constitutional powers, for it elected the king, who ever since 1481, before being elected, had to sign a charter drawn up by the *rigsraad*, embodying the constitution of the country and asserting that the king should conduct no important state affairs without the sanction of the *rigsraad*. But except by open revolt the *rigsraad* possessed in reality no means of compelling the king, once elected, to observe the rules laid down in this charter, and further, this large assembly of men from all parts of the country who were themselves fully preoccupied with their own concerns, had naturally to leave to the king and his chancery the actual daily management of the political affairs of the country. Only in matters of local government was the king virtually compelled to make use of the nobles, who, insisting on their right to be appointed lords lieutenant, were in charge of the local administration in the 200 *herreder* (hundreds) of the provinces which were governed from the king's castles.

In the 15th century also the Danish people became divided more sharply into distinctive estates. Denmark's principal industry, then as at all times, was agriculture, and the cultivated soil, apart from about 700 manorial estates, consisted of about 80,000 farms, from 10 to 20 of which would be clustered together in country villages. Each of these villages was administered by the peasant farmers in common, whether these owned their farms themselves or were tenants paying a yearly rent—*landgilde*—to the actual owners. In the year 1500 there were about 12,000 Danish peasants who owned their farms, 18,000 were cultivators of land which belonged to the crown, the so-called *jaestebønder* or leasehold tenants, while about 30,000 were leasehold tenants of the church estates or of the estates belonging to the nobles, this large number resulting from the freedom enjoyed by these properties from the old land taxes due to the state. In one or two respects, however, this tax exemption had other results. Thus the leasehold tenant on a manorial estate was liable to certain terms of forced labour and feudal duties and, when, as a result of the Black Death of 1348-49, many leasehold farms became vacant, a law was introduced by the lords of the manors in Zealand that the next heir to any leasehold tenant must take over his farm. This form of serfdom, therefore, which enacted that a farmer's sons who had become artisans or tradesmen in a town could be forced to abandon their occupations in order to continue the cultivation of their father's farm, had the result that an estate owner in return for a payment would place his rights at the disposal of a neighbour, so that it is no exaggeration to speak

of the actual sale of farmers' sons.

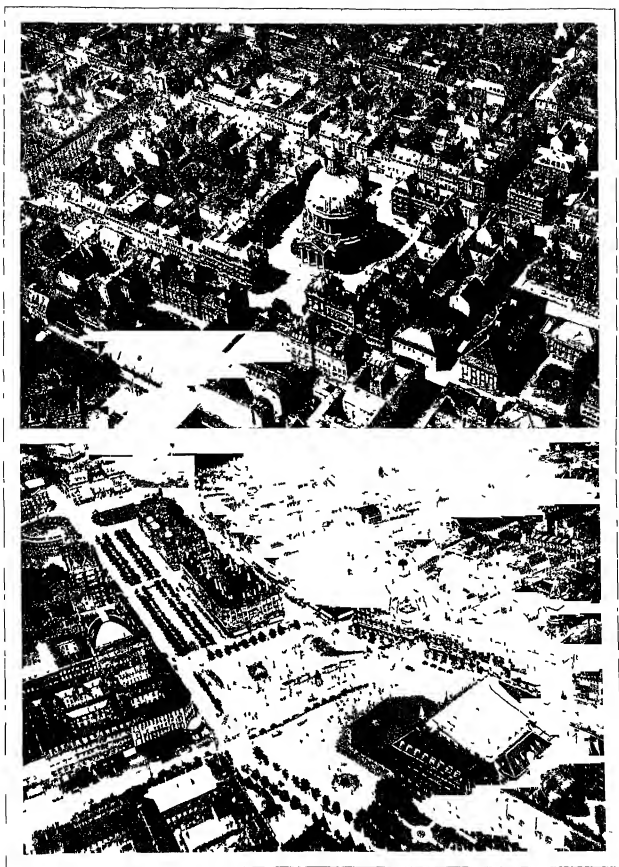
The Danish church at this period, with its 7 bishoprics and more than 70 monasteries, was immensely rich. It derived a huge income from its estates and leasehold farms, which were exempt from the old land taxes and on which extraordinary taxes could be levied only with its consent. It drew still greater revenues from the tithes on the entire corn production of the country, one third of such tithes going to the bishops, one third to the parish churches and one third to the parish priests. The pope, since the Council of Basle, had assumed the right to make all ecclesiastical appointments in Denmark, although he allowed the king certain nominations when he sought in 1458 to render the Vienna concordat of 1448 applicable also to Denmark. The Danish nobles, however, considered that the ecclesiastical appointments ought to come to their younger sons, who were too poor to buy estates, so they demanded and in 1523 obtained from King Frederik a decree that to become a bishop a man must be of the Danish nobility and to obtain an important prebend he must be either of the Danish nobility or else a doctor of theology. The result was that the service of religion was neglected, and the people turned away from a church most of whose leaders were concerned in spending the riches provided for them by their high offices. The setting up of a university and school of theology in Copenhagen in 1479 had the effect of bringing about a more serious study of the principles of Christianity. Paul Helgesen, who became *lektor* in 1519, vigorously attacked the malpractices in the church, especially in the matter of the sale of indulgences, but Martin Luther's break with Rome in 1521 changed Helgesen into one of the last great champions of the Catholic Church in Denmark.

The 15th century also was to mark a turning point in the history of the Danish nobility. Until then any Dane might become a noble by presenting himself in time of war well equipped for military service at his own expense. In return for this he was exempted from all taxes on his entire estate.

But from the 15th century the nobility marked itself off as an estate apart to belong to it a man had to show that his forefathers also for at least three generations had been exempted from taxation.

The nobles thus put a stop to the incursion of new families into their ranks. The king sought to effect an addition on a small scale by assuming to himself the right to issue titles of nobility but in contrast with England, where this practice secured for the nobility a continuous addition in each successive generation, the Danish nobility in the 15th century was made into something like a caste. After increasing from 242 families to 264 during the years 1400-50, the number sank from 230 families in 1500 to 140 (including at most 3,000 persons) in 1650. Of the noble families in the 15th century the Gyldenstjerne and the Rosenkrans (whose names are commemorated in William Shakespeare's *Hamlet*) were among the most important.

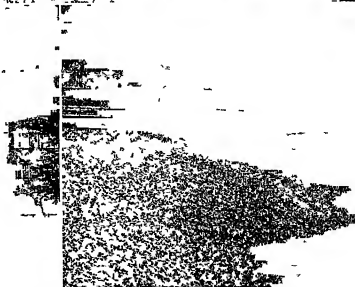
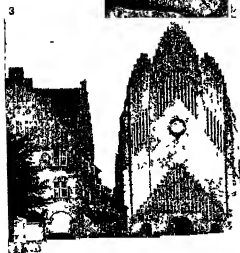
The Danish landowners of noble birth in the 15th century acquired estates in great numbers and were capable agriculturists. Their efficiency was demonstrated especially in Denmark's increased export of produce from the farms. The country had long had a market for its horses, now stall fed bullocks were added and the landowners had to find sales not only for their own output of corn, butter, bacon, hides and meat but also for the supplies of these goods levied by them in the form of rent from their leasehold tenants. In this way the estate owners, lay and clerical, also became merchants, many of them had their own ships. An estate owner of a peasant family who sold over to Iibek and Rostock, with corn, butter or pork, needed to maintain his right to sell his own produce and to make purchases abroad to supply his own needs. But in this he found himself retarded by the policy proclaimed by Eric VII in 1422 and for a century maintained by the government namely, the enactment that Danish merchants in the Danish mercantile towns had a monopoly in the transaction of business with other countries. Accordingly all Danish agricultural products had to be brought to these towns and there sold to citizens who in their turn exported them, and in the same way only citizen merchants might import foreign goods which had to be bought in the same towns. In practice, however, the Danish



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AERIAL VIEWS OF COPENHAGEN, THE DANISH CAPITAL

- 1 A view of the Frederikskirke, or Marble church (1875-94) situated in the finest of the residential quarters of Copenhagen
- 2 Rådhusplads (Town Hall square) At the lower right is the modern Renaissance town hall, built in 1901



FAMILIAR SIGHTS IN DENMARK

- 1 The fish market at Copenhagen
- 2 A small Danish girl in national costume
- 3 The famous "Little Mermaid" statue in Copenhagen harbour
- 4 The Christiansborg in Copenhagen—the Danish parliament house
- 5 Grundtvig church, Copenhagen
- 6 Granite quarry on the island of Bornholm in the Baltic sea

merchants were not wealthy enough to finance the trade in question, though the German merchants who had become Danish citizens were very eager to see the policy carried out and took up a position against the Danish estate owners and the Hanseatic merchants who were still doing good business in Denmark.

The Burghers and the Reformation.—In 1466 a cleavage had come about between King Christian I and the then leading Danish Swedish family of Thott. In 1468 Christian called together at Kallundborg the first Danish assembly of the estates of the realm consisting of representatives of the church, the nobility, the burghers and the peasants, so that they might vote him means for waging war against Sweden. From that time the government was on the side of the burghers against the landowners. It sought to create competition with the Hanseatic league by concluding treaties of commerce with England and the Netherlands. Christian II at this time was guided by the Dutch woman, Sigbrit Willenszoon, whose standing was more or less that of a controller of customs and finance, and by Hans Mikkelsen, burgomaster of Malmö. This ministry made the king, especially after the great victory in Sweden, an absolute monarch.

Under the leadership of Hans Mikkelsen were formulated two great laws, the law for the land and the law for the towns, which came into force at the end of 1521. Their tendency may best be gathered from the fact that they forbade "the evil and unchristian custom of selling the poor peasants" and strongly maintained the monopoly of the Danish towns and burghers in regard to Danish trade. Thus the landowners of noble birth and their rights were entirely set aside.

The landowners, therefore, when Sweden was in insurrection in 1522, resolved to sweep aside this burgher government. The nobles from Jutland co-operated with Duke Frederick and the Hanseatic league, renounced allegiance to King Christian and on March 26, 1523, acclaimed the duke as Danish king. On April 13 King Christian left Denmark for the court of his brother-in-law the emperor Charles V. In 1531 he made an effort to win back his kingdom, but was taken prisoner in Norway and remained in captivity until his death in 1559.

It was not until 1524 that Frederick I (1523-33) assumed his position, when Copenhagen and Malmö, which had heroically supported King Christian, were forced to surrender by the great Holstein general Johan Rantzau. The victory was that of the Danish landowners and the *rigsraad*, King Christian's two great laws were abrogated, the landowners were now once more free to sell their peasants and to trade with any foreign merchants that they wished. It was the *rigsraad* that governed, Frederick I was king only in name. He came however to exercise a considerable influence in Denmark, for he and even to a greater extent his son Duke Christian gave their protection to the zealous reformers of the church, who were striving to bring about Denmark's accession to Lutheranism. Led by Hans Tausen, these reformers secured strong support among the burghers and the peasants, nor were all the landowners blind to the fact that they might benefit by demanding back the properties which their forefathers had bequeathed upon the church and the monasteries, although the majority sided with the Catholic Church. When the struggle was at its height, in 1533, King Frederick died and the *rigsraad* decided under the leadership of the Catholic bishops, who would not have Duke Christian king at any price, that Denmark should do without a king altogether and that the *rigsraad* would be government enough. The Danish burghers, however, would not agree to this. Their leaders, Ambrosius Bogbinder, burgomaster of Copenhagen, and Jørgen Kock, burgomaster of Malmö, concluded a treaty with Lübeck—where Jurgen Wullenweber had overthrown the old aristocratic ruling council—and joined together to restore the burgher king Christian II to the throne and to incorporate Copenhagen and Malmö in the Hanseatic league. The lay members of the *rigsraad* then, in 1534, recognized the necessity of choosing Duke Christian, and a bitter civil war followed, known to history as the "Count's War"—the count in question being Christopher of Oldenburg, great-nephew of King Christian I, whom Lübeck and her allies raised up to oppose Duke Christian. He acted throughout as the nominee of the captive Christian II.

Everywhere the burghers and the peasants took up arms and in North Jutland they won victories over the Danish nobles. But Johan Rantzau returned with his Holstein and German troops, and the peasants suffered severely in Jutland as well as on the islands. With Swedish and Prussian assistance a fleet was formed which, under Peder Skram, admiral, defeated the citizens of Lübeck. The Holstein army was conveyed over to Zealand and in July 1535 the siege of Copenhagen and Malmö began. Malmö surrendered in April, Copenhagen not until it had been besieged for a year in July 1536. On Aug. 6 Christian III (1534-59) made his entry into Copenhagen.

It was the king who had won the victory with the help of his Holstein troops, the effects of this decisive triumph of the monarchy became very perceptible in the future political development of the country. The most direct outcome of the conflict was the remodelling of the church. In accordance with a decision of the king's council of war on Aug. 22, first the bishops resident in Copenhagen were imprisoned, then the others all over the country, they were released only after they had submitted to the new organization of the church.

At an assembly of the estates in Copenhagen in Oct. 1536, at which representatives of the peasants were present for the first time, assent was given to the king's charter and to a statute which established the new church. The social life of the country was revolutionized. The church became a Lutheran state church with the king as its supreme head, while seven bishops were to exercise supervision over the parish clergy. The property of the bishops and eventually also all the property of the monasteries fell to the king, and at the same time one-half of the farms of the peasant proprietors were confiscated, as a punishment for their having sided against the king. The possessions of the crown were thus trebled, so that it now owned rather more than half the soil of the country. The bishops' tithes henceforward went into the king's coffers, the revenues of which were increased through the better administration of the crown estates.

The lords lieutenant more often than not held their fiefs on a fixed rent or else only in return for feudal military service; henceforth they were obliged to account for the expenses and revenues of the fiefs so that the king should receive the balance. In 1533, of the country's 162 *herreder* (Schleswig not included) 43 were on the register, in 1559 there were 123. In the succeeding years efforts were made to combine the *herreder* into larger fiefs, the number of which in 1642 was 54. Centralization of government was carried out on a firmer basis, financial matters were dealt with under an exchequer, while the chancellors took over the administrations of the interior and the exterior. The defeated estates—the burghers and the peasants—lost in 1536 their political influence the burghers for 100 years, the peasants for more than 300. The burghers had to abandon entirely their great trade policy and to share with the landowners the right to export bullocks (which gave the landowners almost a monopoly) and generally to put up with their commercial operations. For the peasants, what was of most importance was that the king and the landowners during the second half of the 16th century had started farming on a large scale. A great many leasehold tenants were thereby turned out of their fathers' farms, and since the larger new estates called for increased labour the leasehold tenants in the parishes of the large estates were called upon to give their services three days a week. In order to compel the unwilling, both the crown and the landowners began to make use of legal punishments, and many of the latter set up law courts on their own estates where they themselves or their bailiff sat in judgment on the peasants. Moreover the landowners retained in 1536 all their rights as nobles and even extended their economic and political power.

From 1560 agriculture became increasingly a remunerative occupation and, further, from 1590 the Dutch were steadily buying corn in Denmark and the Baltic provinces for shipment via Amsterdam to southern Europe. Apart from two quite fruitless wars against Sweden (1563-70, 1611-13), Denmark had enjoyed peace and made full use of it. Many of the landowners built themselves beautiful dwellings. The names of Tycho Brahe the

astronomer, Holger Rosenkrans the theologian and Arild Hvitfeldt the historian show that in the intellectual world also Denmark played its part. The burghers too were acquiring capital and were thus enabled to compete with the Hanseatic towns—for instance in the trade with Iceland. Frederick II (1559–88) built Kronborg as a support for the collection of the Sound dues, which continued to bring in larger and larger revenues. Christian IV (1588–1648) built, in the Dutch Renaissance style, the beautiful castles of Frederiksborg and Rosenborg, founded Glückstadt and Christianshavn and enlarged and adorned Copenhagen with new edifices such as the Bourse and new harbour works and fortifications.

The Swedish Wars—Christian IV was encouraged by success to make Denmark the leading country in northern Europe and to check the increase of Swedish influence. This aim was unattainable, for Sweden's power at this period was superior to Denmark's. Denmark could hold her own against Sweden only with her navy and it was this which repeatedly saved Denmark from destruction.

A period of misfortune began for Denmark when Christian IV, at the behest of England, intervened in the Thirty Years' War, first as Protestant leader against the emperor (1625–29), later, when he had had to cede his position to Gustavus Adolphus, as a mediator, until prevented by a Swedish attack in the years 1643–45. Both wars resulted in bitter defeats for Denmark. Denmark had to purchase peace at Bromsebro in 1645 by surrendering the islands of Gotland and Oesel and the Norwegian provinces Herjedalen and Jemtland. In order to find the money to defray the wars, Christian had to increase greatly the Sound dues, but this evoked much ill will on the part of the western powers, and although the Dutch in 1645 obtained considerable reductions they came to feel strongly that it would be a good thing if Denmark did not possess both banks of the Sound. Over and above all this, Lennart Torstensson's campaign (1643–44) brought the friendship of Frederick III of Holstein-Gottorp to the side of Sweden, and this developed into a definite alliance when Frederick III of Denmark (1648–70) rashly declared war on Sweden in 1657. This war, famous for the advance of the Swedish king Charles X over the ice from Jutland to the islands, ended in 1658 with the peace of Roskilde by which Denmark gave up Bornholm and Trondhjem and the southern provinces of the Scandinavian peninsula, while the duke of Holstein-Gottorp was acknowledged as a reigning prince in part of Schleswig.

These wars caused the Danish burghers' hatred of the nobles to break out more strongly than ever, and their differences were accentuated at the state assemblies which from 1638 onward were now and again called together. All the proposals made, even those on behalf of the king, for the betterment of the condition of the country, were rejected by the *rigsraad*, which was led by the high steward Korfits Ulfeldt, the husband of Christian IV's daughter Leonora Christina. As a condition of his accession the high steward compelled Frederick III to sign a charter which considerably diminished the royal prerogative in nominating at his own pleasure lords, lieutenants and members of the *rigsraad*. With great shrewdness and firmness, Frederick began to work for a change in the constitution. He succeeded in overthrowing Korfits Ulfeldt, who had been timid and glibly evasive, and when Charles X proved at not having completely conquered Denmark, recommenced the war in 1658 and soon invested Copenhagen the burghers or the city were stimulated into a heroic defence by the offer of great privileges. Copenhagen became a free *rigstad* (crown city) whose assent was necessary for the settling of state affairs and whose burghers were to enjoy the same privileges as the nobles. The Dutch, who did not relish the idea of both shores of the Sound being in the hands of the Swedes any more than in the hands of the Danes, dispatched a fleet to the relief of Copenhagen, and on Feb. 11, 1659, the Swedish attack on the capital was repelled. Charles X's death was followed by the peace of Copenhagen in 1660. Bornholm and Trondhjem were given back to Denmark, but in other respects the treaty of Roskilde was confirmed because the western powers so willed it. Skåne, Halland, Blekinge and Bohuslän were forever lost to Denmark.

The Constitutional Revolution of 1660—After peace had been declared the estates met in Copenhagen in Sept. 1660. Measures of taxation were necessary but the nobles were as unwilling as ever to forego their exemption from taxes. The church representatives under the leadership of the Bishop Huns Svane, together with the burghers whose leader was Hans Nansen, the burgomaster of Copenhagen, then allied themselves to form an opposition party and forced the *rigsraad* and the nobles to take on a share of the taxes and to enter into negotiations with the king for a change in the constitution. They constrained the *rigsraad* and the nobles to confer on Frederick III and his family the hereditary succession to the throne, and when the *rigsraad* negated this proposal the opposition submitted it on Oct. 10 direct to the king. Under the pressure of threats the *rigsraad* gave in on Oct. 13, and the king was acclaimed with great pomp as hereditary sovereign on Oct. 18. In Jan. 1661 the government sent out an instrument or pragmatic sanction to be signed by all the more prominent citizens, landowners, bishops, professors, magistrates, etc., in which the king had conferred on himself not merely the succession but also absolute sovereignty.

The constitution which Frederick had promised was signed on Nov. 14, 1665. The king's law as it was called, made the Danish sovereign absolute inasmuch as it imposed on him the sole duties of keeping the kingdom undivided and of maintaining the Christian religion in accordance with the Confession of Augsburg while it further settled the succession on Frederick's heirs both in the male and female lines. An absolute monarchy was, indeed, the necessary and only possible constitution for Denmark in 1660 if it was desired to deprive the nobles of their political power. For the burghers were clever enough to perceive that however influential the nobles still were, a constitution would only have given them new power. The absolute monarchy meant that from now onward every distinction of rank between the noble and the unfree estates was done away with and that, as far as possible, all Danish citizens would be on a level under the absolute rule of the king.

The first task awaiting the monarchy was to bring about a new order in the kingdom. After the terrible misfortunes of the wars military affairs were completely separated from the civil administration. In the sphere of local government the country was divided anew into distinct under superior magistrates who replaced the lords' lieutenants. In the sphere of central government there were established administrative boards (*kollegie-ordninger*), the two chanceries to which the name *kancellis* was applied and the office of the exchequer were changed into administrative boards, other boards were instituted to deal with war and the admiralty, and yet another special board was set up apart as the supreme court of law of the kingdom.

The boards laid proposals before the king, who gave his decisions soon after the matter had been dealt with by a secret council the members of which, selected chiefly from among the heads of the boards, were nominated by the king. While the old Danish nobility held aloof on their country estates their places in the administration were taken by burghers.

The Burgher Bureaucracy—Thus there was formed a burgher bureaucracy in which the first and most significant figure was the brilliant Peder Schumacher, a member of a rich and highly respected Copenhagen burgher family, who in Nov. 1673 was made state chancellor (*rigskansler*) and created count of Griffenfeldt (*g v*). Griffenfeldt sought to remove the old deep-rooted differences between the estates. Though he himself was overthrown in March 1676, the burgher bureaucracy remained to play an important role during the first period of the absolute monarchy. Not until about 1730 did there come a change when the landowners—some belonging to the old nobility, others to the new one that had been created by a law of 1671—came again to power, but now only as servants of the absolute monarchy.

A joint code of laws for the entire kingdom was issued under the name of Christian V (1690–99) in 1683, serfdom was abolished in 1702 and for a brief period the Zealand peasant became free, trade and industry were protected in accordance with mercantile principles, schools were opened in the provinces and thus a

foundation was laid for a system of elementary education. But almost the most important reform of the whole period was the setting up in 1684 of a registration system throughout the kingdom whereby the land was classified according to its value, with the intention of attaining a more equitable distribution of taxes.

The absolute monarchy regarded it as an inherited responsibility to fight the traditional enemy Sweden and to reconquer Skåne. Hence the Skåne war of 1675-79 and the great Scandinavian wars of 1700 and 1700-20, which entailed terrible sacrifices. Skåne was not regained, but it was as a result of victories over Charles XII of Sweden and his ally, the duke of Holstein-Gottorp, that Frederick IV of Denmark (1699-1730) in 1721 was able to take possession of the ducal part of Schleswig and include it in the monarchy. The outcome naturally was a bitter hatred against Denmark on the part of the ducal family of Gottorp, the more dangerous since the dukes became in 1743 heirs to the crown both in Sweden and in Russia.

When the duke himself in 1761 became emperor of Russia as Peter III a war seemed inevitable, and Denmark had to arm on a great scale. But the tsar was murdered at the instigation of his wife, who succeeded him as Catherine II, and Denmark's foreign policy, which since 1775 had been controlled by J. H. E. Bernstorff, took on a new aim, namely, to induce the empress to exchange the Gottorp portion of Holstein for Oldenburg (which Griffenfeldt had won in 1673 for Denmark).

This aim was achieved in 1773 and the Danish king once again held possession of both dukedoms, Schleswig as a Danish, and Holstein as a German fief.

The 18th Century State.—The weight of taxation was burdening the people, especially as the period preceding the year 1767 had been one of terrible depression for Danish agriculture. The price of corn had gone steadily down, for the Dutch could now buy wheat in England, which at this period supported her wheat exports with a premium. The exportation of bullocks had ceased, the Dutch about 1730 having instituted a heavy tax on Danish bullocks. The Danish peasant population was impoverished and Danish land sank lower and lower in value. To cover the expenditure which the war with Sweden had entailed, the crown was obliged after 1660 to effect considerable sales of its property. Gifts from the king to ministers and favourites and continual sales resulted in a steady increase in the landowner's share of the soil. In order to collect taxes from the peasants the crown had to make the landowner responsible for the taxes which their leasehold tenants had to pay. In return for this the owners were granted exemption for their principal estates, thus exemption for the landowners was restored, though upon a new basis of law. The new nobility of counts and barons not only acquired all the rights formerly enjoyed by the old Danish nobility, to gether with the exemption from taxation on a part of their peasant farms, but also the right to leave all their estates together in entail to the eldest son, although as a fief which on the extinction of the direct line should revert to the crown. The harder the times the more the crown had to accede to the demands of the landowners, which were, as before, that they should be able to compel occupation of their leasehold estates and obtain free labour from their tenants. One of the first acts of Christian VI (1730-46) had been the abolition of the national militia, but in 1733 it was reintroduced, in combination with the so called *støvningsbånd*, which provided that all Danish farmers' sons from their 14th to their 36th year should be bound as villeins to the estates on which they were born. In 1745 it was further decreed that even a soldier who had served his time was bound to return to the same estate and to take up a tenant farm. As soon as the landowners had obtained these rights over their leasehold tenants, they could set their requirements in the matter of forced labour as high as they liked; they could have the refractory conscripted for the hated military service and could employ any bodily punishment.

In the middle of the 18th century, however, an economic advance became observable when, under the leadership of France colonial goods from the West Indies (especially sugar, coffee and tobacco) began to find a European market. Denmark

acquired three West Indian islands of which the most important was St. Thomas. The eastern Asiatic trade also began to flourish under the leadership of England. Danish trade expanded and the new Asiatic and West Indian companies both prospered. In 1736 a Danish bank of issue was founded which supported these ventures and when the great colonial war broke out between France and England the neutral trade of Denmark greatly benefited thereby. A. G. Moltke, the favourite of Frederick V (1746-66) and a great landowner, was the first person to realize that this might also benefit Danish agriculture by opening up greater possibilities of production. But the landowners were thoroughly conservative and would not consider the economic freedom of the peasants. Their rule was overthrown in 1770 by Johan Frederik Struensee, an accomplished physician and a man of great gifts who secured power through his liaison with Caroline Matilda, sister of King George III of England, who had been united in an unhappy marriage with the degenerate and morbid Christian VII (1766-1808). Struensee carried through a number of reforms, but conservatism again revived under Ove Hagh. Guldberg who declared that the "yoke of the peasants could not be removed without Denmark's shaking and quivering to its foundation."

Agricultural reforms were imminent, however, and when the crown prince Frederick in 1784 had acquired power by a coup d'état, he found a brilliant spokesman in a Danish landowner of old Danish stock, Christian Ditlev Reventlow, who had studied agriculture in England. Reventlow became the life and soul of a commission which brought about the liberation of the Danish peasant. The *støvningsbånd* was ended on June 20, 1788, villeinage was stopped, compensation in money being given, the ancient agricultural associations were done away with, and the peasant was allotted his own plot of land. Many at once quit the villages for the country. Transition to freehold ownership was the ultimate aim of this great land reform, which was carried through thoroughly and with excellent results.

The Napoleonic Wars.—The circumstances of the moment were helpful. By 1767 England, as the result of its industrial awakening, had changed from a corn exporting to a corn-importing country. As a result Amsterdam once again had to purchase corn in the Scandinavian countries and the prices of corn and agricultural products rose steadily during the period of the French Revolution and the Napoleonic wars. It was in this favourable period, which continued until 1807, that more than half the Danish peasants obtained ownership of their farms.

The period was favourable also for Danish trade, for the foreign minister, Andreas Peter Bernstorff, succeeded like his uncle, J. H. E. Bernstorff, before him in keeping Denmark out of the wars. After his death in 1797 there came a clash with England, for Denmark together with Russia and other neutral powers was attempting to safeguard trading vessels by convoys of men-of-war. Lord Nelson was sent with a fleet to break up the alliance of the northern powers. There followed the sea fight off Copenhagen on April 2, 1801. After a gallant resistance the Danish fleet was destroyed and Denmark had thenceforward to cease sending convoys. The period which followed brought great benefits to Danish agriculture and trade. Commerce had been facilitated by the toll law of 1797 which extended the principle of free trade. Wealthy businesses grew up in Copenhagen, and the bank of issue granted ever-increasing credit. After 1757 the bank was exempted from having to meet its notes with silver, and after it was taken over by the state in 1773 it had not only to emit as many notes as were required for the carrying on of business but also to meet in this respect the state's need of money.

In 1807 England called upon neutral Denmark to give up her considerable navy lest it should be used by Napoleon against England. George Canning's demands had to be complied with, but not before an English army had laid large portions of Copenhagen in ruins. In anger over this, Frederick VI (1808-39) from that time onward attached himself politically to Napoleon. Seven burdensome war years followed, in the course of which relations between Denmark and Norway were completely broken off and Danish trade was gradually brought to a standstill. When

at last victory fell to the coalition Denmark had to conclude a peace at Kiel in 1814 by which Norway was handed over to Sweden and Heligoland to England, in exchange Denmark acquired Lauenburg.

The war had cost immense sums of money which, since neither taxes nor loans were available, the bank of issue had to meet by a limitless issue of notes. In 1813 the bank went bankrupt and a new national bank was founded, which in 1818 became a private concern entirely independent of the state. Its notes first reached par in 1838 and became payable on demand in 1845. The failure of the bank, the destruction of Danish trade and the fall of corn prices during the first ten years after the war left a period of poverty and stagnation during which, moreover, the land reforms came to a standstill.

The June Constitution.—This condition of things naturally called forth criticism of Frederick's absolute government. Then under the influence of the July Revolution in France, Frederick in 1834 set up four consultative provincial assemblies. These marked the beginning of parliamentary life and encouraged public discussions of political questions. A Liberal party came into existence and set itself the task of substituting for the absolute government a new constitutional government representative of the people. Even Christian VIII (1839-48), who as king of Norway in 1814 had co-operated in framing Norway's free constitution, did not seem disposed to perform the same service for Denmark. Immediately after his death on Jan. 20, 1848, came the revolution of February in France and the short-lived victory of liberalism. In Copenhagen the movement had its outcome in a public procession on March 31 to the new king, Frederick VII (1848-53), who was able to reply that he intended to renounce the absolute rule and that he had already taken steps toward forming a government responsible to the representatives of the people.

This was appointed next day with A. W. Moltke as premier, among the ministers were leading National Liberals like D. G. Monrad, A. F. Tscherning and Orla Lehmann. On Oct. 23 a national assembly met which, on the basis of a draft submitted by Monrad, prepared the constitution of the Danish kingdom of June 5, 1849. The legislature became a *rigsdag*, with specified powers, consisting of a *landsting* and a *folketing*, the members of the former were to be elected for eight years by indirect vote and the latter for three years by direct vote.

The Schleswig-Holstein Question.—In the meantime the question of the new constitution was thrown into the shade by the widening differences between Germans and Danes. The Napoleonic wars had awakened the German national feeling, and the political bonds which had existed between Schleswig and Holstein ever since 1460 suggested that these two regions should form a single country within a united Germany. These efforts evoked a counter-movement among the Danish population in North Schleswig and from 1838 in Denmark itself, where the Liberals especially had taken up the fight and, from 1842, were insisting that Schleswig had belonged to Denmark for centuries and that the frontier between Germany and Denmark must in the future as in the past be the Eider. (See SCHLESWIG-HOLSTEIN QUESTION.) This difference between Eiderism, as it came to be called, and Schleswig-Holsteinism led in March 1848 to an open Schleswig-Holstein revolution, helped by the armed intervention of Prussia. The outcome of this was a three years' war (1848-50) which ended in a victory for Denmark. Great Britain, France, Russia, Norway-Sweden in 1850 recognized the integrity of the Danish monarchy and, in the London convention of 1852, together with Austria and Prussia acknowledged Prince Christian of Glücksburg as heir to the whole monarchy after the death of the childless Frederick VII. In the agreement with Prussia however the Danish government was obliged (1831-52) to undertake that in the ultimate framing of the constitution of the monarchy Schleswig should not be brought into closer relationship to Denmark than to Holstein. The impossibility of fulfilling this condition was soon to be seen.

In the Danish *rigsdag* three parties had been formed: the Conservatives comprising the landowners and all those who were

against the free constitution, the National Liberal Burgher party, which had arisen through the June constitution, and the left, including the Peasants and "Friends of the Peasants" (*Bonde vennerne*), whose chief desire was for a continuation of the land reforms. The Conservatives were in favour of restricting the June constitution as much as possible being ready to fulfill their promise to Prussia by creating a conservative joint constitution for the whole kingdom, with a joint *rigsraad* in which the Holstein landowners should also be represented. Such a constitution came into existence in 1855 but the Holsteiners promptly refused to meet in a joint *rigsraad*. After 1857 the National Liberals returned to power with Carl Christian Hili (*qv*) as prime minister. He abolished the joint constitution for Holstein and on Nov. 18, 1863, prevailed upon the new king, Christian IX (1863-1906), to sign a new joint constitution for Denmark and Schleswig which brought Schleswig into closer relationship to the kingdom than to Holstein. Otto von Bismarck was anxious for a popular war and desired the harbour of Kiel for Prussia, Austria agreed to join in and the two predominant German powers crushed down Denmark's heroic defence at Dybbøl (Dybbol) in 1864. By the treaty of Vienna the three duchies of Schleswig, Holstein and Lauenburg, including the Danish North Schleswig, were surrendered. In 1866 after the Austro-Prussian War they became part of Prussia. Napoleon III in the treaty of Prague procured the insertion of an article (art. v) to the effect that North Schleswig should be reunited with Denmark when the majority of the population by a free vote should so desire, but it was in vain, for in 1878 Prussia and Austria agreed to the cancellation of the article.

The July Constitution.—The National Liberal Eider-Danish policy had brought about Denmark's defeat. The Conservatives took office and earned through in co-operation with the Peasants, who disliked the National Liberals, the new constitution of July 28, 1866, which was considerably more conservative than that of June. The general suffrage was indeed retained in the case of the *folketing*, but in the composition of the *landsting* the landowners and the most highly taxed people were given an altogether overwhelming influence. This resulted in the two chambers entering into a state of permanent opposition to each other. In 1872 the left severed their alliance with the Conservatives, who soon combined with the National Liberals to form a right. This right leaned on the *landsting* and maintained the king's privilege of selecting his ministers without regard to the majority in the *folketing*.

In 1872 the left secured a majority in the *folketing* and insisted on the parliamentary system—the king's duty to choose his ministers from the party with such a majority. The struggle persisted from 1875, when J. B. Estrup, the leader of the right, became prime minister, until 1894 when he went out of office, other and weaker ministries of the right held power until 1901. The contest was bitter, for throughout all this period the left had a growing majority in the *folketing*. The election of 1884 gave them 81 seats out of 102, of which a were held by the first Social Democrats ever elected to the chamber. The right demanded large appropriations for defense, in particular for the fortifications around Copenhagen, the left, under the leadership of A. O. Høp, who after the 1870s stood for a foreign policy of neutrality and disarmament, refused to admit this. Under the leadership of Kristen Berg the *folketing* went so far as to negative the budget in 1876, in 1885 and again in 1894. But Estrup, like Bismarck, did not shrink from letting the king declare a "provisional budget," and by this means the right were able to provide for the fortifications of Copenhagen and to maintain themselves in power. Only when the election of 1901 had reduced the government's strength in the second chamber to 8 members of the right and 16 of the so-called Moderates, as against 76 of the left and 11 Social Democrats, did King Christian IX request J. H. Deuntjers to form the first left ministry, of which Jens C. Christensen, Høp and Christopher Hage became members.

Economic Progress.—The continual rise of prices down to 1873 had made possible a resumption of the land reforms which the Friends of the Peasants and the left desired and which were supported also by the National Liberal government in the case of

Monrad's law of 1861 changing the leasehold tenancies into freehold land. Thus 76% of the farms were freehold by 1875, and 94% by 1905. The increasing exports of corn from America and Russia between 1875 and 1895 again brought Danish agriculture to a precarious state, but it saved itself by producing butter and bacon instead of corn and by making these goods standard commodities in the English market through its co-operative dairies and slaughterhouses. Later there came co-operative export associations.

Estrup's policy had made Esbjerg an important centre for the English export trade. C. F. Tietgen founded the United Steamship Co. (whose Esbjerg Harwich line took over the export to England) and the great Northern Telegraph Co., which acquired its greatest importance through its relations with China and Japan. New banks were founded, including the Landmands bank (Agriculturists' bank) in 1871 and the Handelsbank (Trade bank) in 1873. The towns grew, in the course of the '70s Frederick III's old ramparts round Copenhagen were pulled down and new quarters arose on their site. A wage-earning class came into existence who were soon identified with the Social Democrats, which party in 1884 sent two representatives to the lower chamber. A labour conflict in 1899 led to the establishment of a court of arbitration for the settlement of labour disputes. The constitution of June had already acknowledged the full and unfettered right of association. In 1891 there was introduced an old-age pension law, in 1892 a health insurance law, in 1899 an important law for the establishment of small farms with state help.

Ministries of the Left—As a ministerial party the left had great difficulties to overcome. It had to try to introduce universal suffrage in the election of parish councils (*sogneraad*), of county councils (*amtsraad*) and even of the lower chamber itself, for which a new fundamental law was required, it had to proceed with social legislation, it had to change taxes such as the tithe into taxes upon the incomes and property of the citizens, it had to introduce regular budgets. The Deuntze ministry succeeded in carrying through the reform of the taxes in 1903, two years later Jens C. Christensen became prime minister. He was anxious to demonstrate that the left could rule, even with a hostile upper chamber, but he held that to this end it was necessary that the left should break with the Social Democrats and declare themselves willing to carry through measures of defense adequate to the country's needs, even if it should prove impossible to effect a reduction in military expenses. The result was that a small section of the left which would not admit the necessity of these two measures set up as an independent party, the Radical party, under the leadership of Carl Theodor Zahle. In the following year the military problem became the dominant issue, the prime minister endeavoured to solve it in conjunction with the Moderates, whose leaders were Klaus Berntsen and Niels Neergaard. But in 1908 the ministry was severely shaken when the minister of justice, A. Alberti, was forced to resign and subsequently confessed himself guilty of frauds.

The Christensen cabinet was compelled to resign in the following October. Three short-lived cabinets followed, namely those of Neergaard, Count Holsten Ledreborg and Zahle, whereupon Klaus Berntsen (July 5, 1910) formed a cabinet of the left, including the Moderates, which lasted until 1913.

In 1910 the left had opened an agitation for a democratic amendment of the constitution. The right, which was strong in the *landsting*, opposed, and no solution had been reached when the elections were held in May 1913. The Radicals and Socialists now held 63 seats out of the 114 in the *folketing* and united to force the reform under a new Zahle cabinet containing Erik Scavenius (foreign affairs), Edvard Brandes, Ove Rode and Peter Munch. The right answered by obstruction in the *landsting*, which the government then dissolved. The new *landsting* contained 38 supporters and 28 opponents of the constitutional amendment.

(E. A. P., X)

World War I.—During the crisis of July 1914 the Danish government pursued a cautious policy. When war broke out on Aug. 1 it immediately proclaimed its neutrality and mobilized an emergency force of 54,000 men.

On the night of Aug. 4-5 Germany began mining Danish southern waters and next morning the German minister asked if Denmark would lay mines in the Great Belt. Learning that the Germans would otherwise lay the mines themselves and build fortifications on the coast to protect them, the Danes gave an affirmative answer. King Christian X. (1906-47) having informed his cousin the king of England, who sanctioned it. All Danish waters were mined.

During this crisis the Zahle government proposed a coalition of all four parties, but discussions between them came to nothing. The *rigsdag* passed several emergency laws, primarily of economic character. A serious problem was the trade with England and Germany. Germany was able to stop the Danish export to England and England could stop import of necessary supplies for Danish agriculture and industries. Arrangements acceptable to all interests were concluded, and in November the Scandinavian countries declared that they intended to follow a uniform trade policy. In December a meeting of the three Scandinavian kings, premiers and foreign ministers took place at Malmö.

From 1915 the difficulties began. The restrictions on imports, imposed by England, became more severe. The German U-boat warfare was expanded from Jan. 31, and in the following years more and more Danish ships were sunk. The total loss during the war was 667 lives and 28,000 tons. When the United States entered the war in 1917 difficulties increased, because of U.S. restrictions on trade with Germany. Gradually the consequences of war were felt on the domestic scene. Agreements with the belligerents made restrictions on business necessary but were received with resentment. To combat inflation prices on domestic products were fixed, but legislation forcing the farmers to deliver certain amounts of grain met with opposition. From April 1, 1917, rationing was gradually introduced on several goods. Salaries did not rise with prices, and shortages in raw materials created unemployment. Rising governmental expenditure made higher taxes and loans necessary.

Politically, the question of a new constitution was taken up again when the first anxiety over the war had been allayed. The right was now interested in an agreement, and in 1915 the new constitution was passed. This provided a two-chamber parliament with equal suffrage for men and women. The privileged suffrage for the landlords and the wealthier classes electing the upper chamber came to an end. The voting age for the upper chamber (the *landsting*) was 35 years and for the lower chamber (the *folketing*) the age was to be lowered successively from 30 to 25 years. The *landsting* had 72 members, 18 of whom were elected by the outgoing chamber, the remainder by indirect elections. The *folketing* had 149 members, of these 93 were elected in individual districts and 24 in Copenhagen according to proportional representation. The additional 23 seats were distributed according to each party's percentage of the total vote. In the case of an amendment of the constitution a referendum had to take place. After the amendment had passed the two chambers of parliament, according to specific rules, 45% of the eligible voters had to vote in the referendum to give it validity.

A result of the new constitution was that the right accepted political democracy and parliamentary government. In Dec. 1915 the Conservative People's party was formed.

After the new constitution had been signed by the king on June 5, 1915, the Zahle government again tried unsuccessfully to form a coalition government. Nevertheless, important legislation was passed during the following years without much opposition. This included the reform of the administration of justice (April 11, 1916), which separated the administrative and judicial systems and introduced oral proceedings and publicity and trial by jury in criminal and political cases.

The privileged suffrage for county councils (*amtsraad*) was finally abolished in 1916. The land reform of 1919 is explained elsewhere in this article. A law passed on July 6, 1916, made it a duty of all employers to insure their employees against accidents. A law regulating limited companies was passed in 1917 and the first regulatory bank law was passed in 1919.

When the government in Aug. 1916 concluded a treaty ceding

the Danish West Indies (the Virgin Islands) to the United States for \$25,000,000 a political conflict arose. The Conservative and Liberal parties were originally opposed to the sale of the islands but a coalition government was formed on Sept. 30, and a plebiscite was held. At the polls (Dec. 14, 1916) 283,670 votes were cast in favour and 158,157 against, and the treaty was ratified.

The first election for the *rigsdag* in accordance with the new constitution was held in April 1918. Already in January the coalition had been dissolved, but the Zahle government was up held by the Radical Liberal and Social Democratic parties. The election issues were the government's economic policies, as many groups were tired of the restrictions and rationings imposed during the war. The election resulted in losses for the two government parties. The new *folketing* consisted of 22 Conservatives, 46 Liberals, 32 Radical Liberals, 39 Social Democrats and 1 independent, the government majority thus being only 2. In the *landsting* the Conservatives won 18 seats, the Liberals 26, the Radical Liberals 13 and the Social Democrats 15, the opposition parties thus having a majority.

Peace and the Schleswig Question, 1918-24—After the armistice on Nov. 11, 1918, the emergency army was quickly dissolved, the wartime military regulations abolished and the land defenses of Copenhagen destroyed. The defeat of Germany made possible the return of a part at least of Schleswig, but opinions were divided as to how big a part of the province Denmark should try to regain. The Danish population's representative in the German parliament, the Schleswiger H. P. Hansen, and the Zahle government wanted only those parts where the population was indisputably Danish and suggested a plebiscite in the northern zone of Schleswig, but an increasing number of the Danish people wanted the city of Flensburg too, or the whole province of Schleswig.

Hansen had already raised the question of self-determination for the Danes in Schleswig in the German *reichstag* in Oct. 1918. The Danish government on Nov. 28 turned to the victorious Allied powers and suggested a plebiscite in two zones: the first zone should vote as an entity, while in the second, which should include Flensburg, voting should be counted community by community. The Versailles treaty contained these provisions. Voting took place on Feb. 10, 1920, in zone 1, where 75,000 votes were cast for Denmark and 25,000 for Germany, and on March 14 in zone 2, where there were 52,000 for Germany and 13,000 for Denmark, only three small communities voting for the latter. The frontier was thus drawn as close to the nationality line as possible. In June the necessary amendment of the constitution was passed, and on July 10, 1920, North Schleswig was incorporated into Denmark.

At that time disagreement over the Schleswig question and other political controversies had resulted in the "Easter crisis" of 1920. Although the Zahle government had a slight majority in the *folketing* the king felt that the majority of the people was against the government's Schleswig policy and dismissed the ministry on March 29. The Social Democrats considered this move unconstitutional and threatened a general strike, but in a few days a ministry of nonpoliticians was formed with the task of framing an electoral law and holding elections. The election took place on April 26, 1920, with the Conservatives winning 28 seats, the Liberals 49, the Radical Liberals 17 (losing 50% of their seats) and the Social Democrats 42. The Liberal N.

prices in 1921 resulted in a severe crisis. Calculating that markets would be opened up in eastern Europe, many firms had overstocked and when their expectations proved wrong they found themselves in difficulties. Home industries that had grown up during the war were now hit by foreign competition, and in 1921-22 unemployment rose to 19.3%. The industries called for protection, but the government stuck to the free trade policy. Many bankruptcies ensued and several banks closed. In March 1922 the Copenhagen Landmandsbank was saved only by government intervention. Losses amounted to 500,000,000 Kr. Several of the leading bankers were convicted of fraud.

From 1923 the business cycle turned, exports rose and unemployment fell, but the value of the krone continued to decrease. In the elections for the *folketing* held in April 1924 the Neergaard government was defeated. The Liberals got 45 seats, the Conservatives 28, the Social Democrats 55, the Radical Liberals 20 and the German minority 1. Important legislation during the Neergaard period comprised a new defense law in 1922, reducing expenses on defense to 44,000,000 Kr., a sickness and invalid insurance law, an extension of land possibilities for small holders, and several laws concerning the church, such as one that admitted laymen to the pulpit and one that permitted free choice of civil or ecclesiastical marriage.

Social Democratic Government, 1924-26—After the election in 1924 the Neergaard government resigned, and Thorvald Stauning formed the first Social Democratic government in Denmark. Together with the Radical Liberals the Social Democrats had a majority of 2 in the *folketing*, while the opposition had a majority of 43 against 33 in the *landsting*. This forced the government to restrict legislation to the fields where an agreement with the opposition was possible.

On the advice of an expert committee the government in December introduced a law bringing the value of the krone gradually up to par, and in 1926 the gold standard was reintroduced. This deflationary policy led to a new crisis, marked by a heavy fall in agricultural prices, industrial difficulties and unemployment. The employers declared the biggest lockout in the history of Denmark, which ended in a deadlock when they were forced to give up the planned wage reductions. Bad economic conditions continued through 1926, unemployment figures reaching 29.8%. A bad harvest and German tariff on agricultural products increased the difficulties. In October the government introduced extensive legislation to combat the crisis, but the Radical Liberals voted against it. The ensuing election resulted in defeat for the government, the Social Democrats losing 3 seats and the Radical Liberals 4, while the Liberals and the Conservatives gained 2 seats each. A new party adhering to the ideas of the American Henry George won 2 seats and the German minority party 1 seat.

The Social Democrats, representing industrial and agricultural labour and small landholders, introduced legislation reducing the army and the navy to a frontier guard and proposed factory councils, an eight-hour working day and certain laws regarding banking and limited companies. These were all rejected, but in co-operation with the Liberals the government had passed a tax reform, which partly based land taxes on land values exclusive of improvements.

The Madsen Mygdal Government, 1926-29—The king failed in his attempt to get a coalition government, and the Liberal leader T. Madsen Mygdal, an estate owner, became prime minister. In February Madsen Mygdal introduced a budget cutting governmental expenditure by 60,000,000 Kr. through reduction in civil servant salaries, social legislation and military appropriations, but this did not solve the problems arising from unemployment and agricultural distress. In 1928-29 economic prospects seemed brighter, but a bank crisis in Sept. 1928 indicated further worries ahead. The government's continued deflationary policy, together with a law restricting the activities of trade unions, raised bitter opposition among labour groups.

A conflict with the Conservative party on military appropriations forced the Madsen Mygdal government to dissolve the *folketing*. In the following election the Social Democrats gained 8 seats, the Liberals lost 3, the Conservatives lost 6, the Radical

Liberals retained their previous number and the Henry George party (Retsfrie-partiet) won 1.

The Stauning-Munch Government, 1929-40—The new government was a coalition of the Social Democrats and the Radical Liberals with Stauning as prime minister and the Radical Liberal leader P. Munch as minister of foreign affairs, its program included disarmament, reform of the social legislation and the abolition of the *landsting*.

Shortly after the formation of this ministry the world economic crisis broke out and Denmark being highly dependent on foreign trade (especially with England and Germany), soon felt its consequences. At the end of 1930 there was a heavy decline in agricultural prices. The crisis spread to industry and to the building trades and unemployment increased. In 1932 one third of registered labour was unemployed and in the winter of 1932-33 economic collapse seemed imminent. Under these circumstances any idea of a return to prewar economy was untenable, and many forms of state planning were introduced. But strained economy and social unrest gave extreme parties a chance. During the early 1930s dissatisfied farmers formed a party and the Communists won seats in the *rigsdag*. A small group had adhered to fascism in the 1920s, and a Nazi party was also formed in the 1930s. Neither fascists nor Nazis gained any substantial following, and their activities were curtailed by the law of April 1933, which forbade the civilian use of uniforms in public (except for Boy Scouts).

When England left the gold standard in Sept. 1931 Denmark followed suit. In Jan. 1932 all trade in foreign currencies was centralized in a governmental authority, restrictions on imports were introduced and the government succeeded in keeping the krone stable in relation to the pound.

After the Ottawa agreements an Anglo-Danish trade agreement was concluded in April 1933, increasing imports from England. Bilateral trade agreements were made with Germany and other countries in the following years.

The economic crisis made extensive domestic legislation necessary and brought about co-operation between the coalition parties and the opposition. In Oct. 1931 the first "crisis agreement" was concluded with the Conservative party, providing relief for the unemployed and help to farmers, financed by increased taxation. In 1932 a new agreement was concluded, with all four parties co-operating.

In Nov. 1932 the *folketing* was dissolved. The following elections resulted in a victory for the government parties, but for the first time the Communists were represented in parliament. In Jan. 1933 a compromise was concluded (*Kanslersgadeforliget*) by which the agreements on wages were prolonged, the value of the krone reduced and fixed prices guaranteed to farmers for specified amounts of each agricultural product. By this legislation planning was further advanced. Earlier social legislation was coordinated and expanded into the *Socialreform*, which made Denmark one of the most progressive "welfare states" of western Europe. A new criminal code was passed and several public works projects were initiated, e.g., the building of bridges connecting the islands.

In the autumn of 1935 the government again dissolved the *folketing*, and the Social Democratic party won a great victory. At the elections for the *landsting* next year the government coalition won a majority in this chamber too. New legislation on public works and working hours in factories was passed.

Having now won control of both chambers, the government introduced a new constitution, abolishing the *landsting*. The Liberals opposed any change in the constitution, but the Conservatives, now that they had lost their hold on the upper chamber, were interested in constitutional reform. Discussions between the Conservative party under Christmas Møller, and the government coalition resulted in a constitutional bill on the principle "one electorate and one election day." The age limit for voting was lowered to 23 years. Parliament was to be elected as one body but to be divided after the election into two chambers, the *folketing* and the *rigsting*. The amendment further contained provisions for plebiscites. The bill was introduced in parliament

in Oct. 1938 and passed. According to the provisions for constitutional amendments parliament was then dissolved and a new election held. The new parliament also passed the bill. A plebiscite followed and the bill was rejected, since the required 45% of the electorate did not vote. After this defeat the government declared that the constitutional question would rest. A few months later World War II began.

Foreign Relations, 1918-40—From the beginning of the 20th century public opinion in Iceland had turned more and more toward independence, and in 1918 the constitutional relationship between Iceland and Denmark was amended. According to the new Danish-Icelandic treaty of union the two countries were independent sovereign states, united through the king. The treaty contained provisions for common citizenship and stipulated that the Danish foreign service should represent Iceland in foreign countries, that Danish naval ships should take care of the inspection of fisheries in Icelandic waters, that a Danish-Icelandic council, meeting alternately in the two countries, should give advice on questions of common interest, and finally that amendments or a declaration of complete Icelandic independence could take place in 1940.

Already before the end of World War I a Danish committee had worked on a charter for an international organization. In March 1919 a delegation participated in forming the covenant of the League of Nations, and in Jan. 1920 Denmark accepted the invitation to join the new organization. The parliamentary resolution authorizing this stated that the charter did not bind the small nations to participate in military sanctions or restrict their freedom to reduce armaments. Denmark took part wholeheartedly in the activities of the League in the following years and had from 1933 to 1936 a nonpermanent seat in the council. It concluded arbitration treaties with several countries in the 1920s and signed the Kellogg-Brand pact in 1928.

In 1931 a conflict with Norway arose over Greenland. When the Norwegian-Danish union was dissolved in 1814 this island had remained with Denmark. The Danish trading system had been extended to the western coast during the 19th century, and the United States had acknowledged Danish sovereignty over the whole island in connection with the sale of the Danish West Indies. In 1919, when Norway raised the question of sovereignty over Spitsbergen, the Danish government had secured from the Norwegian foreign minister an oral acknowledgment of Danish sovereignty over Greenland and acknowledged in return the Norwegian claims to Spitsbergen. The Norwegian government nevertheless raised the question again in 1921 and during the following negotiations, maintained that East Greenland, apart from one Danish settlement, was no man's land. In 1931 the country between the 71st and the 75th parallel and in 1932 the district between the 60th and the 63rd were occupied by Norwegian expeditions and proclaimed to be Norwegian sovereignty. Denmark appealed to the Permanent Court of International Justice which decided on April 5, 1933, in favour of Danish sovereignty over the whole of Greenland. Excitement over this conflict soon subsided in both Norway and Denmark, and Scandinavian co-operation in foreign affairs increased in the later 1930s, meetings of the Scandinavian foreign ministers had been taking place since World War I. A common attitude was discernible in the League of Nations, and as the European and international atmosphere grew serious in the 1930s understanding between the Scandinavian states, now joined by Iceland and Finland, became closer. Denmark joined Finland, Norway, Sweden, Belgium and the Netherlands in the "Oslo group" created in 1930 for co-operation in tariff questions, and these states tried also to form a political partnership. But as the influence of the League of Nations declined the Oslo group at a meeting in Copenhagen in July 1938 declared that members of the League were no longer bound to participate in applying sanctions.

As the power of Adolf Hitler's Germany grew, Danish apprehensions increased, and it was feared that Germany would raise the question of North Schleswig. Early in the 1930s the German minority in this province had become restless, and its representative in the *folketing* raised the question of reunion with Germany.

The government in many ways tried to satisfy the German-speaking citizens, and when Germany in May 1939 proposed a non-aggression treaty Scandinavian co-operation broke down. Denmark accepted the German offer which was rejected by Sweden and Norway. The treaty was signed May 31 in Berlin. The two countries pledged themselves not to go to war against each other or give help to belligerents against the other. The treaty, valid for 10 years, provided that normal trade should be allowed during a conflict between one of the powers and a third country.

During the 1930s the question of Danish defenses had been discussed several times. In 1932 and 1937 new defense laws had been passed, but when war broke out in Sept. 1939, Denmark was badly prepared to withstand an attack.

World War II—When World War II broke out, the government immediately proclaimed Danish neutrality and, as in 1914 parliament passed laws adapting the economy to the new situation. The Stauning Munch government suggested a coalition backed by the so-called "old parties," but the offer was rejected by the Liberals.

On Sept. 4, 1939, British aeroplanes bombed the city of Esbjerg by mistake, causing material damage. The Danish ship "Vendila" was sunk in the North sea and 33 ships were lost by April 1940.

King Christian X conferred with the other Scandinavian kings and with the president of Finland in Stockholm. Then, when the USSR attacked Finland, Denmark's sympathy was all with the latter. Danish volunteers participated in the war, and medical and other supplies were sent.

It was hoped that Denmark would be able to stay neutral, as in World War I. Precautions were taken to prevent violations of Danish waters by U boats, and a discussion in parliament on defense in Jan. 1940 resulted in a declaration from the government that Denmark would fight, if attacked.

In February came the "Altmark" affair in a Norwegian fjord, and controversies over the transport of iron ore from Sweden to Germany caused new anxiety. Although Germany at the end of Aug. 1939 had declared that Danish neutrality would be respected, Hitler in October discussed action against Scandinavia and in Jan. 1940 gave orders to make plans for the occupation of Norway and Denmark. The German interest was concentrated on Norway, but Denmark was included as the vital passage for the operation. Herluf Zahle, the Danish minister in Berlin, reported rumours of German concentrations in Baltic harbours on April 4, and the departure of transport ships from Stettin on April 7. England and France on April 7 and 8 mined Norwegian waters, and at the same time German troops were reported on the move between Rendsburg and Flensburg. The government considered giving orders for mobilization, but the German minister Cecil von Renthe-Fink warned Munch against taking any measures that might provoke Berlin to retaliation. After consultations with the leaders of the parties the government decided not to mobilize the emergency army, but an order of readiness was issued to the navy. On the same day a German fleet went through the Great Belt. Two of the ships, the troop transport "Hansestadt Danzig" and the icebreaker "Stettin" went north of Zealand, then turned south and sailed through the Sound.

The attack was planned to begin on April 9, at 4 o'clock. At that time Renthe-Fink presented Munch with a memorandum (the 13 points) stating that England planned to occupy Denmark and that Germany was therefore forced to protect Danish territory but promised not to violate Denmark's integrity or political independence.

Simultaneously German troops crossed the border and landed at several points on the islands, where fighting broke out with Danish troops. German troops also entered Denmark's only naval harbour, Copenhagen. Ice had prevented the necessary patrolling and confusion in one of the forts at the harbour entrance allowed two German ships to enter without a shot being fired. Troops were landed, occupied the citadel and moved toward the Amalienborg palace, where fighting with the royal guards began.

The king and several of the ministers were discussing the ultimatum while German bombers were circling over the city. As help from England or France could not be expected, it was decided to

accept occupation under protest. The reaction of the people was a feeling of despair mingled with humiliation and resentment against the government and the army. The king's proclamation that order was to be maintained and conflict with the German troops avoided, was obeyed and normal life was gradually resumed.

The Danish people, generally pro British and for historical reasons antagonistic toward Germany, at first adopted an attitude of "wait and see" in view of the correct behaviour of the Germans. But the ostensible willingness to co-operate ceased and a period of passive resistance began when the Germans broke their promise not to interfere in Danish affairs.

A coalition government was formed on April 11, with Stauning as premier and the democratic parties in parliament formed a co-operation committee. The necessary collaboration with the Germans was established, and the necessary economic provisions were passed by parliament. Imports from the west were stopped and despite agricultural production stocks of food ran low. The requirements of the Germans led to severe shortages and structural rationing became necessary. Inflation was kept under control.

On April 9 the connection between Denmark and Iceland was broken, and on April 12 the Icelandic ministry took over the functions of the king. The Faeroe Islands were occupied by British troops on April 25, and the Danish minister in Washington, D. C., Henrik Kaufmann, laid the foundation for the U.S. occupation and protection of Greenland. During the summer there was extensive political unrest, primarily aimed at the foreign minister, who was blamed for the lack of military preparedness on April 9.

The government was reconstructed in July. Erik Scavenius, known for his pro German attitude as foreign minister during World War I, took over the portfolio of foreign affairs, and the industrialist Gunnar Larsen was appointed minister of traffic. On July 8 Scavenius issued a declaration promising co-operation with Germany. This led in the following weeks to negotiations on a customs and currency union, but the German proposals invariably involved Danish subservience to the German economy and the government in August succeeded in postponing the negotiations indefinitely. However, a Danish German association to promote cultural understanding was formed in August.

Passive resistance soon increased. The king's 70th birthday (Sept. 29) was made the occasion for loyal demonstrations. The minister of trade, Christmas Møller, leader of the Conservative party, was one of the first politicians to express Danish antagonism toward the conqueror. During the negotiations on the customs and currency union the first underground newspaper was printed.

In the autumn antidemocratic and pro-German forces tried their strength. A Nazi-infiltrated farmers' group and a group of industrialists and rightists attempted unsuccessfully to force a change of government. In November the Nazi party, under the leadership of F. Clausen, tried a coup that ended in utter failure. Around the New Year, 1941, the Germans tried in vain to have Stauning dismissed. However, they succeeded in forcing two leading Social Democrats to resign from their party posts and used the ensuing conflict to press the government into delivering a number of destroyers to the German marines.

From the beginning of 1941 the Germans increased their efforts to absorb Denmark into "the new Europe." They cajoled and threatened the press for a "positive" attitude, inaugurated a German scientific institute, and arranged journeys to Germany for editors, trade union leaders and others (though the majority of those invited found excuses not to go). A crisis arose in April, when Henrik Kaufmann, who from the beginning of the occupation had detached himself from the government, concluded the Greenland treaty with the United States; the government repudiated this step and dismissed him from office. In May Iceland dissolved the union with Denmark, not awaiting the time when negotiations would be possible.

The Communists had taken a benevolent attitude toward the occupation, but after the German attack on the USSR they were arrested and interned. The Communist party being made illegal in July Danish volunteers joined "Frikorps Danmark" to participate in the war on the eastern front. This was officially approved by Scavenius but led, in connection with other tensions within

the ministry, to a crisis in July, when Scavenius threatened to resign.

In the autumn the Germans forced the government to sign the Anti-Comintern pact, which provoked the first serious anti-German demonstrations in Copenhagen. Opposition against the Germans increased in 1942. In April Christmas Møller and the Communist leader Axel Larsen, who had gone underground, founded the underground paper *Frit Danmark*. Christmas Møller fled to England in May and was elected chairman of the Danish council in London. His broadcasts strengthened the will to resistance, and the first saboteurs, trained in England, were parachuted into Denmark.

Gradually German irritation matured. In September, when Erikorps Danmark returned home on leave, clashes between citizens and soldiers broke out because the population generally considered them traitors. Moreover the Germans were extremely annoyed at the flight of Christmas Møller and accused the Conservatives of duplicity. As sabotage increased their anger grew. Speeches and lectures by patriots won more and more resonance, and sentences of imprisonment only augmented their number and audacity.

The king's answer to a telegram from Hitler on his birthday was thought by Hitler to be too cold and unfriendly and was made the excuse for a change of action. Their German minister was recalled, the Danish minister in Berlin was handed his passport and for several weeks the Germans were completely silent as to the measures that they were going to take. Then they demanded the resignation of the Social Democratic prime minister Vilhelm Buhl (who had taken office on Stauning's death in May 1942) and the formation of a ministry that would actively collaborate with them. Scavenius, though he despised German and Danish nazis, nevertheless was convinced of Germany's strength; he accepted the premiership, but was received with resentment both among the people and in parliament.

A new German representative in Denmark was now appointed. Werner Best was reputed to be an intelligent nazi who wanted to restore quiet in Denmark and to be able to exhibit the country as a "model protectorate." In pursuance of this policy the Germans in March 1943 permitted an election for the *folketing*. The democratic parties fought the campaign on a closed front, there was an enormous poll and the result was a resounding defeat for Danish nazism. But Best could interpret the result as a victory for the government and his appeasement policy.

During the summer of 1943 Danish German relations grew progressively worse. Sabotage increased regardless of warnings from the king and from the prime minister. The Liberty council (*Frihedsraadet*) was formed by representatives of all groups participating in active resistance. After the fall of Italy general unrest prevailed.

In August violent riots broke out in several cities, followed by waves of sabotage. On Aug. 28 Best handed the government an ultimatum demanding proclamation of martial law and death sentences for acts of sabotage. Unanimously the government rejected the German ultimatum the same day. Next morning the German

mans accepted a compromise, by which the strike was called off and the German troops moved away from the city.

In September the Danish police, rightly suspected of helping the resistance, were arrested and sent to German concentration camps. From then on lawlessness and terror reigned. Several leaders of the resistance who had been interned by the gestapo in the Shell building in Copenhagen escaped when the building was destroyed by the R.A.F. (March 21, 1945), and the gestapo's archives disappeared in the flames.

From Feb. 1945, with the defeat of Germany in sight, thousands of German civilian refugees began to arrive in Denmark. On May 4, 1945, German forces in northern Germany, the Netherlands and Denmark capitulated, and the next day British troops moved over the Danish frontier. While the main part of Denmark was liberated by British troops, soviet troops moved into Bornholm, where on May 7 several places were bombed because the German troops refused to capitulate.

The Postwar Situation—A government under V. Buhl, which included members from the political parties and from the resistance movement, was appointed on May 5. During the summer parliament abolished all legislation enacted under German pressure and passed laws for the prosecution of collaborators and war criminals. In an election held on Oct. 30 the Social Democrats lost 18 seats, the Radical Liberals 2 and the Conservatives 5, while the Liberals won 10 and the Communists no less than 15. The Buhl ministry resigned and the Liberals formed a minority government under Knud Krastensen, with the diplomat Gustav Rasmussen as foreign minister.

During 1946 there were frequent strikes and often illegal ones, partly in support of demands for higher wages and partly because of dissatisfaction over the manner in which the prosecution of collaborators and war criminals was carried out. Another question that gradually brought the government into conflict with the majority in parliament was that of South Schleswig. After the liberation the government had declared that it would not seek immediate revision of the frontier and that it favoured self-determination for the Danish population of South Schleswig. But as pro-Danish sympathies manifested themselves there, groups in Denmark came to desire action toward recovering South Schleswig for Denmark, and the prime minister's speeches indicated his agreement with this policy. On Oct. 28, 1946, the *folketing* was dissolved. In the ensuing election the Social Democrats gained seats, while the Communists lost half of the number that they had had and the Liberals also lost some. Knud Krastensen resigned, and the Social Democratic leader Hans Hedtoft formed a new government. King Christian X died and was succeeded by his son Frederick IX in April 1947.

After 1945 the government's major problems were economic. New investment was necessary to bring production back to prewar levels, and occupation costs had to be liquidated. The 200,000 German refugees who stayed in the country until 1949 increased these difficulties. The Marshall plan was therefore of decisive importance for reconstruction. From the second half of 1948 economic prospects were better; production reached prewar levels and rationing was abolished for most goods.

When the United Kingdom devalued the pound sterling in Sept. 1949 Denmark likewise devalued the krone, and price developments began subsequently to work against Denmark. At the same time the liberalization of foreign trade entailed by membership of the Organization for European Economic Co-operation presented more worries. The Conservatives and the Liberals wanted to push liberalization but the government was reluctant.

An election in the summer of 1950 did not decisively alter the strength of the parties in the *folketing*, but shortly afterward the Hedtoft government was replaced by a coalition of Liberals and Conservatives under Erik Eriksen. Economic troubles continued and rearmament contributed to the growing deficit. The government introduced several measures to combat inflation and to limit imports, and early in 1952 there was some indication that the situation was beginning to improve.

Immediately after the war a delegation went to San Francisco to participate in the United Nations' conference. During 1945 and

lished between the Liberty council and the political parties.

The Germans, assisted by Danish traitors, formed terror groups (*Schalburghorps*), arranged countersabotage and murdered patriots, the so-called "clearing murders." In June 1944 the population of Copenhagen revolted and called a general strike (*folkestrejken*). For several days the situation was tense. The Germans shut public utilities off and threatened to bombard the city, the strike seemed likely to spread to the provinces. Finally the Ger-

1946 the South Schleswig question occupied a dominating place in foreign relations, but from the beginning of 1948 questions of defense and potential alliances began to overshadow all other issues. Denmark had hoped that the United Nations would inaugurate a period of international co-operation, and despite the increase in soviet power and the disillusioning developments in eastern Europe the Danish prime minister declared that his country would join neither a western nor an eastern bloc. But the Communists' coup in Czechoslovakia changed public opinion, and during the second half of 1948 Denmark, Norway and Sweden began negotiations for a defensive alliance. In Jan 1949, however, these negotiations broke down, primarily because of Norwegian-Swedish disagreements.

The Hedtoft government suggested a Swedish-Danish defense arrangement, but this was rejected by the Swedes. Thereupon Denmark in April 1949 accepted the invitation to join the North Atlantic Treaty organization. This complete break with the traditional policy of neutrality was accepted by the majority of the people but was opposed by the Communists and, because of their belief in neutrality, by the Radical Liberals.

Denmark also joined the Council of Europe but rejected, together with England and the other Scandinavian states, the continental European policy in this body. The same attitude was taken toward plans for a European army. Although Scandinavian defense plans had broken down, Denmark still tried to develop Nordic co-operation. Negotiations for a customs union came to nothing, but in 1952 closer co-operation between the parliaments was planned.

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POPULATION

The total population in 1950 was 4,281,275 (cf. 3,844,312 in 1940), with an average of 258 per square mile. The density in the islands is nearly twice that in the peninsula. Against greater Copenhagen's 1,169,340 inhabitants in 1950 (800,130 in 1910), the next largest is Aarhus, had 110,167 (99,587), Odense 100,940 (82,321), Ålborg 79,806 (55,677) and Esbjerg 84,205 (33,155). Other provincial towns had not more than 40,000 each. The urban population in 1950 amounted to half the total that is to 2,105,817 (or, with suburbs included, 2,424,360), whereas in 1875 it constituted only one quarter. The great concentration of the capital and the rapid growth of the larger provincial towns in the preceding decades accounted for most of this increase. The smaller provincial towns having been stagnant.

On the total population, 95% belong to the Lutheran church which was introduced as early as 1536. A there is complete religious toleration, the other important Christian communities

are represented, and 1% of the population is of no confession. The king must be a Lutheran. The primate is the bishop of Copenhagen, and there are nine dioceses.

Employment.—Agriculture or fisheries provided the living, directly or indirectly, of 1,065,000 persons in Denmark in 1950, handicrafts and industry that of 1,285,000, commerce and finance that of 485,000, transportation that of 248,000, and administrative and intellectual occupations that of 268,000. Classified as "economically inactive" were 420,000 (Figures include children and dependents).

At the opening of the 20th century unemployment was about 10% (annual average). In 1913 it had sunk to 7 3/4%, but it increased to 18 1/2% in 1918 because of the deterioration of Danish economy during World War I. In the 1920s the average unemployment was 16%, and during the international depression in the early 1930s it rose further to 25%-30%. It had sunk to 18 1/4% in 1939 but increased to 23 1/2% the next year on account of the situation created by World War II. It sank to 8 1/2% (annual average) in 1948 but rose slightly, to 9 1/2%, in 1949. As, however, much work in Denmark is seasonal, a truer picture of unemployment will be found in the monthly percentages than in the annual average. The maximum monthly percentage in 1949 was 18 1/2% (December), the minimum 4 7/8% (June). In fact, Denmark had full employment in the later 1940s. Moreover, social insurance alleviated the difficulties of the unemployed after World War I (E. E. E., H. LN).

GOVERNMENT AND ADMINISTRATION

Constitution.—The constitution of Denmark is laid down in the act of June 5, 1915, amended in 1920 on the restoration of North Schleswig in accordance with the treaty of Versailles. Legislative authority rests jointly with the crown and parliament, the executive power is vested in the crown, while the administration of justice is exercised by the courts. Parliament consists of two chambers, the *landsting* (senate) and the *folketing* (lower house). The franchise is held by all persons over 25 years of age. The members of the *folketing* numbered 151 (including 2 from the Faeroe Islands) in 1951; they are elected for four years. Of the members of the *landsting*, 57 (including one from the Faeroe Islands) are elected by the votes of the *folketing's* electors who are over 35 years of age, while 19 members are elected by the former *landsting*. The *rigsdag* (parliament) must meet every year on the first Tuesday in October. The privy council is the highest executive power in the state, it deals with all new bills and all important government measures. For administrative purposes there are 22 *amt*er (counties), each of which is under the superintendence of a governor. Local government is largely in the hands of the municipal councils.

Education.—Since 1814 education has been compulsory for those between 7 and 14 years. The school laws of 1937 made this instruction free. However in 1949 only 35 of these schools were government institutions, 3,713 were maintained locally and 364 were private. Teachers are trained in about 20 teachers' schools. After five years of elementary instruction, a pupil may receive four years of secondary education and may then proceed to a high school, of which there were about 430 at mid century. Here there is a choice between classical, modern-language and scientific courses terminated by a state examination. There are approximately 60 popular high schools for adults, all private but assisted by the state. For specialized study there were 27 agricultural schools at mid century (one including veterinary courses), two dairy schools, more than 200 commercial schools and more than 300 technical schools, as well as institutions for dentistry, pharmacy, music and art. Copenhagen university was founded in 1479 and had about 6,000 students in 1950. Aarhus university, founded in 1928, had about 1,500 students. Women are received on a parity with men in all departments. There are 1,300 public libraries.

Defense.—The principle of national conscription was adopted in 1849. Recruits are enrolled at 17 and receive instruction of at least 18 months between the ages of 19 and 25. Liability to call extends over 16 years, in two classes.

During the German occupation 1940-45 the Danish army was dissolved and its equipment taken over by the Germans. Having joined the North Atlantic Treaty organization, however, Denmark started to rearm. The Army act of 1951 brought the total strength of the army under war conditions to 100,000 men, that of the home guard to 40,000. The navy was by 1954 to comprise smaller vessels for coastal guard, motor torpedo boats, mine layers and mine sweepers, escorting vessels and submarines, the air force, nine squadrons of fighters.

ECONOMICS

Agriculture—One of the most significant facts of the Danish economy is the high ratio of productivity of the land: 90% is productive and 75% actually farmed (3,145,000 ha in 1950).

Farm Holdings—Denmark possesses an unusually large number of freehold farms—95% as against 5% rented. In the first half of the 20th century a trend toward tenantry could be discerned in many countries but Denmark proceeded in the opposite direction. The conscious governmental attempt to subdivide large farms and to establish agricultural workers on independent holdings began with the legislation of 1899 and was reinforced by the three land laws of 1919 and by the acts of 1933, 1934, 1948 and 1949. Co-operatives helped to make small farm operation profitable, and animal husbandry, a prominent feature of its activity, also lent itself to small individual enterprise.

The Small Holdings acts and the agricultural expansion of the country resulted in the subdivision of large estates, the parceling out of glebe land and the abolition of leasehold. Tiny parcels were added to other small holdings or enlarged by land from larger farms. The steady growth of independent small farms under the law of 1899 and its amendments is shown in Table I.

TABLE I—Increase of Small Farms Under the Act of 1899 and Its Amendments

| Year | Number | State loans and grants |
|---------|--------|------------------------|
| 1900-10 | 5 092 | 31 300 000 Kr. |
| 1910-20 | 4 171 | 28 400 000 Kr. |
| 1920-30 | 5 893 | 70 000 000 Kr. |
| 1930-40 | 8 758 | 49 400 000 Kr. |
| 1940-49 | 8 758 | 13 300 000 Kr. |
| Total | 18 453 | 182 300 000 Kr. |

The addition of the 7,203 farms established under the acts of 1919 brought the aggregate number (1900-49) of newly established farms under the Small Holdings acts to 25,626. State loans to farms established under the acts of 1919 amounted to 96,300,000 Kr., bringing the total of state loans and state grants to small holding farms (1900-49) to 281,500,000 Kr.

Purchasers under the acts of 1919 of glebe land, fiefs or estates paid no purchase sum but only an annual interest to the government. In effect these holders become owners.

The distribution of farms according to size is shown in Table II. The total of farm holdings in July 1946 was 208,147, representing a notable increase over the 171,495 of 1903. However, it must be remembered that the acquisition of South Jutland in 1920 added 14,364 farms.

Production and Marketing—During the period from 1875 to 1950 Danish agricultural production increased rapidly, though World Wars I and II and the agricultural depression in the early 1930s brought some temporary falling off. The crop yield increased 250%, mainly through the purposeful application of science in the breeding of plants and a more enlightened use of manure and fertilizers, apart from expansion of the area cultivated. The increase of crop yield is shown in Table III.

In Table III statistics include the crops of grain, hay, potatoes, fodder, beets, sugar beets and chancy roots, but not green fodder, the crop of which in 1949 was estimated at 36,500,000 hectokilos of barley, thus bringing the aggregate crop yield in 1949 to 129,800,000 hectokilos of barley.

Barley and oats in 1949 accounted for about 80% of the total grain crop, which was 41,330,000 hg. Fodder beets made up about 80% of the root crops, which in 1949 totalled 246,610,000 hg. Production of hay amounted to 78,000,000 hg.

TABLE II—Distribution of Farms According to Size

| Size in hectares | Number | | Agricultural area 1946 (thousand hectares) |
|------------------|---------|---------|--|
| | 1913 | 1946 | |
| 0.5-1 | 15 620 | 3 715 | 47.4 |
| 1-2 | 23 257 | 22 210 | 84.1 |
| 2-5 | 41 113 | 55 649 | 234.1 |
| 5-10 | 29 118 | 37 195 | 170.8 |
| 10-20 | 41 485 | 48 717 | 204.5 |
| 20-50 | 22 847 | 21 008 | 110.6 |
| 50-100 | 4 534 | 3 534 | 161.0 |
| 100-250 | 901 | 731 | 115.7 |
| 250 and more | 201 | 205 | 24.7 |
| Total | 200 693 | 208 147 | 3 177.2 |

The increase of harvest yield together with the importation of grain and feeding stuffs, the latter in 1949 amounting to 324,000,000 Kr., made the Danish specialization in animal husbandry possible. The rise in the livestock production, which began in the 1880s, must also be attributed to the application of science in

TABLE III—Crop Yield

| Years | Average annual yield (in hectokilos of barley) |
|---------|--|
| 1880-84 | 31,000 000 |
| 1885-89 | 33 500 000 |
| 1890-94 | 37 800 000 |
| 1895-99 | 40 600 000 |
| 1900-04 | 46 100 000 |
| 1905-09 | 54 300 000 |
| 1910-14 | 58 600 000 |
| 1915-19 | 52 500 000 |
| 1920-24 | 59 000 000* |
| 1925-29 | 73 800 000* |
| 1930-34 | 79 700 000* |
| 1935-39 | 81 500 000* |
| 1940-44 | 86 500 000* |
| 1945-49 | 83 300 000* |

*Including South Jutland

breeding and to improved methods in feeding and care. Its progress is shown in Table IV.

As is apparent from Table IV, World Wars I and II injured the industrialized agricultural economy seriously. The intensive swine marine activity in the last two years of World War I and the German occupation of Denmark in World War II made the importation of grain, feeding-stuffs and fertilizers difficult or impossible, consequently the number of farm animals was reduced. The

TABLE IV—Number of Farm Animals (In thousands)

| Year | Horses | Cattle (total) | Cows | Pigs | Sheep | Poultry |
|------|--------|----------------|-------|-------|-------|---------|
| 1884 | 375 | 1 638 | 981 | 697 | 1 612 | 5 000 |
| 1914 | 965 | 719 | 1 410 | 711 | 533 | 15 495 |
| 1918 | 578 | 2 093 | 1 560 | 606 | 405 | |
| 1926 | 548 | 2 838 | 1 480 | 3 222 | 213 | 18 524 |
| 1931 | 521 | 3 072 | 1 647 | 3 030 | 199 | 28 508 |
| 1939 | 591 | 3 346 | 1 642 | 3 222 | 147 | 33 296 |
| 1941 | 611 | 3 36 | 1 517 | 1 610 | 120 | 17 890 |
| 1949 | 514 | 2 618 | 1 514 | 2 681 | 65 | 25 161 |
| 1951 | 450 | 3 102 | 1 583 | 1 200 | 55 | 21 000 |

*Figures even before 1930 include South Jutland for purposes of comparison
†Figures for 1946

stocks of horses and cattle of course fluctuate less widely than those of pigs and poultry, which can be adjusted very quickly to changing conditions. The peak in livestock production was reached at the beginning of the 1930s, the number of pigs being 5,453,000 in 1931, but the international agricultural depression of that time caused a severe reduction. The increase in number of horses during World War II was the result of shortage of fuel, but after the war tractors took the place of thousands of horses.

During World Wars I and II not only the number of cows, but also the yield of milk per cow was drastically reduced. It fell from 2,750 kg in 1914 to 1,810 in 1919 and from 3,295 in 1938 to 2,323 in 1942. In 1949 the milk yield per cow reached 2,994 kg, and by 1951 it was estimated to be near that of 1938. However, the milk's percentage of butterfat rose so that 22 kg of milk were used for producing 1 kg of butter in 1949 as against 23.6 kg in 1949. Nevertheless butter production fell from 183,000,000 kg in 1939 to 109,000,000 kg in 1942, though in 1950 it came up to the level of 1939.

The aggregate production of animal husbandry showed in 1950 the following figures (in parentheses the annual average for

1935-39) milk 5,400,000,000 kg (5,270 000 000), butter 179 000,000 kg (180,000,000), cheese 59 000 000 kg (33,000,000), meat of oxen and calves 170,000,000 kg (176 000 000), bacon pork filets etc 357,000,000 kg (329 000,000), eggs 132,000,000 kg (120 000 000)

In 1913 Denmark exported agricultural produce worth about 550,000,000 Kr, about 97% of which was made by animal products. The value of agricultural products exported rose to 1,174 000 000 Kr in 1927, more than double that of such exports in 1913, by 1950 it had risen to 2,826,000,000 Kr, 95% of which was made by animal products (See Table V)

TABLE V—Export of Animals and Animal Products

| Years | Thousand head | | | Million kilograms | | | | | | Million score |
|---------|---------------|--------|-------|-------------------|--------|----------------|-------|------|------|---------------|
| | Horses | Cattle | Pigs | Butter | Cheese | Condensed Milk | Bacon | Beef | Eggs | |
| 1910-13 | 68 | 143.0 | | 88.5 | 0.3 | 2.5 | 116 | 27.0 | 25.2 | |
| 1914 | 67 | 188.0 | | 95.3 | 0.3 | 7 | 147.1 | 27.1 | 7.5 | |
| 1918 | 29.2 | 111.8 | | 74.7 | 3.2 | 1.4 | 7 | 110 | 19.7 | |
| 1924 | 15.6 | 172.0 | 205.7 | 124.4 | 8.8 | 14.2 | 197.2 | 1.9 | 30.0 | |
| 1929* | 12.0 | 172.0 | 167.0 | 153.0 | 0.0 | 18.0 | 175.0 | 1.0 | 81.0 | |
| 1930* | 11.4 | 163 | 137.1 | 119.8 | 0.5 | 17.0 | 180.5 | 20.0 | 85.0 | |
| 1936* | 21.8 | 372.7 | 254.0 | 109.9 | 8.9 | | 143.0 | 12.4 | 67.1 | |
| 1943* | 33.8 | 67.0 | 48.7 | 50.4 | 2.1 | 7.6 | 63.0 | 0.9 | 1.8 | |
| 1945* | 35 | 39.1 | 9.9 | 61.2 | 0.5 | 3.9 | 40.9 | 21.0 | 7.8 | |
| 1949* | 20.1 | 38 | | 139.3 | 30.1 | 40.5 | 105.6 | 61.1 | 79.8 | |

*Including South Jutland

Both change and increase in the agricultural and animal products and their export between 1910 and 1949 were largely the result of demand in the foreign market—especially in the British, to which Denmark shipped by far the greater portion of her produce. In World War II, however, Germany was the main importer of Danish agricultural products (See Table VIII)

Co-operatives—Agricultural production and marketing in Denmark undoubtedly owed much to the growth of farm organizations. Associational promotion began as far back as the founding of the Royal Agricultural society (1769), and both it and numerous special societies stimulate breeding and other improvements. By 1950 local farmers' associations had 141,900 members and smallholders' societies 114,000 members, each group in a national federation. The national federation of farmers' associations established a joint organization with the Federation of Danish Co-operative Societies known as the Agricultural Council (*Landsbrugsrædet*). This council and the national federation of smallholders' societies represent agriculture in dealings with the government and with industry and in foreign trade. Numerous co-operative societies flourish, and in the important dairy and bacon business they dominate the scene. In 1950 there were 1,566 dairies, of which 1,321 were co-operative societies, and 61 co-operative bacon factories. About 85% of all cows belong to dairy farms that are members of the co-operative organization, and 15% of the pigs belong to the 70% of farm members of the bacon-factory co-operative. Only about 30% of the egg production is co-operatively organized, but even this is of great importance in the maintenance of standards for the export trade. The extraordinary success of the Danish farmers in managing their co-operative societies, following the establishment of the first dairy co-operative society in 1882, resulted largely from the spread of adult education and especially the folk high schools.

Financial Returns—After the long period of depression at the close of the 19th century prices improved, and the relatively few financial accounts available for the years 1910-23 show an average yield of interest on capital invested in well-managed farms of about 4%-5%. During the first years of World War I the prices of corn and seed, as well as of live animals and meat, rose considerably, increasing the capital yield for large and middle-sized farms. In the later years of the war, prices of eggs, bacon and dairy products rose, increasing the returns on small farm investment, so that the average yield of interest rose to 8.3% in 1918-19. A sharp decline to 0.9% occurred in 1921-22, and in the following ten years the average yield of interest was from 1.1% to 6.4%. The international agricultural depression brought an average loss of 0.4% on agricultural produce in 1931-32, when

the depression was overcome the average yield of interest rose to 3.8% in 1939-40. Rising prices during World War II increased the interest to 7.1% in 1940-41 and to 6.6% in 1943-44, but much of this increase was also caused by reduction of live stocks (see Table IV). When the reduction was stopped after the war and prices were reduced the average yield of interest dropped to 2.3% in 1945-46. As the result of a very good harvest in 1948, increased prices and a considerable rise in live stocks, the interest rose to 6.5% in 1948-49.

Fisheries—In the course of the 19th century the fisheries were rejuvenated as an export industry through improvements in means of transportation and expansion in Icelandic and Greenland waters. In 1940 Denmark had 7,513 rowboats, 743 sailboats and 7,640 motorboats. The fish market of Copenhagen which contributed largely to that city's supremacy remains a visual and olfactory memory to visitors. About 20,000 persons were directly engaged in fishing in 1950 and numerous others were dependent on it. Workers in herring oil factories, merchants, netmakers, boat builders and motor makers (most of the motors and gear are manufactured in Denmark). Both the quantity and the value of the total haul increased after 1900. The value is shown in Table VI.

TABLE VI—Yield of Fisheries (In million kroner)

| | 1908 | 1918 | 1928 | 1938 | 1949 |
|--|------|------|------|------|-------|
| North sea, Iceland and Greenland waters | 23 | 12.0 | 15.2 | 21.6 | 100.4 |
| Lemfjord | 1.7 | 3.0 | 2.4 | 1.7 | 5.2 |
| Inner waters (east and south of the Sound) | 9.2 | 6.7 | 10.1 | 10.3 | 77.0 |
| Total | 33.2 | 41.7 | 36.7 | 44.6 | 177.5 |

The quantitative yield of fisheries in 1949 was 227,000,000 kg consisting largely of plaice (flatfish), with cod, herring, mackerel eel and haddock following in order of importance, of this total 127,000,000 kg were exported usually fresh, ice packed or live. Coastal fishing supplies mostly cod, plaice, eels, herring and mackerel, while deep sea fishing yields cod, plaice and haddock.

The fishermen have marketing and purchasing co-operatives, though not on the same scale as the farmers' societies.

Other Industries—Compared with agricultural produce and fisheries, the natural resources of the country are of minor importance. Though coal is found in Bornholm, neither coal nor metals can be profitably mined anywhere. Extensive strata of bog iron ore in Jutland are used for purifying purposes in gas works. The newer chalk is utilized in lime burning and also forms the basis of an important cement industry. Tertiary and glacial clays are used in the tile industry, while calcareous deposits of clay have been widely utilized, particularly in Jutland, for soil improvement. Bornholm supplies granite for building and paving and kaolin for the china and paper manufactures.

Danish industry produces primarily for home consumption, though certain products, such as diesel motors, steam and motor ships, dairy and agricultural machines, refrigerators, cement machines, Portland cement, sugar, pharmaceutical products and electrical equipment, are exported in large quantities. Though there are no iron mines there is a large casting and machine-building business. Textile manufacturing is important for the home market, as are margarine factories and the breweries (which also export). Bicycles are also manufactured and provide the most popular transportation for Copenhageners.

In the 1930s and the 1940s the export of industrial produce was increasing rapidly, and in 1950 it provided 1,537,000,000 Kr or 33% of the aggregate Danish export.

The metal industries employ the most workmen (130,000), food processing employs 85,000, earthworks and building 102,000, textile and footwear industries and clothing 97,000, woodworking 41,000, and chemicals 30,000. About one-quarter of the total number of industrial workers are women. The internal wholesale trade employed about 84,000 in 1948, retail establishments 188,000, and cafes and restaurants 46,000.

Table VII shows the development of handicraft and industry.

TABLE VII.—Handicrafts and Industries

| | 1907 | 1911 | 1925 | 1935 | 1948 |
|-----------------------------|---------|---------|---------|---------|-----------|
| Number of establishments | 77 256 | 82 404 | 89 180 | 100 017 | 109 288 |
| Total employees | 472 456 | 550 101 | 592 475 | 666 361 | 647 370 |
| Of which workmen | 178 413 | 227 158 | 260 890 | 317 305 | 427 602 |
| Works with mechanical power | 1 859 | 12 370 | 6 332 | 41 414 | 50 124 |
| Horse power of machinery | 48 000 | 220 843 | 437 010 | 651 738 | 1 190 150 |

Commerce and Shipping—The per capita rate of Denmark's foreign commerce is exceptionally high. This commerce depends especially on Great Britain, to which Denmark in the first three decades of the 20th century sent about 60% of its exports. In the years just prior to 1940 the proportion of trade with Britain declined slightly because of the "Buy British" policy inaugurated in the United Kingdom in the early 1930s and never completely overcome by trade agreements. Conversely, trade with Germany increased somewhat after 1930 because of German military and economic preparations, and during the German occupation of Denmark in World War II most Danish exports were sent to Germany or to German controlled territories. After the war trade with Great Britain was resumed and the United Kingdom again became the main purchaser of Danish exports. Details are given in Tables VIII and IX.

TABLE VIII.—Imports and Exports, Value and Distribution

| Value in million kroner | | | Distribution 1950 (in percentages) | |
|-------------------------|---------|---------|---------------------------------------|-----------------|
| Year | Imports | Exports | Country | Imports Exports |
| 1913 | 855 | 727 | | |
| 1917 | 1,080 | 1,066 | Great Britain | 31.8 43.0 |
| 1920 | 1 543 | 1 06 | Germany | 3 7 |
| 1926 | 1 480 | 1 517 | Sweden | 6.7 5.3 |
| 1930 | 1 620 | 1 340 | United States | 15.0 3.2 |
| 1939 | 1 740 | 1 377 | Norway | 3.7 5.6 |
| 1940 | 1 370 | 1 517 | France | 4.8 4.8 |
| 1942 | 1 509 | 1 053 | Belgium Luxembourg | 4.0 5.0 |
| 1943 | 697 | 904 | Poland | 2.0 2.3 |
| 1944 | 2 847 | 1 917 | Finland | 3.6 3.0 |
| 1947 | 3 058 | 2 135 | Other countries | 21.3 20.1 |
| 1948 | 3 423 | 2 730 | | |
| 1949 | 3 212 | 3 559 | World | 100.0 100.0 |
| 1950 | 2 997 | 4 519 | | |

Denmark's favourable position for shipping gives it a large mercantile marine in proportion to its population, with 300 tons per 1,000 inhabitants in 1950, the aggregate tonnage being 1,307,000 tons. The number of steamships fell from 651 in 1915 to 311 in 1950, but motor ships increased from 27 to 348 and combination sail motor ships from 370 to 1,412. Sailing vessels of more than 20 tons had almost disappeared, dropping from 870 to 3. Denmark was one of the leaders in the modern transition to motor ships, building them both for itself and others in its diesel works. Danish vessels carry about three fifths of the country's sea-borne trade and do a large foreign business, which in 1950 rendered a net amount of about 475,000 Kr.

Communication—Regular connection with England is by sea from Esbjerg to Harwich. There are ferry passages for travellers and trains from Gedser to Warnemünde (eastern Germany) and to Grossenbrode (western Germany) and Swedish services from Copenhagen to Malmö and from Elsinore to Helsingborg. Elsinore and Helsingborg also form a link in communications with Norway, another line being from Fredrikshavn (to Oslo). The main land route is the railway via Padborg and Schleswig to Hamburg. Denmark possesses about 5,000 km. of railways, nearly half of this total belongs to the state, and the state and the larger towns hold nearly all the shares in the "private" lines. There are highly organized tram-ferry schemes for communication between Zealand and Fyn and between Zealand and Jutland. A bridge (800 m.) connects Fyn and Jutland, and another bridge (3,200 m.) connects Zealand and Falster. Motor transport is highly developed, the number of motorcars was 169,194, of motorcycles 16,691 in 1949, and the total length of principal roads was 8,162 km., of byroads 44,854 km. Copenhagen is a centre of international air traffic. S.A.S. (Scandinavian Airlines System), a joint Danish, Norwegian, Swedish enterprise, serves European and intercontinental lines.

Finance, Exchange and Banking—After World War I ended in 1918 Denmark experienced a great credit expansion, due to loans abroad and to the state internally, to the demands of a

TABLE IX.—Principal Commodities Imported and Exported

| Imports | Million kroner | | Exports | Million kroner | |
|----------------------------|----------------|-------|---------------------|----------------|-------|
| | 1949 | 1950 | | 1949 | 1950 |
| Cran | 170 | 170 | Meats | 617 | 1 000 |
| Feeding stuffs | 310 | 310 | Dairy products | 1 135 | 1 150 |
| Coal oil electrical energy | 680 | 1 027 | Live animals | 68 | 25 |
| Iron and steel | 347 | 461 | Eggs | 305 | 349 |
| Textiles thread etc. | 600 | 957 | Fish | 100 | 170 |
| | | | Machines | 715 | 138 |
| | | | Vehicles ships etc. | 123 | 112 |

refreshed trade and to the development of South Jutland. The krone fell below par and it required steady state policy to bring it up to its gold parity by Jan. 1, 1927. Agriculture suffered but was able to weather the difficulties caused by this deflation. Then the British pound sterling collapsed in Sept. 1931, and the Danish krone was affected with it. From that time until 1940 Denmark adjusted its currency as well as possible to the pound sterling, as one of the so called sterling bloc. During this period state regulation of the imports was required to prevent the krone from falling below the rate of 22.4 Kr. to the pound sterling. During the German occupation from 1940 to 1945 financial relations with Great Britain and the pound were severed, but after the liberation in May 1945 Denmark again attached itself to the sterling bloc. The exchange rate was now 19.36 Kr. to the pound sterling and was maintained when the British pound was devalued in Sept. 1949, the krone being devalued with the pound.

The Nationalbanken had been compelled to finance the German occupation, issuing about 8,000,000,000 Kr. from 1940 to 1945. About 3,000,000,000 Kr. were confiscated through extraordinary taxation in 1945-46, but the remainder of the issue, together with a credit expansion in order to modernize industries and handicrafts and to make possible the importation of necessary goods, caused an inflationary development of prices, so that state regulation of foreign trade and of prices had afterward to be maintained.

The old joint stock private National bank, successor to the Rigsbank founded in 1813, was reorganized in 1936 as Nationalbanken. It is the only bank of issue and is controlled by a board of governors (25) who are chosen by the government, the *rigsdag*, the ministry of trade and by the board itself. At mid 20th century there were three large private banks and 158 smaller ones, the three large ones doing about one-half the total business. There were 506 savings banks, with deposits, in 1949, of 4,845,000,000 Kr. The Bourse is in Copenhagen. Insurance companies several dating from the 18th century, do a large business abroad as well as at home.

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DENNEWITZ, a village of Germany, in the Prussian province of Brandenburg, near Jüterbog, 40 mi. SW from Berlin. It was the scene of a decisive battle on Sept. 6, 1813, in which Ney, with an army of 58,000 French, Saxons and Poles, was defeated with great loss by 50,000 Prussians under Bulow and Taubertzen.

DENNIS, JOHN (1657-1734), English critic and dramatist, was born in London, and educated at Harrow and Cambridge. After travelling for some time on the continent he settled in London, and obtained, through the patronage of the duke of Marlborough, a small place in the customs, which he sold for a small charge covering a long period of years. His first successful plays were *A Plot and No Plot* (1697), a satire on the Jacobites, and *Rinaldo and Armida* (1699), and *Liberty Asserted* (1704). *Appius and Virginia* (written 1705 and produced at Drury Lane 1709) was satirized by Alexander Pope in the *Essay on Criticism*.

Appius reddens at each word you speak,
And stares tremendous with a threatening eye,
Like some fierce tyrant in old tapestry

Dennis replied in 1712 with *Reflections on the Essay*, and the quarrel was pursued in a series of pamphlets provoked by various incidents. He also quarrelled with Joseph Addison, and published *Remarks upon Cato* (1713), which drew from Pope the *Narrative of Dr Robert Norris, concerning the strange and deplorable Frenzy of John Dennis* (1713). In the end Pope and Dennis were reconciled, and exchanged friendly letters. But Dennis' best claim to remembrance lies neither in his plays nor in his literary quarrels but in the body of his, on the whole, sane critical work. He had the prejudices of his time, and is tiresomely insistent on poetical justice.

The most important of his critical works are *The Advancement and Reformation of Modern Poetry* (1701), *The Grounds of Criticism in Poetry* (1704), and *An Essay on the Genius and Writings of Shakespeare* (1712).

Dennis' *Miscellaneous in Prose and Verse* were collected in 1693. See H. G. Paul, *John Dennis, His Life and Criticism* (New York, 1911), and Elwyn and Courthope's *Works of Pope* (1871-79).

DENNISON, a village of Tuscarawas county, Ohio, U.S.A., 80 mi S by E of Cleveland, on federal highways 36 and 250 and the Stone fork of the Tuscarawas river, served by the Penn sylvania railroad. The population was 4,435 in 1950 and 4,413 in 1940 by the federal census.

DENOMINATION, the giving of a specific name to anything, hence the name or designation of a person or thing (Lat *denominare*, to give a specific name). In arithmetic it is applied to a unit in a system of weights and measures, currency or numbers. The most general use of "denomination" is for a body of persons holding specific opinions, usually religious, and having a common name, or for the various "sects" into which members of a common faith may be divided. "Denominationalism" is thus the principle of emphasizing the distinctions, rather than the common ground, in the faith held by different bodies professing one sort of religious belief. This use is particularly applied to that system of religious education by which children belonging to a particular religious sect are instructed in the tenets of their belief by members belonging to it and under the general control of the ministers of the denomination.

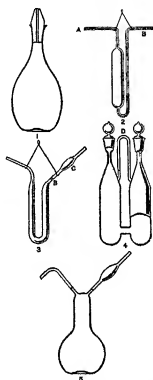
DENON, DOMINIQUE VIVANT, BARON DE (1747-1825), French artist and archaeologist, was born at Chalon sur-Saône on Jan. 4, 1747. He studied law in Paris, and in his twenty-third year produced a comedy, *Le Bon Père*, which obtained a succès d'estime. Louis XV entrusted him with the collection and arrangement of a cabinet of medals and antique gems for Madame de Pompadour, and appointed him attaché to the French embassy at St Petersburg. On the accession of Louis XVI Denon was transferred to Sweden, but he returned, after a brief interval, to Paris with the ambassador de Vergennes, who had been appointed foreign minister. In 1775 Denon was sent on a special mission to Switzerland, and visited Voltaire at Ferney. He made a portrait of the philosopher, which was engraved and published on his return to Paris. He spent seven years (1780-87) at Naples, first as secretary to the embassy and afterwards as *chargé d'affaires*. After a brief interval spent in Paris he returned to Italy, living chiefly at Venice. During the Revolution he returned to Paris, where he was protected by his friend the painter David. At Bonaparte's invitation he joined the expedition to Egypt, and there made numerous sketches of the monuments of ancient art, sometimes under the very fire of the enemy. The results were published in his *Voyage dans la basse et la haute Égypte* (2 vol fol, with 141 plates [Paris, 1802]). From 1804 to 1815 he was director-general of museums. He accompanied Napoleon in his expeditions to Austria, Spain and Poland, advising the conqueror in his choice of spoils of art from the various cities pillaged. He died in Paris on April 27, 1825. He left unfinished a history of Egypt.

See J. Renouvier, *Histoire de l'art en France*, t. 4, p. 111; *Revue des Beaux-Arts*, 1825, p. 101; *Revue des Beaux-Arts*, 1825, p. 101; *Revue des Beaux-Arts*, 1825, p. 101.

DENOTATION, in logic, a technical term used strictly as the correlative of connotation, to describe one of the two functions of a concrete term (from Lat *denotare* to mark out, specify). The concrete term "connotes" attributes and "denotes" all the individuals which, as possessing these attributes, constitute the genus or species described by the term. Thus, "cricketer" denotes the individuals who play cricket and connotes the qualities or characteristics by which these individuals are marked. In this sense, in which it was first used by J. S. Mill, denotation is equivalent to extension, and connotation to intension. It is clear that when the given term is qualified by a limiting adjective the denotation or extension diminishes, while the connotation or intension increases, e.g., a generic term like "flower" has a larger extension and a smaller intension than "rose", "rose" than "moss rose". In more general language denotation is used loosely for that which is meant or indicated by a word, phrase, sentence or even an action. Thus, a proper name or even an abstract term is said to have denotation (See CONNOTATION). Some writers would confine the term denotation to real things (as distinguished from merely imaginary ones) and use "extension" in the wider sense. In that case, the term "fairy" would have extension but not denotation.

DENSITY The density of a substance is the mass of a unit volume of the substance.

Density determinations can be made using simple laboratory apparatus and a high degree of precision is often obtainable.



FIGS 1-10—FORMS OF PYCNOMETER

Accurate density determinations form a means of estimating the molecular weight of gases. The density of crystals examined is valuable in X-ray analysis of crystal structure and may be used in connection with X-ray data to obtain the molecular and atomic weights of substances in crystals. Density determinations are used in the study of the constitution of liquids and solutions, of the dissociation of gases and of the effects of cold working on metals. Lord Rayleigh's investigation of the density of "atmospheric nitrogen" led to the discovery of argon. The density of alcoholic solutions is a measure of the alcohol content on which taxes are assessed. The amount of "heavy water" present in ordinary water is calculated from the density. In the evaluation of other physical constants (surface tension, viscosity, etc.) the density of the substance under investigation must be known.

These examples suffice to show ways in which the knowledge of the density of materials is of service and indicate why the

density is a fundamental property of matter.

Units of Density.—Density may be expressed in terms of any consistent units of mass and volume as, for example, pounds per gallon, pounds per cubic foot, grams per cubic centimetre or grams per millilitre.

The most generally used unit is grams per millilitre. The litre is defined as the volume occupied by one kilogram of pure water at 3.98° C (this is the temperature at which water has the maximum density and the minimum change in density with temperature). The millilitre is one one-thousandth of a litre, while the cubic centimetre is the volume of a cube one centimetre on an edge. Although the millilitre and the cubic centimetre may be considered as being synonymous for practical purposes, they are actually defined in terms of independent standards, the kilogram

and the metre. In precise work the difference ($\pm 1 \text{ ml} = 1.000028 \text{ cc}$) must be kept in mind.

The symbol d is frequently used to represent the density while the symbol d_{wt} represents the specific gravity (the weight of a given volume of substance at temperature t , divided by the weight of an equal volume of water at temperature t). d_{wt} is identical with the density in grams per millilitre.

Temperature and Pressure Effects—In general, an increase in temperature or a decrease in pressure results in a decrease in density. These effects are large for gases so that both the temperature and the pressure must be taken into account in determining and reporting the density. The effect of moderate changes in pressure on the density of liquids or solids may be ignored, but the effect of temperature must always be taken into account.

Determination of the Density of Liquids.—Pycnometer Method—The density may be calculated readily from the weight of liquid required to fill a vessel of known volume. A pycnometer is a vessel that can be filled with precision, is easy to clean and weigh and can be brought to a uniform temperature. Five conventional forms of pycnometer fulfilling these requirements are illustrated in figs 1 to 5.

The quantities required to determine the density of a liquid are (a) W_p , the weight of the empty pycnometer, (b) W_{pw} , the weight of the pycnometer filled with water or other liquid of known density, and (c) W_{pl} , the weight of the pycnometer filled with the liquid whose density is to be determined.

The density of the liquid d_l is calculated from the relation

$$d_l = \frac{M_l}{V} \quad (1)$$

where M_l is the mass of the liquid filling the internal volume V of the pycnometer. This volume is in turn obtained from the mass M_w of the liquid of known density d_w required to fill the pycnometer

$$V = \frac{M_w}{d_w} \quad (2a) \quad \text{since } d_w = \frac{M_w}{V} \quad (2b)$$

The masses M_l and M_w are obtained from the observed weights W_{pl} , W_{pw} and W_p by correcting for the difference between the buoyant effect of the air on the contents of the pycnometer and on the weights used to balance the contents. If the density of the air σ does not change between the time of weighing the empty pycnometer and the time of weighing the pycnometer filled with liquid,

$$M_l = (W_{pl} - W_p) + \left(V - \frac{W_{pl} - W_p}{\Delta} \right) \sigma \quad (3)$$

where Δ is the density of the weights used. Similarly,

$$M_w = (W_{pw} - W_p) + \left(V - \frac{W_{pw} - W_p}{\Delta} \right) \sigma \quad (4)$$

The difference in density between the unknown and standard liquids is obtained by subtracting equation 2b from equation 1

$$d_l - d_w = \frac{M_l - M_w}{V} \quad (5)$$

Substituting in the values for M_l and M_w (equations 3 and 4) and simplifying,

$$d_l - d_w = \frac{W_{pl} - W_{pw}}{V} \left(1 - \frac{\sigma}{\Delta} \right) \quad (6)$$

This form of the equation is most convenient where small differences in density are being determined as in isotopic analyses. The volume V is obtained by combining equations 2a and 4 and need be calculated only to the precision required by the density difference. The factor $(1 - \sigma/\Delta)$ has the numerical value 0.99986 when σ is 1.2 mg per millilitre and Δ is 8.4 (brass weights) and may be neglected therefore if errors as large as 2 parts in 10,000 in the density difference can be tolerated.

In the above discussion it has been assumed that the density of the air has remained constant throughout the weighing operations. If this is not true, equations 3 and 4 must be modified to take into account the true air density prevailing during each

weighing operation. The effect of the buoyancy of air may be eliminated entirely by using a tare of approximately the size and weight of the filled pycnometer.

Sinker Method—A hollow glass cylinder with closed hemispherical ends that can be suspended from a balance pan by means of a wire forms a convenient sinker for density determinations. It is necessary to load the sinker so that it will sink in any liquid whose density is to be determined.

When a sinker is weighed suspended in a liquid, the buoyant effect of the surrounding liquid is equivalent to an upward force on the sinker equal to the mass of liquid displaced. If this upward force is determined (the apparent loss in mass of the sinker on being immersed in the liquid) and the volume of the sinker is known, the density may be calculated from equation 1. The sinker is weighed (a) in air (W_a), (b) suspended in water (W_w) and (c) suspended in the liquid (W_l). The first and second weighings serve to determine the volume of the sinker and the first and third weighings determine the mass of an equal volume of liquid. By considering these weights in the same manner as in the case of the pycnometer, it can be shown that if the liquid and water are at the same temperature,

$$d_l - d_w = \frac{W_w - W_l}{V} \left(1 - \frac{\sigma}{\Delta} \right)$$

V may be calculated from the relation

$$V = \frac{W_a - W_l}{d_w - \sigma} \left(1 - \frac{\sigma}{\Delta} \right)$$

As in the pycnometer calculations the factor $(1 - \sigma/\Delta)$ may be neglected in most cases.

The sinker method is much more convenient than the pycnometer method for determining the density of a liquid at a sequence of temperatures. If the sinker has not quite attained the temperature of the surrounding liquid, the resulting error is of much

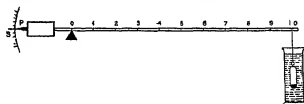


FIG 6—WESTPHAL BALANCE

less consequence than if the liquid inside a pycnometer has not attained the temperature measured outside.

N S Osborne, E C McKelvy and H W Bearce investigated the densities of mixtures of ethyl alcohol and water using both the pycnometer and sinker methods. Their work might be consulted for details of both methods.

The Westphal balance is an application of the sinker method in which the upward force on a sinker is measured directly on a balance of the steel yard type. The balance is shown diagrammatically in fig 6. Such a balance is usually provided with three sizes of weights, the largest having a value in grams numerically equal to the volume of the sinker in millilitres, the next size have one-tenth this weight and the smallest one one-hundredth. The positions of the heaviest weights on the balance arm give the units and first decimal place of the density, the position of the next smaller weight gives the second decimal place and that of the smallest the third decimal place. A chainomatic balance may be used conveniently in place of the balance illustrated.

The chief error in the sinker method is the uncertainty concerning the surface tension effects on the supporting wire. This

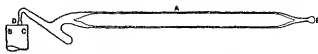


Fig 7—PROFESSOR A POLLARD'S TOTAL IMMERSION INDICATING HYDROMETER

venient liquids for mixing together to obtain intermediate densities.

Very accurate densities of crystals are obtained by determining the temperature at which the crystals will neither rise nor sink in a suitable liquid. The density of the suspending liquid must be determined accurately at some temperature by either the pycnometer or sinker method and the temperature coefficient of density of the liquid must be known. Sufficient sensitivity is attained to detect differences in isotopic composition of salts such as lithium fluoride, potassium chloride, etc.

Direct Displacement Methods—If a solid is added to a vessel partially filled with liquid, the level of the liquid surface will be raised and the volume of liquid between the original and final levels will be equal to the volume of the solid. Flasks with graduated necks having scales on which the volume corresponding to the rise in the liquid surface can be read directly are used for determining the density of fine materials such as sand and cement.

Sometimes a flask with a single mark is used and the volumes required to fill it to the mark, (a) when initially empty and (b) when containing a known weight of solid, are measured by means of a burette.

In H. V. Regnault's volumometer the solid displaces air in a chamber connected to a manometer. By observing pressure changes on expanding or contracting the air by a definite amount, (a) when the chamber contains air only and (b) when it contains the solid also, the volume of the solid can be determined.

In the methods for the determination of the density of solids it is assumed that the solid is insoluble in the liquid in which it is immersed. Water is therefore unsuitable in the great majority of cases. Toluene, where it is otherwise satisfactory, is a good liquid to use since its density is quite accurately known, most inorganic compounds are insoluble in it, it has a relatively low vapour pressure and it readily wets most solids.

Density of Gases.—The volume of a given mass of gas and consequently the density of the gas varies considerably with changes in either temperature or pressure. In order that results may be comparable it is customary to report the density of a gas under standard conditions of temperature and pressure. The standard temperature adopted is 0°C and the standard pressure is 760 mm of mercury. These conditions are referred to as "normal temperature and pressure" (abbreviated NTP).

If V is the measured volume of a given mass m of gas at a pressure P and a temperature $t^{\circ}\text{C}$, the volume at NTP can be calculated by use of the perfect gas laws (see KINETIC THEORY OF MATTER) and the density at NTP is

$$d_{\text{NTP}} = \frac{m}{V_{\text{NTP}}} = \frac{m}{V} \frac{760}{P} \frac{273+t}{273}$$

An accuracy of 2%–5% can be assumed for the perfect gas laws and therefore for densities calculated by their use. The perfect gas laws more nearly represent the real behaviour of a gas the higher the temperature and the lower the pressure.

Calculation of the Molecular Weight of a Gas.—*The Method of Limiting Densities*—One form of the perfect gas law is

$$PV = \frac{m}{M} RT,$$

where P , V and m have the same significance as above, M is the molecular weight of the gas, R is a constant and T is the absolute temperature. Since $m/V = d_g$, the density of the gas under the experimental conditions, the molecular weight

$$M = \frac{d_g RT}{P} \quad (7)$$

At a given temperature d_g/P would be a constant for a given gas if the gas laws were strictly valid. Experimentally, this ratio is not constant but depends on the pressure. If measured values of d_g/P are plotted against P , a linear relationship is obtained. Extrapolation to zero pressure gives a limiting value of d_g/P which may be substituted in equation 7 to give the true molecular weight of the gas.

Methods of Determining the Density of Gases.—*By Weighing a Globe Filled with the Gas*—This method is the counterpart of the pycnometer method for determining the density of liquids. The volume of the globe is determined from the weight of water required to fill it.

The globe is then weighed, first evacuated and second filled with gas, at a measured temperature and pressure.

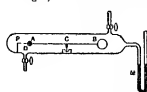


FIG 9—MICROBALANCE

Because of the large volume occupied by a small mass of gas the mass of the globe must inevitably be large compared with that of the enclosed gas. Hence, small percentage errors in the weighings cause large percentage errors in the mass of the gas.

This coupled with the necessity for accurate control and measurement of both temperature and pressure, renders the accurate determination of the densities of gases by this method a matter calling for the utmost refinement of experimental procedure.

By Measuring the Volume of a Known Mass of Gas—This method is the reverse of the preceding one and consists in using one or more globes to determine the volume of the gas whose mass is determined separately. For example, one of the methods used by E. W. Morley in his determination of the density of hydrogen was to weigh the hydrogen absorbed in palladium and to measure the volume of the hydrogen in three globes having a total capacity of 42 l. E. P. Perman and J. H. Davies absorbed a measured volume of ammonia in concentrated sulphuric acid in order to obtain its mass.

By Means of the Microbalance—A very light quartz beam represented by AB in fig. 9 is delicately pivoted at its centre C. At one end of the beam is a small quartz sphere filled with air. The whole balance is enclosed in a vessel which can be filled with gas under a pressure measured by the manometer M.

If the balance is at equilibrium (δ), with the point D opposite the fixed point P in one gas at a pressure p_1 and in a second gas at pressure p_2 , the temperature remaining constant, the density d_2 of the second gas at NTP is given by

$$d_2 = d_1 \frac{p_2}{p_1}$$

FIG 10—DIAGRAM OF VICTOR MEYER'S APPARATUS

The microbalance affords an accurate means of comparing the densities of two gases and can be used with small quantities of gas. More robust instruments based on the same principle have been designed for the commercial determination of gas densities.

Determination of the Density of Vapours—*Dumas' Method*—The liquid is vaporised in a globe having a neck drawn down to a capillary. So long as any liquid remains in the globe, vapour may be seen issuing from the capillary, but this ceases abruptly when the supply of liquid is exhausted. At this instant the capillary is sealed. By weighing the globe the mass of the contained vapour may be determined and its volume may be obtained by weighing the globe both filled with air and filled with water.

The resulting density is that of the vapour at the temperature and pressure prevailing when the bulb was sealed.

To avoid the errors involved in weighing a large globe, H

Schulze introduced an ingenious modification in which the vapour is liquefied in a small subsidiary bulb for weighing.

Joseph Gay-Lussac's Method—This consists in volatilizing a known mass of liquid over mercury and measuring the volume of vapour produced. By using a long vertical tube to contain the mercury the liquid can be volatilized under low pressure. A number of modifications of the method have been introduced from time to time, two recent ones being those of Sydney Young and of A. G. Egerton.

Victor Meyer's Method—A simple arrangement of apparatus for Victor Meyer's method of determining the density of a vapour is shown in fig. 10. The liquid in A is heated until air ceases to issue from the tube B. The calibrated tube C, filled with water, is placed over B and a small bulb containing a known weight of liquid is released into the inner bulb D. The temperature in A is high enough to ensure rapid volatilization of the liquid. The vapour displaces air which is collected and measured in C. The volume of this air reduced to N.T.P. is equal to that of the vapour reduced to N.T.P. since before displacement from D the air was at the temperature and pressure of the vapour.

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(V. St. H. E. W.)

DENT, JOHN CHARLES (1841-1887), Canadian journalist and historian, was born at Kendal, England. He was educated in Canada, being called to the bar in 1865. After writing for the *English Daily Telegraph* and then for certain Boston newspapers, he joined the editorial staff of the *Toronto Globe* in 1870. Later he turned to history, producing *The Canadian Portrait Gallery* (biographical studies, 1870), *Canada since the Union of 1841* (1881), *Rev. Henry Scadding* (1884) and *The Upper Canada Rebellion* (1885).

DENTAL RUBBER, a form of vulcanite, coloured pink to simulate the human gums, and used extensively, strengthened with metal, to form the setting of artificial teeth, for which it is admirably suited. It is manufactured from over-vulcanized rubber, i.e., pure rubber which is rolled with about 40% of sulphur, and in which a considerable amount of vermilion or other suitable pigment is incorporated. It takes a high polish, is tasteless and odourless, and is comfortable in wear.

DENTATUS, MANIUS CURIUS, Roman general, conqueror of the Samnites and Pyrrhus, king of Epirus, was born of humble parents, and was possibly of Sabine origin. In 290 B.C., when consul with P. Cornelius Rufinus, he gained a decisive victory over the Samnites, which put an end to a war that had lasted 50 years. He also reduced the revolted Sabines to submission, a large portion of their territory was distributed among the Roman citizens, and the most important towns received the citizenship without the right of voting for magistrates (*censitas sine suffragio*). With the proceeds of the spoils Dentatus cut a channel to carry off the waters of Lake Velinus so as to drain the valley of Reate. In 275, after Pyrrhus had returned from Sicily to Italy, Dentatus (again consul) took the field against him and defeated him completely near Beneventum. Dentatus was consul for the third time in 274, when he finally crushed the Lucanians and Samnites. As censor in 272 he began to build an aqueduct to carry the waters of the Anio into the city, but died (270) before its completion. Dentatus was looked upon as a model of old Roman simplicity and frugality.

Livy, epitome, iv, 14; Polybius, II, 19; Eutropius, i, 9, 14; Florus, i, 18; Val. Max. i, 3, 5, vi, 3, 41; Cicero, *De senectute*, 16; Juvenal, xi, 78; Plutarch, *Pyrrhus*, 25.

DENT DU MIDI, a conspicuous peak of the Swiss Alps 6 mi. S.W. of St. Maurice in the lower valley of the Rhône, with an altitude of 10,666 ft. See Alps.

DENTIL, in architecture, a small, rectangular block, used in a row as a decoration for the bed moulding of a cornice. It is undoubtedly a decorative interpretation in stone of projecting beam ends in earlier wooden construction, and many of the famous rock cut tombs of Lycia, in Asia Minor, which represent wooden

structures, show similar forms. Moreover, the tomb of Darius at Nakshi Rustron (c. 485 B.C.), which represents the entire front of a Persian palace, plainly shows the beam ends appearing as a dentil band. In ordinary classic usage the dentil decorates the cornices of the Ionic and Corinthian orders (see ORDER). The Attic custom, followed generally by the Romans and the Renaissance architects, kept the dentil relatively small, and spaced the dentils with an interspace of about half the width of the block itself. Occasionally, as in the Pantheon at Rome (c. 120), an unbroken band, known as a dentil band, replaces the separate dentils. In the Hellenistic temples of Asia Minor, such as the great temple of Athena Polias at Priene (c. 350 B.C.), a special type of heavy Ionic entablature is used, in which the dentils are much enlarged, more widely spaced, and resemble brackets. The Byzantine dentil was a specific type of band ornament, possibly with little relation to the classic dentil, and was used especially as a border for panels. It consists of an alternation of projecting blocks with splayed faces between, usually arranged in a double band, with the blocks on one side of the centre in every case opposite the splayed faces on the other. It is so found bordering the marble panels of S. Sophia at Constantinople (6th century), and became a favourite ornament in Venice, where it was used as a panel mould, as a horizontal band and around arches.

DENTISTRY is the healing art concerned with the health of the mouth, especially the teeth. It is also the profession practising this art. (For anatomy see TEETH.)

Of the many conditions of the mouth treated by the dentist, the three that occupied most of the profession's attention throughout its history are dental caries (or decay of the teeth) and its consequences, disease of the supporting and investing structures of the teeth (periodontitis, commonly called pyorrhoëa) and irregularities (malpositions) of the teeth.

Caries, the principal problem of dentistry, is produced by acid dissolution of the calcium salts which constitute most of the tooth. W. D. Miller showed, 1880-90, that micro-organisms participate in the formation of the acid. Destruction begins in spots on the surface where the micro-organisms are undisturbed, and the action is believed to occur within a few minutes after carbohydrate foods, especially sugars, are taken into the mouth. In saliva, these are transformed, through products of the micro-organisms, into lactic acid or other organic acids. Caries, from its inception, is a liability of the tooth, because it may lead, successively, to loss of part or all of the crown, involvement of the dental pulp, infection of the structures about the end of the root, loss of the entire tooth, or impairment of health by dissemination of the infectious influence through the circulation. Dentistry may prevent or remedy, by treatment, all of these conditions. Preventive measures, although logically the first step in combating caries, were largely neglected until the early years of the 20th century. The historical order in which measures were taken against the destruction of caries was, probably, first of all, use of medicinal applications to the teeth when toothache was present, second, removal of affected teeth after the inefficacy of medicinal remedies became generally apparent, and the substitution of artificial teeth, third, removal of the decay and restoration artificially of the lost part—the means most largely employed after the early 19th century, and, finally, steps to prevent the disease or arrest it at an early stage.

Operative Dentistry—This phase of dentistry aims to conserve the tooth and restore it, when carious, before the crown is lost. The first step in filling is preparation of the cavity. Before 1800, the preparation was limited to gaining access to the cavity and to removing the decay. From 1800 to 1860, attention was given to modifying the cavity so that the filling would not be displaced. From 1860 to 1900, largely through G. V. Black, cavity preparation was systematized and modification of the cavity outline, called extension for prevention, was introduced to obviate recurrence of decay. After 1907, slight modifications were made for the cast gold inlay.

The earliest fillings known, placed during the middle ages, were resins, waxes, or gums. In the late middle ages, leaf metals—particularly lead and gold—were employed. Gold was used as

early as 1450. In 1855, Robert Arthur introduced the technique of cohesive gold foil in which the foil was heated to render the surface pure, and cast welded in the cavity under pressure of hand instruments. When the cohesive property was understood and a control of saliva was found in the rubber dam (invented by S. C. Barnum, in 1864), cohesive gold became, by 1875, the preferred filling, since by it alone the form of the tooth could be restored. Cohesive gold serves perfectly as a preserver of the tooth, but because of the tediousness, for patient and dentist, of placing it, it was partly superseded, after about 1910, by silver amalgam and the cast gold inlay. Amalgam was introduced by 1828. It consists of silver or some of its alloys combined with mercury to make a plastic mass that can be adapted to the cavity and will harden within a reasonable time. Because of leaky margins of fillings and the unfounded belief that the contained mercury could affect the patient's health, amalgams were not altogether in good repute until after 1895. Then the experimental work of G. V. Black placed them upon a scientific basis. In posterior teeth, amalgams are satisfactory fillings and are the most frequently placed.

In 1907, William H. Taggart introduced a practical method of making cast gold inlays. An impression of the cavity is taken in wax, after this has been invested with an artificial stone material to form a mould, and the wax burned out, molten gold is forced into the mould. The resulting casting is cemented into the cavity. Methods of compensating for the shrinkage of gold upon solidifying made the gold inlay a satisfactorily fitting restoration, and the advantage of restoring the anatomical contours of the tooth often gives it preference. The gold inlay largely restricted the use of gold foil. An ideal filling material unites durability with appropriate colour. The durable materials, mentioned above, are all lacking in tooth colour, the materials with aesthetic properties lack durability. Baked porcelain inlays (c. 1889) and silicic cement (1904), improperly called synthetic porcelain, have been extensively employed. About 1938, inlays of synthetic resins began to be tried. These inlays have high aesthetic properties but lack hardness comparable with tooth structure. Other materials—oxycarbonate of zinc cement (1860), zinc phosphate cement (1878) and gutta percha (1848) have been used for temporary or special purposes.

When caries penetrates to the pulp, toothache usually occurs, and the actual or potential diseased condition of the pulp must be considered in the treatment. In children's teeth, where the root end is not completed, sometimes capping of the pulp with filling material has been resorted to. In other cases, ordinarily, the pulp is removed if the tooth is retained. Until about 1880, extirpation of the pulp was regarded as out of harmony with current pathological principles, nevertheless, after 1836 with the introduction of arsenic by J. R. Spooner to destroy the pulp, the practice of pulp removal increased greatly because the operation became almost painless. Recognition, after 1880, that micro-organisms are responsible for pulp disease was thought justification for pulp extirpation on theoretical grounds, and for the next 30 years, drastic germicidal methods were employed to sterilize root canals. About 1910, it began to be realized that these methods often lead to injury of the structures about the root end, with the result that this region becomes vulnerable to further infection, which may be extended to other parts of the body. An address by William Hunter, a British medical man, criticizing dental practices, especially in crown and bridgework, and disregard for dangerous septic conditions prevailing in the mouths of patients, greatly influenced dentists and physicians to consider general health in relation to conditions of the teeth. The X-ray played an important part in the discovery of these conditions. As a result, some dentists advocated extraction of all teeth with involved pulps. Others resorted to more conservative measures of pulp removal, using milder antiseptics, and in general, substituting an aseptic technique for more drastic antiseptic measures. In place of arsenic, cocaine (1896) and procaine (1906) were employed for an anesthetizing the pulp for removal. When the pulp is removed the root canal should be completely filled to the apex of the

tooth and for this purpose, gutta percha was generally employed after about 1870.

Prosthetics is the substitution of artificial replacements for lost natural parts. Strictly speaking, a filling is a prosthesis, but conventionally, prosthetic dentistry is confined to the restoration of whole crowns and lost teeth.

When a tooth crown cannot be saved, an artificial crown may be adjusted to the root. Crowns are of several sorts. The earliest, described in 1728, was an artificial or natural crown mounted on the root by a post inserted into the root canal. This post crown was developed in numerous forms by U.S. dentists. The Richmond crown, introduced in 1880, was one of the best known. W. N. Morrison, in 1860, devised the gold shell crown consisting of a band of gold plate adapted to the circumference of the root, with a swaged chewing surface soldered to the band. It was extensively used on posterior teeth, especially to support bridgework. Often instead, the cast gold crown, cast like an inlay, is preferred. For aesthetic purposes, on the front teeth, the porcelain jacket crown, devised by C. H. Land, about 1890, is available. It consists of a porcelain shell baked onto a platinum matrix fitted to the natural crown, from which the enamel has been removed.

Lost teeth are supplied either by bridgework or by dentures. In bridgework, the load is borne by teeth on either side of the gap, in a denture the load is on the gum and underlying structures. Bridgework is probably the oldest form of prosthesis, being constructed by Etruscan goldworkers, perhaps as early as 1000 B.C. Bridges are either removable by the patient or fixed. From the 18th century, bridges were supported by posts as were single crowns. Ligated teeth, originating in antiquity, may be regarded as the earliest removable bridges. Many ingenious and patented devices for retaining removable bridges were introduced during the late 19th century. With the advent of the gold inlay, great improvements in the treatment of the supporting teeth were possible. So-called fixed movable bridges were constructed, in which one end of the bridge was attached to a gold crown or inlay while the other was supported by a spur merely resting on an inlay in the other supporting tooth. This device allows slight physiologic movements of the supporting teeth during mastication.

Dentures are either partial or complete, the former being used when some teeth are present in the jaw, and the latter when all teeth are missing. Both types have been made since the late 17th century. Beginning about 1800, partial dentures could be retained by metal clasps partly encircling the crowns of teeth present. Complete dentures, until about 1850, were usually held in place by spiral springs, one on either side, extending from the lower to the upper denture. Beginning about 1800, in the United States, dentures were designed without special retention devices, to be held by close adaptation to the supporting parts and by the extension of the baseplate of the upper denture over a large part of the hard palate. Proper fit of dentures was greatly facilitated by the adoption of impressions and models of the mouth, at the close of the 18th century. Beeswax was usually employed for taking impressions, and plaster of Paris for making the model, about 1844, plaster began to be used for both purposes and about 1857 impression compound was introduced, a combination of various ingredients including a resinous material capable of softening by heat and an inert solid such as soapstone. Plaster and compound are the materials in general use, though some elastic and other materials are also employed. Better methods of making impressions, beginning about 1910, greatly improved complete dentures. In the 18th century, bone, ivory, hippopotamus tusk and gold were the chief baseplate materials, and these were difficult to conform to the supporting tissues. About 1790, use of porcelain began, and about 1860, vulcanite (vulcanized rubber), first used in dentistry in the 1840s, came into general favour. These materials could be adapted to the model, as could also swaged bases of gold or platinum. Until 1935, vulcanite remained the most generally satisfactory baseplate material, but at that time, various kinds of synthetic resins were introduced, and some of these were

or supported public health dentistry. The nature and extent of the service is extremely variable. Educational work and dental inspections are frequent in public schools, prophylaxis is sometimes included, fillings and extractions are less commonly provided. Buenos Aires, Argentina, established (1934) municipal clinics furnishing all services, including orthodontics.

Professional development.—Dentistry as a vocation existed in ancient Roman times, for Martial mentioned one Caecilius who "re-moves or restores a bad tooth." Dentistry received some recognition as a profession in France during the 18th century, but institutions characteristic of a profession did not appear until 1840. Previously, dental education was secured largely through apprenticeship to dentists and technical craftsmen. In 1839-40, in the United States, the first regular dental school (the Baltimore College of Dental Surgery), the first dental journal (*The American Journal of Dental Science*), and the first national dental organization (the American Society of Dental Surgeons) were established. Similar developments took place a few years later in England, Germany and France. Considerably later, effective measures for licensing dentists in government agencies were instituted. Technical literature on dentistry began with Pierre Fauchard's *Chirurgie Dentaire* in 1728. It was followed by a continuous issue of professional books in France, England, Germany and other countries. The earliest notable work in the United States was Chapin A. Harris' *Dental Art* (1839). In England the outstanding work was John Tomes' *Dental Philosophy and Surgery* (1848). Periodical publication increased enormously throughout the world during the 19th century. Dental education in the United States has been carried on independently of medicine and surgery. From a few months, the dental course was gradually lengthened until, by 1940, it consisted of two years' pre-dental study in college and four years in dental school. The course covers basic sciences, medical sciences and technical training, as well as clinical practice. In England, the first licenses were issued by the Royal College of Surgeons, 1859, and the dental professions remained largely under medical control. Two views of dentistry competed for supremacy throughout its history, especially in Europe: that of the stomatologists, who consider dentistry as a specialty of medical practice, and the odontologists, who hold that dentistry is a distinct practice. Dentistry is completely organized in professional societies in most countries of the world. In the United States the American Dental Association is the national organization. In England, the British Dental Association is the official society.

Specialization in the practice of dentistry developed largely in the 19th century. The practice of orthodontics has been largely carried on by specialists. Other branches sometimes practiced exclusively are exodontia (extractions), prosthodontia (denture work), ceramics (porcelain work), pedodontia (children's dentistry), periodontia (care of pyorrhea), radiodontia (X ray work) and oral surgery.

The technical and scientific progress of dentistry closely paralleled the progress of science and technology generally throughout the 19th and 20th centuries. The inventions and discoveries in physical, biological and medical sciences particularly pertaining to dentistry have, in the main, been the work of dentists or persons closely associated with that profession.

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DENTON, urban district, Mossley parliamentary division, Lancashire, Eng., 4½ mi N.E. from Stockport, on the London Midland Region railway route. Pop. (1938), 21,700. Area, 4.1 sq mi. In the township are reservoirs for Manchester's water supply. The leading industry is the manufacture of felt hats. Coal occurs in the district.

DENTON, a city of Texas, U.S.A., 35 mi N.W. of Dallas and N.E. of Fort Worth, the county seat of Denton county. It is on federal highways 77 and 377, and is served by the Missouri-Kansas-Texas and the Texas and Pacific railways. Pop. (1950) 21,345. Wheat, oats, corn, cotton, peanuts, grain sorghums, fruit and truck are raised in this region. It is a livestock, dairy and poultry centre.

Industries include flour mills, a brick plant, a food products plant, a cheese plant, a garment factory and bottling plants. It is the seat of the North Texas State college and the Texas State College for Women. Denton was settled in 1857 and incorporated in 1866.

D'ENTRECASTEAUX ISLANDS, a group of islands in the Pacific Ocean 15 to 30 mi N.E. of New Guinea. They com-

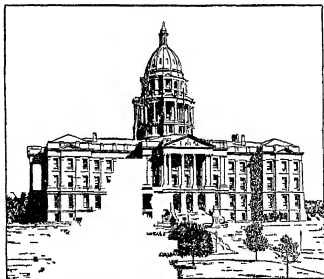
prise three large islands, Ferguson, Goodenough and Normanby and a number of islets separated by narrow channels with a total area of 12,000 sq mi.

There are traces of extinct volcanoes, and gold has been discovered in certain parts. They were discovered by Bruni D'Entrecasteaux in 1792 and are now part of the dependency of New Guinea (q.v.).

DENVER, capital of Colorado, U.S., on the South Platte river, in the centre of "the west." Population in 1950 was 412,856; it was 322,412 in 1940, 287,861 in 1930 and 256,491 in 1920 by the federal census. It is on federal highways 40 and 85, is served by the Burlington, the Rock Island, the Santa Fe, the Union Pacific, the Denver and Rio Grande Western and the Colorado and Southern railways, and by Braniff, Continental, United and Western air lines. The Moffat tunnel of the Denver and Rio Grande Western railway through James peak in the continental divide built by the city of Denver in co-operation with parts of several counties in northwestern Colorado and opened in 1928, eliminated 27 mi of 4% grade and made possible shortening the distance to Salt Lake City and other points west by 175 mi.

The altitude of Denver, at the state capital, is exactly one mile above the sea. Its area, co-extensive with that of the county of Denver, is 66 sq mi. It lies at the edge of the great plains, in the river valley running north and south, 12 mi E. of the main range of the Rocky mountains, which stretches in a snow-capped background visible for 150 mi from Pikes peak on the south to Longs peak on the north. The climate, with a low degree of humidity throughout the year and a high percentage of sunshine, is favourable alike to health, industry and recreation. The city is well planned, with broad streets and a system of boulevards and parkways. Because of severe restrictions against wooden structures adopted in the early days, most of the residences, as well as the business and public buildings, are of brick, stone, tile or cement.

All railroads enter the Union station, a fine and commodious structure built in 1914 at a cost of more than \$3,000,000. There are 35 parks and 17 supervised playgrounds within the city limits,



THE COLORADO STATE CAPITOL, BUILT 1887-95 IN THE CENTRE OF DENVER SHOWING THE DOME WHICH IS OVERLAIN WITH NATIVE GOLD

comprising 1,563 ac., and the city owns a chain of 30 mountain parks (in one of which is the grave of "Buffalo Bill"), aggregating 25,000 ac. in area, and connected with one another and with the city by 100 mi of boulevard.

In the centre of the city is a stretch of half a mile (40 ac.) devoted to public buildings set in landscaped grounds. The massive state capitol of native granite (built in 1887-95, at a cost of \$3,000,000), topped by a dome overlaid with gold from Colorado mines, stands on a terraced hill, flanked by the state office building, state capitol annex and the state historical museum, which

contains exhibits of prehistoric and Indian life and of pioneer days.

Immediately west of the capitol grounds is the beautiful civic centre (built through the initiative of Robert W. Speer, who was mayor 1904-12 and 1916-18), including the Public library, a Greek theatre and a \$5,000,000 city and county building, and beyond this group is the U. S. mint. In City park, a tract of 408 ac set aside at an early date, is the Denver museum of natural history. There is a municipal auditorium, seating 12,000 where the Democratic national convention which nominated William J. Bryan met in 1908.

The water supply taken from the river at a point 23 mi above (i. e., southwest of) the city, is supplemented by a system of reservoirs in the mountains and in, or adjacent to, the city, which have a capacity of 74,000,000 gal., enough to supply the city for three years without replenishing. The eight-foot pioneer bore of the Moffat tunnel, paralleling the main bore, brings water from the western slope of the continental divide supplementing the South Platte watershed supply. The assessed valuation of property for 1949 was \$577,255,900.

Education—The public school system includes 63 elementary, 11 junior high, 5 senior high and several special schools, including one for deaf children, one for crippled children and the Emily Griffith Opportunity school. The Catholic schools include 21 parish elementary schools and 5 parish high schools.

Among the institutions for higher education are the University of Denver (Methodist), chartered in 1864 as Colorado seminary, Colorado Woman's college (1838), Regis college (1837), the Iliff School of Theology (Methodist Episcopal), the medical school of the University of Colorado, Loretto Heights college, and the Westminster Law school.

Tourist Amenities and Climate—As a recreation centre Denver has so many attractions that providing for tourists is one of the leading industries. Motorbuses for sight seeing run in every direction. The tourist bureau lists 60 excursions to points of beauty and interest which can be made in a day or less each.

Sports include glacier climbing, skiing, bathing in pools of hot mineral water, trout fishing and yachting on Grand lake (8389 ft above sea level), where an annual regatta is held in August. A mountain highway to the top of Mt. Evans, 14,260 ft, is the highest automobile road in North America. It is estimated that tourists spend more than \$64,000,000 annually in the city.

The climatic advantages of Denver led to the establishment there of many hospitals and sanatoria of national scope, philanthropic and commercial, especially for the treatment of tuberculosis. They are associated with the University of Colorado Medical centre, the Denver General Hospital, Tufts General Hospital, U. S. Army and the Veterans Administration hospital, make the city one of the upper tier medical centres of the country.

Commerce and Industry—Denver is the administrative centre of the mining and industrial metropolis of the west. There is no larger city than 100 mi in any direction. Ten departments of the federal government are represented by approximately 225 bureaus and commissions—more than in any other city outside Washington. The mint was established in 1860 when the secretary of the treasury purchased the site and mint of Clark Gurnee and when a virgin and coined gold pieces containing 17% more gold than U. S. coins of corresponding denominations. It is one of the three federal coinage mints, making silver dollars and small

The Denver stockyards is the largest cattle market in the west and it is the largest sheep market in the world. At the National Western stock show (held annually in January since 1907) pedigreed breeding cattle are bought and sold in carload lots, feeder stock by the trainload.

Distance from the manufacturing centres of the east forced Denver in its early days to develop industries to supply the needs of the mining and frontier population for wagons and harness, mining machinery, meat, flour and other necessities. On this foundation, utilizing the raw materials—mineral, animal and vegetable—at its doors, developing its specialties, but also diversifying its products, and gradually extending its markets the manufactures of the city grew. A favourable factor is the abundant supply of coal and fuel oil from mines and refineries within a very short haul. In 1928 natural gas was piped in from the Amarillo district of Texas.

The leading industry, in point of value of product, is slaughtering and meat packing. Receipts at the stockyards in 1949 included 961,689 cattle and calves, 432,531 hogs and 1,857,935 sheep.

Other manufactures of importance are mining machinery, which is marketed all over the world, sugar mill equipment which goes as far as Hawaii and the Philippines, and luggage that is sold in every state of the union. A rubber manufacturer sells about 2,000 products in the domestic market as well as in all foreign countries.

The manufacture of candy is favoured by the dry atmosphere. In spite of its distance from ports, Denver has many businesses engaged in world trade. Export business was (in 1950) estimated at \$30,000,000.

History—John Simpson Smith, trapper and trader, with his Sioux wife Wapoola, settled on the site of Denver in the autumn of 1857. The following summer, after traces of gold were found in the sands of Cherry creek by W. Green Russell of Georgian settlements grew up on opposite sides of the creek, near its confluence with the South Platte river (at 14th street in the present city plan). Auraria on the west bank, and on the east bank St. Charles, which was almost immediately renamed Denver, after the territorial governor, Gen. James W. Denver. The two settlements, with a population of about 1,000, were consolidated in 1860 and in 1861 received a charter from the first territorial legislature of Colorado.

In 1867 Denver was made the capital of the territory, and in 1881, five years after Colorado became a state, the choice was confirmed by popular vote.

On Oct. 29, 1858, in a blinding snowstorm, two men drove in with a wagon train and opened the first "store." A second was opened on Christmas day, and a jewellery store a few days later. At the opening of 1859 lumber sold for \$100 per 1,000 ft., flour for \$20 to \$40 per 100 lb., and sugar, coffee and tobacco for almost their weight in gold dust, the currency of the region for some years.

The first hotel (the Eldorado) was opened in a large log house on Feb. 1, 1859. On April 23 the first number of the *Rocky Mountain News* was issued. On May 9 arrived the first coach of the Leavenworth and Pike's Peak Express company, which carried letters at 25 cents an ounce. News of Lincoln's election was brought from St. Joseph, Mo., nearly 700 mi., by the Pony Express in 69 hours. Letter postage by Pony Express was \$5 per letter. Telegraph connection with the east (\$9 for ten words) was established in 1863.

A private mint and a bank were opened in 1860. In 1863 there was a severe fire, and in 1864 a terrible flood came down Cherry creek and washed away many buildings. The first schoolteacher, dressed in a black broadcloth frock coat and a silk hat, drove into town late in the summer of 1859, behind a team of oxen which he apostrophized with Greek and Latin oaths that won him infinite respect from the local masters of profanity. In October he opened a school in a log cabin, after \$250 had been subscribed for its "endowment." In 1864 Colorado seminary was established, largely through the efforts of Gov. John Evans, who had been one of the founders of Northwestern university at Evanston, Ill. When the Union Pacific passed through 106 mi. to the north of Denver,

a local company was organized to connect the city with it by a line to Cheyenne, Wyo., and on June 23, 1870, the first passenger train arrived. On Aug. 15 the Kansas Pacific was completed to Denver, and other transportation facilities soon followed.

By 1870 there were 1,500 buildings in the city, and the population was 4,759. In the next 20 years it grew to 106,713. All the facilities of a modern city were introduced in the '70s, and the '80s were a period of great activity in real estate. Since 1890 growth has been steady though less spectacular. In the early days, Denver had its problems with "squatters" and "land jumpers."

There were the social conditions usually found in new mining communities, including crimes of violence and some exercise of extrajudicial methods of administering justice. At the Palace gambling hall and variety theatre, celebrated the world over, fortunes were won and lost in a night. A flood in 1878 and the famous strike in Denver and Leadville in 1879-80 were temporary checks to prosperity.

In 1880 there was a memorable election not, under the guise of an anti-Chinese demonstration. A serious streetcar strike in 1920 involved the loss of seven lives, the importation of armed strikebreakers, the intervention of federal troops and military rule for a month. Denver was the first city to undertake to finance its charitable agencies by a joint "community chest." Its juvenile court, under Judge Ben B. Lindsey (1869-1943), who served from 1901 to 1927, was a pioneer in its field. In 1902 a city and county of Denver was created, with power to frame its own charter, and the charter was adopted in 1904, but dual sets of officers served until 1912.

A commission form of government was in force in Denver for four years from 1912, but in 1916 the mayor and council form was resumed.

DENVER AND RIO GRANDE WESTERN RAILROAD, incorporated in 1870, was conceived as a narrow gauge (3'6") trunk line from Denver, Colo., to Mexico City, Mex. The route was projected along the Rio Grande del Norte, hence the first name, Denver and Rio Grande railway. Course of the railroad was turned westward through the Royal Gorge to tap the Leadville mining district, by 1883 the narrow gauge line was completed between Denver and Ogden, Utah, with branches reaching into the mountains wherever mining development demanded transportation. The Royal Gorge route, a through standard gauge (4'8 1/2") line, Denver to Ogden, via Tennessee Pass (10,240 ft.), 78 mi., supplanted the narrow gauge line in 1890, as the Rio Grande became an integral part of several transcontinental systems. Remaining narrow gauge are 68 mi. of track, all in southwest Colorado, longest in the U.S., these lines are the model for all similar operations in the world. The Moffat Tunnel route, shortening Rio Grande's Denver-Salt Lake City distance to 570 mi., in 1934 strengthened the road's position as a transcontinental route by utilizing the 6.2 mi. bore through the Continental Divide 50 mi. from Denver.

The Rio Grande operates 2,566 mi. in Colorado, Utah and New Mexico.

DEODAND, in English law, any personal chattel which, having moved *ad mortem* or been the immediate cause of the death of any reasonable creature, was forfeited to the king for pious uses. It was originally designed as an expiation for the souls of those suddenly snatched away by violent death, and was abolished by 9/10 Vict. C. 62. This imputation of homicidal guilt to inanimate objects or the lower animals is of great antiquity and led in the middle ages to the judicial trial of animals or things for man slaughter.

In England, subsequent to the Reformation, deodands were distributed as alms by the king's high almoner, though more recently they were regarded as mere forfeitures.

If a horse or other animal in motion killed a person, whether infant or adult, or if a cart ran over him or a tree fell upon him, it was forfeited as a deodand and its value was appraised by the jury. It was at one time held that if death were caused by falling from a cart or a horse at rest, the law made the chattel a deodand only if the person killed were an adult, not if he were below years

of discretion, but in later times this distinction was abolished. Blackstone says "where a thing not in motion is the occasion of a man's death, that part only which is the immediate cause is forfeited, as if a man be climbing up the wheel of a cart, and is killed by falling from it, the wheel alone is deodand." Whereas, if the cart were in motion, not only the wheel but all that moves along with it (as the cart and loading) are forfeited. On the other hand, if a man riding on the shafts of a wagon fall to the ground and break his neck, the horses and wagon only are forfeited and not the loading, because it in no way contributed to his death. Where a man is killed by a vessel at rest, in fresh water, the cargo is not deodand, where the vessel is under sail, hull and cargo are both deodand. But accidents on the high seas, or on an arm of the sea, did not cause forfeiture "because manners are continually exposed to so many perils that the law imputes misfortunes happening there rather to them than to the ship." The finding of a jury was necessary to constitute a deodand, and the death must take place within a year and a day of the accident. The investigation of the value of the instrument by which death was caused at one time occupied an important place among the provisions of English criminal law. More recently these forfeitures became extremely unpopular, and jurors, with the connivance of judges, found deodands of trifling value, so as to defeat what was regarded as an inequitable claim.

DEODAR The deodar or "god tree" (*Cedrus Deodara*) is a species of coniferous evergreen tree closely allied to the cedar, the timber obtained therefrom being of considerable value. It forms extensive forests in the Himalayas at elevations of from 7,000 ft. and is also found in Afghanistan and north Baluchistan. The wood is durable and light red in colour and is used particularly for cabinetwork as it can be highly polished. See also CEDAR.

DEODORIZER, a disinfectant which acts by oxidizing or otherwise changing the chemical constitution of volatile substances disseminated in the air. It also prevents noxious exhalations from organic substances, and in virtue of its properties is an effective disinfectant in certain diseases. See also DISINFECTANTS.

DEOGARH (known in Bengal as Baidyanath, also called Baidyanath Deogarh), a town in the Santal Parganas district of Bihar, India. Pop. (1941) 17,792. It has a famous temple dedicated to Baidyanath or Siva, the resort of numerous pilgrims. It also enjoys a reputation as a health resort among Bengalis, many of whom have country houses here.

DEOLS, a suburb of the French town of Châteaurox, in the department of Indre. Pop. (1946) 3,394. Deols lies to the north of Châteaurox, from which it is separated by the Indre. It preserves a fine Romanesque tower and other remains of the church of a famous Benedictine abbey, the most important in Berry, founded in 917 by Ebbes the Noble, lord of Deols. A gateway flanked by towers survives from the old ramparts of the town. The parish church of St. Stephen (15th and 16th centuries) has a Romanesque façade and a crypt containing the ancient Christian tomb of St. Lude and his father St. Leodead, who according to tradition were lords of the town in the 4th century. The pilgrimage to the tomb of St. Lude gave importance to Deols, which under the name of *Vicus Dolenus* was in existence in the Roman period. In 468 the Visigoths defeated the Gauls there the victory carrying with it the supremacy over the district of Berry. In the middle ages the head of the family of Deols enjoyed the title of prince and held sway over nearly all Lower Berry, of which the town itself was the capital. In the 10th century Raoul of Deols gave his castle to the monks of the abbey and transferred his residence to Châteaurox. The abbey church was burnt by the Protestants during the religious wars and in 1622 the abbey was suppressed by the agency of Henry II, prince of Condé and of Deols.

DEONTOLOGY is the title of a book by Jeremy Bentham (q.v.), who introduced the term to denote a utilitarian system of ethics. The name has since then come to be applied to a system of ethics in which prominence is given to ideas of *duty* rather than to those of *right* or *goodness*.

DEPARTMENT, a division or part of a system; one of the branches of the administration in a state or municipality. In Great Britain it is commonly applied to the subordinate divisions of the chief executive offices of state such as the savings bank or other department of the post office, the mines department of the board of trade, etc., in the United States these subordinate divisions are known as "bureaus," while "department" is used for the chief branches of the executive.

In France the word is also used for a territorial division corresponding loosely to an English county. Previous to the French Revolution the local unit in France was the military *gouvernement*, roughly corresponding to the old provinces, such as Franche Comte Province, Bourgogne Bretagne etc., but this division being too closely bound up with the administrative mismanagement of the old régime, at the suggestion of Mirabeau, the "provinces" were divided into departments, as nearly as possible equal to a certain average of size and population, and deriving their names principally from rivers, mountains or other prominent geographical features. In 1800 three new departments were created out of the newly annexed territory of Savoy and Nice. The three departments of Bas Rhin, Haut Rhin and Moselle which were lost after the Franco German War in 1871, were restored in 1919. Each department is provided over by an officer called a prefect (*prefet*) and is subdivided into *arrondissements* each in charge of a subprefect. *Arrondissements* are again subdivided into *cantons* and these into *communes*, somewhat equivalent to the English parish. (See FRANCE: Government and Administration.)

DEPARTMENT STORE, the name given in the United States to a retail establishment which sells a wide variety of goods including a general line of apparel, home furnishings and house wares and piece goods. Merchandise lines are normally arranged in separate sections or departments with the accounting on a departmentalized basis. Selling departments and personnel are integrated under a single management. To distinguish the department store as an institution from the general merchandise store and the dry goods store, which are often organized on a departmental basis and render similar services, the bureau of the census in 1948 established as the size basis for this type of store the "normal employment" of 25 or more persons. In 1939 the bureau had used annual sales of \$500,000 or more as the basis.

Department stores are primarily "shopping" and "service" in institutions, i.e., they afford customers the opportunity of comparing quality, style and price before purchase and provide a wide variety of services such as credit delivery, accepting returns of merchandise, personal shopping assistance and many others. Because shopping often is done in more than one store, department stores generally thrive best in groups and are usually located in central or secondary shopping districts where they cater primarily to women.

Department stores are organized as independent unit stores or members of ownership groups or as units of chain store systems. The term ownership group refers mainly to former independent stores which have been brought under common ownership but have not been subjected to so much central control as is typical of the chain store system.

A important characteristic of many department stores is the "leased department." Under this arrangement the store agrees to furnish a fixed organization or personnel to operate a particular selling department. The lessee pays either a flat monthly rental charge or a fixed percentage of sales. Department stores commonly leased art galleries, jewelry, fur stores, candy and optical goods.

Following World War II, numerous department stores opened branches in suburban areas usually adjacent to the main, or "parent," store. This development took place because of the pronounced shift in population from large cities to suburban areas, changes in the shopping habits of women, increased use of the automobile, traffic congestion in central business districts and lack of economical and convenient parking lots in downtown areas.

Sales of department stores increased in about the same ratio as total retail sales after 1929, the first year for which comprehensive data have been available. The department store share of

total retail sales was 9% in 1929, 10 1% in 1935, 9 5% in 1939 and 8 2% in 1948. Operating expenses in department stores are high, approximating 32% in 1950 for example. This figure exceeds those of the chief competitors of such stores and is mainly the result of the wide scope and variety of services offered customers. Significant differences exist, of course, in the operating expenses of various selling departments.

Department stores attempted to meet the competition of non-service chain stores, supermarkets and neighbourhood stores through extensive modernization programs, adoption of self service arrangements in some departments, improved personnel training programs and liberal customer services. The latter while contributing to high expenses became a major factor in enabling the department store to maintain its strong competitive position. (D J D)

DE PERE, a city of Brown county, Wis., 109 mi. N. of Milwaukee, on the Fox river, 6 mi. from its mouth. It is served by the Chicago and North Western and the Chicago, Milwaukee St. Paul and Pacific railways and by lake and river steamers. The population was 8,146 in 1950, 6,373 in 1940.

De Pere is a shipping and transfer point, has grain elevators, foundries and machine shops, manufactures glassine hammocks, paper, farm implements and is the seat of St. Norbert college (Roman Catholic) established in 1902. The state reformatory is just north of the city. In 1634-35 Jean Nicolet found there at the first rapids of the Fox river, a polyglot village of several thousand Indians and there in 1669 Father Allouez established the mission of St. Francis Xavier, the second in the territory that is now Wisconsin. The French called the place *Rapides des Peres*. Nicolas Perrot, the first French commandant in the northwest, made it his headquarters, and there Father Miquette wrote the account of his journey to the Mississippi. A few miles south of the city lived for many years Eleazer Williams (c. 1787-1857), who claimed to be the "lost" dauphin of Louis XVII of France, and was an authority on Indians, especially the Iroquois. De Pere was incorporated as a village in 1857 and as a city in 1883.

The first dam on the Fox river, connecting the Great Lakes to the upper Fox river valley, is located in De Pere.

DEPEW, CHAUNCEY MITCHELL (1834-1928)

US senator and politician, was born in Peekskill, N.Y., on April 23, 1834, of a Huguenot family (originally Du Puy or De Puy). He graduated from Yale in 1856, entered politics as a Republican—his father had been a Democrat—was admitted to the bar in 1858, was a member of the New York assembly (1861-62) and was secretary of state of New York (1864-65). Through his friendship with Cornelius and William H. Vanderbilt he became in 1866 attorney for the New York and Harlem railway in 1869 was appointed attorney of the newly consolidated New York Central and Hudson River railway, of which he soon became a director and in 1872 was made general counsel or the Erie Vanderbilt system of railways. He became chief vice-president of the New York Central and Hudson River railway in 1880, president (1885-88) and chairman in 1893 of the board of directors of the Vanderbilt system. In 1872 he joined the Liberal Republican movement and was nominated but defeated for the office of lieutenant governor of New York. In 1896 he was elected US senator from New York state and in 1904 was re-elected to the office ending in 1911. His orations and speeches were compiled in 1910 as *Depew* and on April 5, 1928.

Bibliography: C. M. Depew, *One Hundred Years of American Progress*, "Excerpts from the Autobiography" in *Scribner's Magazine*, vol. lxxvii, p. 1, 356, 66-670 (Nov. Dec. 1922); *His Memoirs of 1848-1914* (1914).

DEPEW, a manufacturing village of Erie county, N.Y., U.S., c. 10 L. of Buffalo on federal highway 20, served by the Erie, the Lehigh Valley and the New York Central railways. The population in 1950 was 2,127 and in 1940 it was 6,081. It was incorporated in 1894.

DEPLOY, a military term signifying to extend a force or unit of troops into a main open formation, e.g. from column, the marching and approach (*q.v.*) formation, into the wherby the

greatest number of its weapons can be brought to bear

DEPORTATION Deportation or transportation is a system of punishment for crime involving the removal of the criminal to a penal settlement outside his own country. It is to be distinguished from mere expulsion from a country, though the term "deportation" is used in that sense in the English law relating to aliens (see *ALIEN*). It is also to be distinguished from extradition (*q.v.*), which is a procedure applicable to persons wanted for trial under another jurisdiction. The deportation or transportation of convicts from the United Kingdom ceased in 1857, though undesirable persons may be removed from British territories where the Foreign Jurisdiction acts apply (mainly British protectorates) under various orders in council.

English Practice—At a time when English criminal law bristled with capital felonies, when the pickpocket or sheepstealer was hanged when, to use Sir Samuel Romilly's phrase, the laws of England were written in blood, another and less sanguinary penalty rose to great favour, namely, transportation. The deportation of undesirable persons beyond the seas was common in the 17th century and was not unknown in earlier times. The Vagrancy act, 1597, empowered justices in quarter sessions to banish offenders and order them to be conveyed into such parts beyond the seas as should be assigned by the privy council.

But it was only toward the end of the 17th century that transportation began to be used as a regular part of the penal system and as a substitute for capital punishment. Its use in this way became more frequent as people came to realize that the criminal law was unduly severe. Pardons were frequently granted to capital offenders on condition that they consented to transportation. The Habeas Corpus act, 1679, recognized this procedure and in 1717 a statute authorized the courts to order transportation as a direct punishment. In 1768 the power of the judges to respite capital convictions and substitute transportation was confirmed by parliament and the procedure was simplified.

At first transportation was to the American colonies, but this ceased after they had declared their independence in 1776. Instead, it was provided that convicts sentenced to transportation should be employed on hard labour at home and detained in prison ships or "hulks." Transportation was resumed in 1779, and for a time Africa was the destination, but because of the climate this proved disastrous and attention switched to the possibility of using the vast new territories of Australasia, so recently explored by Capt. James Cook, for the purpose of founding penal settlements. An expedition consisting of nine transports and two men-of-war, the first fleet of Australian history, sailed on May 13, 1787 for New South Wales. A few free families were also encouraged to emigrate, but they were lost in the mass they were intended to leave.

Shipsloads of convicts continued to pour into Australia year after year and, as the influx increased, so did the difficulty of finding employment for all the prisoners. The free settlers were too few to give work to more than a small proportion. Moreover, a new policy had been initiated by the governor, Lachlan Macquarie, of paying more attention to the interests of the convicts and discouraging the immigration of any save those who "came out for their country's good." The great bulk of the convict labour thus remained in government hands, and some of the works under taken and carried out were of incalculable service to the young colony. Indeed, its early advance in wealth and prosperity was due in large part to the magnificent roads, bridges and other facilities of intercommunication for which it was indebted to Governor Macquarie.

However, with the increasing numbers of convicts, some change in the system was inevitable, and the policy of "assignment" was introduced. Convicts were freely loaned to anyone who would relieve the authorities of responsibility for them. This system developed its own abuses, and there is a long story of effort and failure and scandal. Suffice it to say that, chiefly because of the protests by the colonists themselves, the system of transportation to New South Wales was abandoned in 1840, and although for a time Van Diemen's Land (later known as Tasmania) was used as an alternative destination, the system of transportation was even-

tually abolished by the Penal Servitude acts, 1853 and 1857. (See *PRISON*.)

French Practice—France first adopted deportation of its criminals during the revolutionary period. A colony of convicts was planned for Madagascar in 1791, but it never materialized. In 1797 a small group of political prisoners was deported to French Guiana, and in the following year about 500 prisoners were sent there. In 1823 the philanthropist Baron Milius formed an expedition consisting of a company of military workers, about 50 orphan apprentices, and others making a total of 164 persons who settled on the banks of the Mana in French Guiana. The experiment was a failure, troops were needed to keep order and the principle of deportation was formally condemned by publicists and by the government. But in 1854 it was reintroduced into the French penal code with many high sounding phrases, only to fail in practice, with deplorable results. Deportation to Guiana was not entirely abandoned, but instead of native-born French, only convicts of subject races, Arabs, Annamites and Asiatic blacks, were sent, with no better success as regards colonization.

In 1864, however, it was possible to divert the stream elsewhere. New Caledonia, an island in the Australian Pacific, was annexed by France in 1853, and ten years later it became a new settlement for convict emigrants. A first shipload was disembarked in 1864 at Nouméa, and the foundations of the city were laid. Outwardly all went well with the settlement. The population increased steadily, rising from 600 in 1867 to more than 9,600 at the end of 1883. But from that time forward the numbers transported each year fell, and as the colony had become almost exclusively penal, its natural growth as a prosperous colonial community was retarded. The reason for the falling off in the numbers transported to this South Pacific island, with its fairly temperate climate and fertile soil, was that it had been found that fear of being deported there no longer proved a deterrent. The French administration therefore resumed the deportation of French born whites to Guiana, which was notoriously unhealthy. Convicts who showed some promise of rehabilitation were still sent to New Caledonia, but those with the worst records who were regarded as incorrigible were sent to the settlements on the equator. After 1897 no more convicts were transported to New Caledonia.

Convicts were still transported to French Guiana in the 20th century, and dreadful disclosures were made about conditions on the islands near Cayenne where prisoners were held, particularly the notorious Devil's Island. In 1938 France abolished transportation, although persons already transported were still detained. The penal colonies in French Guiana were finally abolished by a decree of the Free French government during World War II.

(J. E. H. W.)

United States—Under the laws of the United States, deportation is not banishment or punishment for crime, deportation proceedings are civil and not criminal. This is in sharp contrast with the deportation laws of England, the USSR, France, Italy, Portugal and some other countries where their own citizens or subjects are sometimes exiled or deported to the colonial penal colonies as punishment for crime.

In the United States every person is considered an alien who is not a native born or naturalized citizen, and only aliens can be deported. It has never been the policy of the United States government to punish criminally aliens who remain after the time for which they were admitted has expired, or who have entered unlawfully for the first time in contravention to immigration laws. Deportation is the only remedy.

A legally admitted alien cannot be deported without due process of law but he has no absolute right to remain (*Carlson v. Landon*, 186 F. [2d] 183). Under our immigration laws, the entrance of an alien illegally is not a crime but he may be deported for having entered without a visa. The alien has the burden of proof to show his lawful right to remain (*La Buda v. Karnath*, 47 F. [2d] 944). While an alien is allowed to remain, he is accorded constitutional protection, but his licence to remain is revocable at any time (*Turner v. Williams*, 194 U.S. 279, *Chuocho Traco v. Forbes*, 228 U.S. 549, *Vajtauer v. Shaughnessy*, 273 U.S. 103).

An alien residing in the United States is always subject to de-

portation on any statutory grounds until he has been admitted to citizenship. To deport one who has acquired citizenship by naturalization, a proceeding must first be brought in a United States district court by a United States attorney to revoke such citizenship, usually on the ground that it had been obtained by fraud. If citizenship is revoked by an order of the court the person again becomes an alien subject to deportation. However, if he acquired United States citizenship by birth such proceeding cannot be brought against him; thus he cannot be deported.

An important distinction is to be made between aliens seeking admission who are stopped at the borders and aliens who have entered the country but whose deportation is sought. The former are excluded while the latter are deported. In exclusion the transportation company that brought the alien who is excluded upon arrival must take him back. In deportation the alien is deported at the expense of the U.S. government to his native country or, if that is not possible, to any country where he had acquired a domicile or to the foreign port or place of embarkation.

If no country will accept the alien and even the country of his birth refuses to grant him permission to enter, he may be detained at Ellis Island, New York harbour, for the rest of his life or until such time as the United States government can find a country that will admit him (*Shauvelinsky v. Mezei*, 345 U.S. 206).

(S. Ks.)

Other Countries.—Penal exile has been practised by many other countries as a method of secondary punishment. Russia from 1823 onward directed a continuous stream of offenders to Siberia, and at one time the yearly average sent was 18,000. Transportation of Russian convicts by sea to the island of Sakhalin in the far east was also used. This island was hopefully intended as an outlet for released convicts where they could be rehabilitated by their own efforts, in precisely the same manner as was tried in Australia and New Caledonia. The result followed British and French experience in every respect, and before World War I it was widely recognized in Russia that transportation had failed. However, under the Communist regime, as H. E. Barnes and N. K. Teeters relate in *New Horizons in Criminology* (Prentice Hall, Inc., New York, 1951), "the Czarist system of sending prisoners to Siberia has been continued on an even greater scale, and, apparently, with just as much brutality. There is, however, one difference. Under the Czar's large portion of those exiled were criminals in the conventional sense. Under the Soviet rule, most of those sent to Siberia have been political prisoners." In the view of these writers, "after making all qualifications necessary for the exaggerations of the bitterly anti-Soviet writers, it seems likely that the conditions in the Soviet labor camps in Siberia are as brutal and degrading as anything which was under the Czar's."

Portugal practised transportation as far back as the 15th century. In modern times it has tried deportation to the African colony of Angola. This has been on a small scale, side by side with free emigration, and has been fairly successful. Spain resorted to banishment on a limited scale in the 16th century, and penal settlements were retained at Ceuta and in Africa for many centuries. In 1907 the African prisons were ordered to be abolished, and the penal settlement at Ceuta was closed in 1911.

Italy introduced deportation to various agricultural penal colonies on the islands around its coast. Under the Fascist regime thousands of political prisoners were sent to the nonagricultural islands off the coast of Sicily.

Transportation must be regarded as a most primitive solution to the problem of disposing of prisoners. Moreover, it is a solution likely to be accompanied by deplorable conditions and most unlikely to be a success. Indeed, it has been said that it has proved a ghastly failure wherever it has been tried.

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(J. E. H. W.)

DEPOSIT, anything laid down or separated, as in geology,

any mass of material accumulated by a natural agency (see BED), and in chemistry, a precipitate or matter settling from a solution or suspension. Deposit is also used in the sense of earnest or security for the performance of a contract, in the law of contract, deposit or simple bailment is delivery or bailment of goods in trust to be kept without recompense and redelivered on demand (see BAILMENT). (For banking deposits, see BANKING.)

DEPOT, a place where goods may be stored or deposited, such as a furniture or forage depot, the accumulation of military stores, especially in the theatre of operations (from the fr. *Dépôt*, Lat. *depositum*, laid down). In America the word is used of a railway station whether for passengers or goods, in Great Britain on railways the word, when in use, is applied to goods stations. A particular military application is to a depot situated as a rule in the centre of the recruiting district of the regiment or other unit, where recruits are received and undergo preliminary training before joining active troops. Such depots are maintained in peacetime by armies which supply distant or overseas garrisons, in an army raised by compulsory service and quartered in its own country, the regiments are usually stationed in their own districts and on their taking the field for war leave behind a small nucleus for the formation and training of drafts to be sent out later. These nucleus troops are generally called depot troops.

DEPRECIATION. Depreciation is an accounting charge for the cost of durable property, spread over its economic life. Depreciation covers wear and tear from use, physical deterioration from age and exposure to the elements and obsolescence, i.e., loss of usefulness arising from availability of newer and more efficient types of goods serving the same purpose. It does not cover losses from sudden and unexpected destruction of the usefulness of property—major fires and accidents, theft, war damage or adverse court decisions—nor from declining price levels. Depreciation applies both to tangible property such as machinery and buildings and to intangibles of limited life such as leaseholds and copyrights. Similar costs are involved in depletion and maintenance. Depletion is depreciation on property which cannot be reproduced, such as a body of ore being mined or a stand of timber being cut and not reforested. Maintenance is cost incurred in keeping property in good condition, as by painting a house or replacing defective parts in a truck. Tangible property subject to depreciation also involves maintenance. Where "full maintenance" aims to keep the property intact without deterioration, however (as with a railway roadbed), there may be no depreciation charge. A main object of keeping these costs is to measure income correctly so that if the whole supposed income of a business is withdrawn for the private use of the owners it will not later be discovered that the assets of the business have dwindled away. This leads to the rule that depreciation during the working life of a piece of property must equal the original cost of the property, less ultimate scrap value. For convenience, depreciation accounts are usually kept for groups of assets with similar characteristics and working life, and the estimated average working life of the group is used in figuring depreciation. Since this average can take into account minor losses from fire, etc., depreciation covers such losses insofar as they are self insurable within the business in question.

The general rule of charging off a depreciable asset during its life does not settle annual charges. Allocation among years is recognized as arbitrary, and in practice is strongly influenced by income tax regulations. Straight-line, fixed percentage and, more rarely, annuity methods of depreciation—giving respectively constant, gradually decreasing and gradually increasing charges—are standard. Sometimes charges vary with use (for instance, with the number of miles per year a truck is driven). Special rules allow depletion for tax purposes to exceed original cost.

Basing depreciation on historical cost rather than on probable replacement cost, and on arbitrary rules rather than on actual use, is presumably necessary for definite tax liability and audits of accounts. But very imperfect measurement of the actual using up of property results in times when price levels change. Department of commerce estimates of total recorded depreciation and depletion in the United States were \$4,400,000,000 for 1929, \$44-

300,000,000 for 1931, for example. But since prices and activity were both much lower in 1931, the cost of new property adequate to replace that used up was much lower than in 1929. Thus after a fall of prices, depreciation overstates the using up of capital, and consequently current income and the proportion of new buildings, machinery and other property which exceeds replacement requirements ("net capital formation") are overstated, after a rise of prices the opposite is true, as for example during the inflation following World War II.

In view of technical progress, the cost of new equipment of stated capacity tends to fall from year to year so that maintaining the value of equipment by reinvesting depreciation funds involves some expansion of physical capacity. (See also CAPITAL AND INTEREST, FINANCIAL STATEMENTS, INVESTMENTS IN BUSINESS, NATIONAL SAVINGS) (A G Hr, X)

DEPRETIS, AGOSTINO (1813-1887), Italian statesman, was born at Mezzana Corte, in the province of Pavia, on Jan. 31, 1813. He belonged to the Giovine Italia, and was nearly captured by the Austrians while smuggling arms into Milan. Elected deputy in 1848, he founded the journal *Il Diritto*. In 1860 he was sent on an abortive mission to Sicily to find a compromise between the Cavour and the Garibaldi policies.

As a member of Urbano Rattazzi's cabinet of 1862 he arranged with Garibaldi the expedition which ended in disaster at Aspromonte.

He was a member of Bettino Ricasoli's cabinet of 1866 and on the death of Rattazzi (1873) became the leader of the left. He was premier in 1876-78 and for a brief period in 1879.

Minister of the interior in Benedetto Cairoli's cabinet of 1879, he was again prime minister from 1881 until his death on July 29, 1887.

He reconstituted his cabinet four times, alternately bestowing portfolios upon Cesare Ricotti Magnani, the count di Robilant and other Conservatives so as to complete the political process known as *trasformismo*. A few weeks before his death he repented of his transformist policy, and again included Francesco Crispi and Giuseppe Zanardelli in his cabinet.

During his long term of office he abolished the grist tax, extended the suffrage, completed the railway system, aided Pasquale Mancini in forming the Triple alliance and initiated colonial policy by the occupation of Massawa. On the other hand, however, he vastly increased indirect taxation, corrupted the fibre of the several parliamentary parties and impaired the stability of Italian finance.

DEPTFORD, a southeastern metropolitan and parliamentary borough of London, Eng., bounded north by Brompton, north east by the Thames river, east by Greenwich, south by Lewisham and west by Camberwell. Pop. (1951) 75,694. Area 2.4 sq mi. The name (Depeford) is connected with a ford over the Ravensbourne, a stream entering the Thames through Deptford creek. In 1885 the parish of St. Nicholas, which included the old village of Lower Deptford, a large stretch of water frontage west of the creek, the old cattle market and Sayes court gardens (a part of the former gardens of Sayes court), was transferred to Greenwich in order to bring the latter up to borough status. Since then the borough of Deptford has comprised only the parish of St. Paul (Upper Deptford), the church of which dates from 1712-30.

Southward from the river the land rises, on a low gravel terrace, to 154 ft. on Telegraph hill. The southern part of the borough is largely residential, factories increasing in number toward the river. There is a very great variety of industries one of the chief of which is the timber import-export business that Deptford shares with Rotherhithe, the adjoining district up the river, many timber wharves from the Surrey canal that leads down to the Surrey docks in Rotherhithe.

Henry VIII established a royal naval dockyard at Deptford in 1513 and the shipbuilding industry flourished until wooden ships gave place to iron. Later it became the Royal Victoria Victualling yard and is now an army supply depot. Trinity House (qv) was founded in 1514 by Henry VIII but moved to Stepney in the 17th century and to Tower hill in 1795. Sayes court was demolished in 1729, after having been the residence of the duke of

Sussex in the reign of Elizabeth I, of John Evelyn in the next century and of Peter the Great during his short stay in Deptford in 1698. Part of the gardens is now Deptford park (17 ac.). The Goldsmith's college, New Cross, was built in 1843 and the town hall in 1900-03.

DEPTH, in military language, the space over which a body of troops is distributed from front to rear. In a tactical sense it is used to express the idea of, and need for, distributing a force or unit as to have adequate reserves behind the fighting line to exploit initial success or to meet an emergency. In World War I the tendency was for the distribution of a force or unit to attain an ever increasing depth in proportion to, and with a proportionate reduction of, its frontage.

DEPTH CHARGE See MINES (NAVAL).

DEPUTY, one appointed to act or govern instead of another, one who exercises an office in another man's right, a substitute, in representative government a member of an elected chamber. Various officials are empowered by statute to appoint deputies. Thus, a clerk of the peace, in case of illness, incapacity or absence, may appoint a fit person to act as his deputy. While judges of the supreme court cannot act by deputy, county court judges and recorders can, in cases of illness or unavoidable absence, appoint deputies. So can registrars of county courts and returning officers at elections.

In many countries, members of the lower house of parliament are called deputies.

DE QUINCEY, THOMAS (1785-1859), English author, was born at Greenhay, Manchester, the fifth child in a family of eight (four sons and four daughters). His father left his wife and six children a clear income of £1,500 a year. Thomas was from infancy a shy, sensitive child, with a constitutional tendency to dreaming by night and by day, and, under the influence of an elder brother, a lad "whose genius for mischief amounted to inspirations," who died in his 16th year, he spent much of his boyhood in imaginary worlds of their own creating. The amusements and occupations of the whole family, indeed, seem to have been mainly intellectual, and in De Quincey's case, emphatically, "the child was father to the man." "My life has been," he affirms in the *Confessions*, "on the whole the life of a philosopher, from my birth I was made an intellectual creature, and intellectual in the highest sense my pursuits and pleasures have been." He received a rather desultory education, though at 15 he could speak Greek fluently. He ran away from his last school, Manchester Grammar school, and was sent into the country in Wales. Then he again ran away, this time to London, where, he says, commenced "that episode, or impassioned parenthesis of my life, which is comprehended in *The Confessions of an English Opium Eater*." This London episode extended over a year or more, his money soon vanished, and he was in the utmost poverty, he obtained shelter for the night in Greek street, Soho, from a moneylender's agent, and spent his days wandering in the streets and parks, finally the lad was reconciled to his guardians, and in 1803 was sent to Worcester college, Oxford, being by this time about 19. It was in the course of his second year at Oxford that he first tasted opium—having taken it to allay neuralgic pains. De Quincey's mother had settled at Weston Lea, near Bath, and on one of his visits to Bath, De Quincey made the acquaintance of Coleridge, he took Mrs. Coleridge to Grasmere, where he became personally acquainted with Wordsworth.

After finishing his career of five years at college in 1808 he kept terms at the Middle Temple, but in 1809 visited the Wordsworths at Grasmere, and in the autumn returned to Dove cottage, which he had taken on a lease. His choice was of course influenced partly by neighbourhood to Wordsworth, whom he early appreciated, having been, he says, the only man in all Europe who quoted Wordsworth so early as 1802. His friendship with

*The following account has been abbreviated for this ed. Its original author, John Ritchie Findlay (1824-1898), proprietor of *The Scotsman* newspaper, and the donor of the Scottish National Portrait gallery in Edinburgh, had been intimate with De Quincey, and in 1886 published his *Personal Recollections* of him.

Wordsworth decreased within a few years, and when in 1834 De Quincey published in *Tait's Magazine* his reminiscences of the Grasmere circle, the indirect references to the Wordsworths contained in the article led to a complete cessation of intercourse. Here also he enjoyed the society and friendship of Coleridge, Southey, and especially of Prof. Wilson, as in London he had of Charles Lamb and his circle. He continued his classical and other studies, especially exploring the, at that time, almost unknown region of German literature, and indicating its riches to English readers. Here, also, in 1810, he married Margaret Simpson, the "dear M———" of whom a charming glimpse is accorded to the reader of the *Confessions*, his family came to be five sons and three daughters.

For about a year and a half he edited the *Westmorland Gazette*. He left Grasmere for London in the early part of 1820. The Lambs received him with great kindness and introduced him to the proprietors of the *London Magazine*. It was in this journal in 1821 that the *Confessions* appeared. De Quincey also contributed to *Blackwood's*, to *Knight's Quarterly Magazine*, and later to *Tait's Magazine*. His connection with *Blackwood* took him to Edinburgh in 1828, and he lived there for 12 years, contributing from time to time to the *Edinburgh Literary Gazette*. His wife died in 1837, and the family eventually settled at Lasswade, but from this time De Quincey spent his time in lodgings in various places, staying at one place until the accumulation of papers filled the rooms, when he left them in charge of the landlady and wandered elsewhere. After his wife's death he gave way for the fourth time in his life to the opium habit, but in 1844 he reduced his daily quantity by a tremendous effort to six grains, and never again yielded. He died in Edinburgh on Dec. 8, 1859, and is buried in the West Churchyard.

During nearly 50 years De Quincey lived mainly by his pen. His patrimony seems never to have been entirely exhausted, and his habits and tastes were simple and inexpensive, but he was reckless in the use of money, and had debts and pecuniary difficulties of all sorts. The famous *Confessions of an English Opium Eater* was published in a small volume in 1822, and attracted attention, not simply by its personal disclosures, but by the extraordinary power of its dream-painting. No other literary man of his time, it has been remarked, achieved so high and universal a reputation from such merely fugitive efforts. The only works published separately (not in periodicals) were a novel *Klosterheim* (1832), and *The Logic of Political Economy* (1844). After his works were brought together, De Quincey's reputation was not merely maintained, but extended. For range of thought and topic, within the limits of pure literature, no like amount of material of such equality of merit proceeded from any eminent writer of the day. However profuse and discursive, De Quincey is always polished, and generally exact—a scholar, a wit, a man of the world and a philosopher, as well as a genius. He looked upon letters as a noble and responsible calling, in his essay on Oliver Goldsmith he claims for literature the rank not only of a fine art, but of the highest and most potent of fine arts, and as such he himself regarded and practised it. He drew a broad distinction between "the literature of knowledge and the literature of power," asserting that the function of the first is to teach the function of the second to move.—"maintaining that the meanest of authors who moves his pre-eminence over all who merely teach that the literature of knowledge must perish by supersession, while the literature of power is triumphant for ever as long as the language exists in which it speaks." It is to this class of motive literature that De Quincey's own works essentially belong, it is by virtue of that vital element of power that they have emerged from the rapid oblivion of periodicalism, and live in the minds of later generations. But their power is weakened by their volume.

De Quincey fully defined his own position and claim to distinction in the preface to his collected works. These he divides into three classes, "first, that class which proposes primarily to amuse the reader," such as the *Narratives*, *Autobiographic Sketches*, etc., second, "papers which address themselves purely to the understanding as an insulated faculty, or do so primarily," such as the

essays on Essenism, the Caesars, Cicero, etc., and finally, as a third class, "and, in virtue of their aim, as a far higher class of compositions," he ranks those "modes of impassioned prose ranging under no precedents that I am aware of in any literature," such as the *Confessions* and *Suspira de Profundis*. The high claim here asserted has been questioned, and short and isolated examples of eloquent apostrophe, and highly wrought imaginative description, have been cited from Rousseau and other masters of style, but De Quincey's power of sustaining a fascinating and elevated strain of "impassioned prose" is allowed to be entirely his own. Another obvious quality of all his genius is its overflowing fullness of allusion and illustration, recalling his own description of a great philosopher or scholar—"Not one who depends simply on an infinite memory, but also on an infinite and electrical power of combination, bringing together from the four winds, like the angel of the resurrection, what else were dust from dead men's bones into the unity of breathing life."

In politics, in the party sense of that term, he would probably have been classed as a Liberal Conservative or Conservative Liberal—at one period of his life perhaps the former, and at a later the latter. As he advanced in years his views became more and more decidedly liberal, but he was always as far removed from Radicalism as from Toryism, and may be described as a philosophical politician, capable of classification under no definite party name or colour. Of political economy he had been an early and earnest student, and projected, if he did not so far proceed with, an elaborate and systematic treatise on the science, of which all that appears, however, are his fragmentary *Dialogues* on the system of Ricardo, published in the *London Magazine* in 1824, and *The Logic of Political Economy* (1844). How wide and varied was the region he traversed a glance at the titles of the papers which make up his collected (or more properly, selected) works (for there was much matter of evanescent interest not reprinted), sufficiently shows. Some things in his own line he has done perfectly, he has written many pages of magnificently mixed arguments, irony, humour and eloquence, which, for sustained brilliancy, richness, subtle force and purity of style and effect, have simply no parallels, and he is without peer the prince of dreamers. The use of opium no doubt stimulated this remarkable faculty of reproducing in skilfully selected phrase the grotesque and shifting forms of that "cloudland, gorgeous land," which opens to the sleep-closed eye.

It has been complained that, in spite of the apparently full confidences of the *Confessions* and *Autobiographic Sketches*, readers are left in comparative ignorance, biographically speaking, of the man De Quincey. Two passages in his *Confessions* afford sufficient clues to this mystery. In one he describes himself "as framed for love and all gentle affections," and in another confesses to the "besetting infirmity" of being "too much of an eudæmonist." "I hanker," he says, "too much after a state of happiness, both for myself and others, I cannot face misery, whether my own or not, with an eye of sufficient firmness, and am little capable of surmounting present pain for the sake of any recessionary benefit." His sensitive disposition dictated the ignoring in his writings of traits merely personal to himself, as well as his ever-recurrent resort to opium as a doorway of escape from present ill, and prompted those habits of seclusion, and that apparently capricious abstraction of himself from the society not only of his friends, but of his own family, in which he from time to time persisted? He confessed to occasional access to an almost irresistible impulse to flee to the labyrinthine shelter of some great city like London or Paris—thence to dwell solitary amid a multitude, buried by day in the cloister-like recesses of mighty libraries, and stealing away by night to some obscure lodging. Long indulgence in seclusion, and in habits of study the most lawless possible in respect of regular hours or any considerations of health or comfort—the habit of working as pleased himself without regard to the divisions of night or day, of times of sleeping or waking, even of the slow procession of the seasons—had latterly so disinclined him to the restraints, however slight, of ordinary social intercourse, that he very seldom submitted to them. On such rare occasions, however, as he did appear, per-

haps at some simple meal with a favoured friend, or in later years in his own small but refined domestic circle, he was the most charming of guests, hosts or companions. A short and fragile, but well proportioned frame, a shapely and compact head, a face beaming with intellectual light, with rare, almost feminine beauty of feature and complexion, a fascinating courtesy of manner, and a fullness, swiftness and elegance of silvery speech—such was the irresistible "mortal mixture of earth's mould" that men named De Quincey. It was impossible to deal with or judge him by ordinary standards—not even his publishers did so. Much no doubt was forgiven him, but all that needed forgiveness is covered by the kindly veil of time, while his merits as a master in English literature are still gratefully acknowledged. (J. R. F.)

Bibliography.—In 1853 De Quincey began to prepare an ed. of his works *Selections Greve and Gay Writings Published and Unpublished* (1853–60), followed by a second ed. (1863–71) with notes by James Hogg and two additional vols., a further supplementary vol. appeared in 1878. The first comprehensive ed., however was printed in America (1850–55), and the "Riverside" ed. (1877) is still fuller. The standard English ed. is *The Collected Writings of Thomas De Quincey* (Edinburgh, 1889–90), edited by David Masson, who also wrote his biography (1887) for the "English Men of Letters" series. *The Uncollected Writings of Thomas De Quincey* (1890) contains a preface and annotations by James Hogg, *The Posthumous Writings of Thomas De Quincey* (1891–93) were edited by A. H. Japp ("H. A. Page"), who wrote the standard biography, *Thomas De Quincey his Life and Writings* (2nd ed. 1895), and *De Quincey Memorials* (1891). See also Arvede Barne *Nervosis* (1898), Sir L. Stephen *Hours in a Library*, H. S. Salt *De Quincey* (1904), and *De Quincey and his Friends* (1905), a collection edited by James Hogg, which includes essays by Dr. Hill Burton and Shadworth Hodgson. See also editions of *The Confessions* (1927) by G. Saintsbury, and of *The Diary* (1927) by H. A. Eaton.

DERA GHAZI KHAN, a town and district of British India, in the Punjab. The original town was founded at the close of the 15th century and named after Ghazi Khan, son of Haji Khan, a Baluch chieftain, who after holding the country for the Langah sultans of Multan had made himself independent. The greater part of this town was washed away by the Indus in 1908–09 and the new town, built near by, is now the headquarters of the District.

The district, which consists of an area of 9,364 sq mi., is a long narrow strip of country, 193 m. in length, sloping gradually from its western boundary hills to the river Indus on the east. Although liable to great extremes of temperature, and to a very scanty rainfall, the district is not unhealthy. The population in 1941 was 581,350, the great majority being Baluch Mohammedans. The principal exports are wheat and indigo. The only main factories are for domestic use. There is no railway in the district. In the hills beyond the limit of the district is an area occupied by Bloch tribes which is administered by the deputy commissioner of Dera Ghazi Khan. The frontier tribes here include the Kasranis, Bordars, Khossas, Lagharis, Khetras, Gurichs, Mazars, Marris and Bugtis. The chief of these are described under their separate names.

DERAIL, a device used mainly on the sidings of railways to prevent a car that has been moved by wind, gravity or by the error of trainmen from running foul of the main track. It is also frequently used to protect men at work under a car. The derail is variously designed, but generally acts by providing a surface on which the flange of one wheel mounts and crosses over the head of the rail, dragging the wheel at the other end of the axle off its rail. Each pair of wheels follows in turn and, being forced over the irregularities of the road bed, soon bring the car to a full stop. Some derails are portable, but most are fixed definitely in place and are operated by hand, in unison with a switch or mechanically from a central point. The illustration shows a manual derail with signal target, in operating position.

DERAIN, ANDRÉ (1880–), French painter, was born at Chatou (France), on June 10, 1880. For a considerable time he shared a studio with the landscape painter Vlaminck, he then made the acquaintance of Picasso, Georges Braque and the poet Guillaume Apollinaire. It was from this small group that Cubism developed. Yet Derain cannot be considered as a representative of the Cubist school, his best works adhere to the great tradi-

tions of the classic landscapes, and are formal in character and restrained in colour, while his figures exhibit a grandeur and serenity, which reveal an admiration of the great masters.

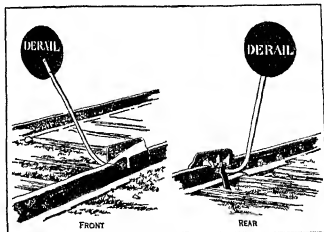
DERA ISMAIL KHAN, a town, cantonment and district in the Deraat division of the North West Frontier Province of India. The town is situated near the right bank of the Indus, here crossed by a bridge of boats during half the year. Pop. (1941) 48,210. It takes its name from Ismail Khan, a Baluch chief who settled here towards the end of the 15th century, and whose descendants ruled for 300 years. The old town was swept away by a flood in 1833. The main channel of the Indus which often changes, was in 1927 2 mi. from the town. The town contains a large bazaar for Afghan traders and is the residence of many Mohammedan gentry. Since the occupation of Waziristan the garrison has been reduced to half a brigade. There is considerable trade with Afghanistan by the Gomal pass.

The district—area 4,216 sq mi., pop. (1941) 298,131—was formerly divided by the Indus, which intersected it from north to south. To the west of the Indus the country resembles Dera Ghazi Khan. To the east of the present bed of the river a wide tract, the *Kachi*, is exposed to river action. Beyond this, the country rises abruptly, and a barren, almost desert plain stretches eastwards, sparsely cultivated, and inhabited only by nomadic tribes. In 1901 the trans-Indus tract was allotted to the newly formed North-West Frontier Province, the cis-Indus tract remaining in the Punjab jurisdiction. The former cis-Indus portions of the Dera Ismail Khan and Bannu districts is now the Punjab district of Mianwali.

The district is the junction of Pathan and Baluch tribes, the Pathan element predominating. The chief frontier tribes are the Sherans and Ustarans and Bhattians.

DERAIYEH (Arab *Dariya*). A city of Arabia formerly the capital of the Wahhabis and of considerable importance prior to 1819 when it was captured by Ibrahim Pasha. It now consists of five walled villages amongst the ruins, with a population of about 1,500 inhabitants, the Wahhab capital is now Riyadh.

DERBENT or **DERBEND**, a town in the A.S.S.R. of Dagestan, on the western shore of the Caspian, 42° 4' N., 48° 15' E. Pop. (1926) 23,111. It occupies a narrow strip of land beside the sea, from which it climbs up the steep heights inland. The environs are occupied by vineyards, gardens and orchards, in which madder, saffron and tobacco, as well as figs, peaches, pears and other fruits, are cultivated. Earthenware, weapons and silk and



BY COURTESY OF THE MAINTENANCE EQUIPMENT CO.

FRONT AND REAR VIEWS OF THE BLUE FLAG PORTABLE DERAIL

cotton fabrics are the principal products of the manufacturing industry. Recently a wool spinning factory has been built, and steamers call at the port, which has a lighthouse and cold storage accommodation for the fruit and fish industry. To the north of the town is the monument of the *Kirk-lar*, or "forty heroes," who fell defending Dagestan against the Arabs in 758, and to the south lies the seaward extremity of the Caucasian wall (50 m. long), otherwise known as Alexander's wall, blocking the narrow

pass of the Iron Gate or Caspian Gates (*Portae Albanae* or *Portae Caspiae*). This, when entire, had a height of 29 ft and a thickness of about 10 ft, and with its iron gates and numerous watch-towers formed a valuable defence of the Persian frontier. Derbent is usually identified with Albana, the capital of the ancient Albania. The modern name, a Persian word meaning 'iron gates,' came into use when the city was re-founded by Kavadh of the Sassanian dynasty of Persia. The walls and the citadel are believed to belong to the time of Kavadh's son, Khosru (Hosroes) Anoshirvan. In 728 the Arabs entered into possession, and established a principality in the city, which they called Bab-el-Awsh ('the principal gate'), Bab el Khadid ('the iron gate'), and Semail el-Dagab ('the golden throne'). The celebrated caliph, Harun al-Rashid, lived in Derbent at different times, and brought it into great repute as a seat of the arts and commerce. In 1220 it was captured by the Mongols, and in the course of the succeeding centuries it frequently changed masters. In 1722 Peter the Great of Russia wrested the town from the Persians, but in 1736 the supremacy of Nadir Shah was again recognized. In 1796 Derbent was besieged by the Russians, and in 1813 incorporated in the Russian empire. During the Civil War 1917 to 1921, the greater part of the town was destroyed.

DERBY, EARLS OF. The 1st earl of Derby was probably Robert de Ferrers (d. 1139), who is said by John of Hexham to have been made an earl by King Stephen after the battle of the Standard in 1138. Robert and his descendants retained the earldom until 1266, when Robert (c. 1247-c. 1279), probably the 6th earl, having taken a prominent part in the baronial rising against Henry III., was deprived of his lands and practically of his title. These earlier earls of Derby were also known as Earls Ferrers, or de Ferrers, from their surname, as earls of Tutbury from their residence, and as earls of Nottingham because this county was a lordship under their rule. The large estates which were taken from Earl Robert in 1266 were given by Henry III. in the same year to his son, Edmund, earl of Lancaster, and Edmund's son, Thomas, earl of Lancaster, called himself Earl Ferrers. In 1337 Edmund's grandson, Henry (c. 1299-1361), afterwards duke of Lancaster, was created earl of Derby, and this title was taken by Edward III.'s son, John of Gaunt, who had married Henry's daughter, Blanche. John of Gaunt's son and successor was Henry, earl of Derby, who became king as Henry IV. in 1399.

In October 1485 Thomas, Lord Stanley, was created earl of Derby, and the title has since been retained by the Stanleys. It is derived, not from Derbyshire, but from the hundred of West Derby in Lancashire. Thomas also inherited the sovereign lordship of the Isle of Man, granted by the crown in 1406 to his great grandfather, Sir John Stanley, and this sovereignty remained in possession of the earls of Derby till 1736, when it passed to the duke of Atholl.

The earl of Derby is one of the three 'catskin earls,' the others being the earls of Shrewsbury and Huntingdon. The term 'cat-skin' is possibly a corruption of *quatre-skin*, derived from the fact that in ancient times the robes of an earl (as depicted in some early representations) were decorated with four rows of ermine, as in the robes of a modern duke, instead of the three rows to which they were restricted in later centuries. The three 'cat-skin' earldoms are the only earldoms now in existence which date from creations prior to the 17th century.

THOMAS STANLEY, 1st earl of Derby (c. 1435-1504), was the son of Thomas Stanley, who was created Baron Stanley in 1456 and died in 1459. His grandfather, Sir John Stanley (d. 1414), had founded the fortunes of his family by marrying Isabel Lathom, the heiress of a great estate in the hundred of West Derby in Lancashire; he was lieutenant of Ireland in 1389-1391, and again in 1399-1401, and in 1405 received a grant of the lordship of Man from Henry IV. The future earl of Derby was a squire to Henry VI. in 1454, but not long afterwards married Eleanor, daughter of the Yorkist leader, Richard Neville, earl of Salisbury. At the battle of Blore Heath in Aug. 1459 Stanley, though close at hand with a large force, did not join the royal army, whilst his brother William fought openly for York. In 1461 Stanley was made chief justice of Cheshire by Edward IV.,

but ten years later he sided with his brother in law Warwick in the Lancastrian restoration. Nevertheless, after Warwick's fall, Edward made Stanley steward of his household. Stanley served with the king in the French expedition of 1475, and with Richard of Gloucester in Scotland in 1482. About the latter date he married, as his second wife, Margaret Beaufort, mother of the exiled Henry Tudor. Stanley was one of the executors of Edward IV. and was at first loyal to the young king Edward V. But he acquiesced in Richard's usurpation, and retaining his office as steward avoided any entanglement through his wife's share in Buckingham's rebellion. He was made constable of England in succession to Buckingham, and was granted possession of his wife's estates with a charge to keep her in some secret place at home. Richard could not well afford to quarrel with so powerful a noble, but early in 1485 Stanley asked leave to retire to his estates in Lancashire. After Henry of Richmond had landed, Stanley made excuses for not joining the king. On the morning of Bosworth (Aug. 22), Richard summoned Stanley to join him, and when he received an evasive reply ordered his son, George, Lord Strange, whom Stanley had given as a hostage, to be executed. In the battle it was William Stanley, his brother, who turned the scale in Henry's favour, but Thomas, who had taken no part in the fighting, was the first to salute the new king. Henry VII. confirmed Stanley in all his offices, and on Oct. 27, created him earl of Derby. As husband of the king's mother Derby held a great position, which was not affected by the treason of his brother William in Feb. 1495. In the following July the earl entertained the king and queen with much state at Knowsley. Derby died on July 29, 1504. Strange had escaped execution in 1485, but he died before his father in 1497, and his son Thomas succeeded as second earl. An old poem called *The Song of the Lady Bessy*, which was written by a retainer of the Stanleys, gives a romantic story of how Derby was enlisted by Elizabeth of York in the cause of his wife's son.

For fuller narratives see J. Gardner's *Richard III.* and J. H. Ramsay's *Lancaster and York*; also Seacombe's *Memoirs of the House of Stanley* (1741).

EDWARD STANLEY, 3rd earl of Derby (1508-1572), was a son of Thomas Stanley, 2nd earl and grandson of the 1st earl, and succeeded to the earldom on his father's death in May 1521. During his minority Cardinal Wolsey was his guardian, and as soon as he came of age he began to take part in public life. He helped to quell the rising known as the Pilgrimage of Grace in 1536, but remaining true to the Roman Catholic faith he disliked and opposed the religious changes made under Edward VI. Under Elizabeth his younger sons, Sir Thomas (d. 1576) and Sir Edward Stanley (d. 1609), were concerned in a plot to free Mary, queen of Scots, and he himself was suspected of disloyalty. He died at Lathom House, near Ormskirk, on Oct. 24, 1572.

Derby's first wife was Katherine, daughter of Thomas Howard, duke of Norfolk, by whom he had, with other issue, a son Henry, the 4th earl (c. 1531-1593), who was a member of the council of the North, and like his father was lord lieutenant of Lancashire. Henry was one of the commissioners who tried Mary, queen of Scots, and was employed by Elizabeth on other high undertakings both at home and abroad. He died on Sept. 25, 1593. His wife Margaret (d. 1596), daughter of Henry Clifford, 2nd earl of Cumberland, was descended through the Brandons from King Henry VII. Two of his sons, Ferdinando (c. 1559-1594), and William (c. 1561-1642), became in turn the 5th and 6th earls of Derby. Ferdinando, the 5th earl (d. 1594), wrote verses, and is eulogized by Spenser under the name of Amyntas.

JAMES STANLEY, 7th earl of Derby (1607-1651), sometimes styled the Great Earl of Derby, eldest son of William, 6th earl, and Elizabeth de Vere, daughter of Edward, 17th earl of Oxford, was born at Knowsley on Jan. 31, 1607. During his father's life he was known as Lord Strange. He was elected M.P. for Liverpool in 1625, received high offices in the North of England, and on March 7, 1628, entered the House of Lords as Baron Strange. When the Civil War broke out in 1642, Lord Strange devoted himself to the king's cause. His plan of securing Lancashire at the beginning and raising troops there, which promised success, was however dis-

couraged by Charles, who was said to be jealous of his power and royal lineage and who commanded his presence at Nottingham. His subsequent attempts to recover the county were unsuccessful. After several defeats he left for the Isle of Man in June 1643 to attend to affairs there, and in the summer of 1644 he took part in Prince Rupert's successful campaign in the north when Lathom House, where Lady Derby had heroically resisted the attacks of the besiegers, was relieved, and Bolton Castle taken. He followed Rupert to Marston Moor, and after the complete defeat of Charles's cause in the north withdrew to the Isle of Man, where he held out for the king and offered an asylum to royalist fugitives. His administration of the island imitated that of Strafford in Ireland. It was strong rather than just. In July 1649 he refused solemnly terms offered to him by Ireton. By the death of his father on Sept. 29, 1642 he had succeeded to the earldom, and on Jan. 12, 1650, he obtained the Garter. On Aug. 15, 1651, he landed at Wyre Water in Lancashire in support of Charles's invasion, and met him on the 17th. Proceeding to Warrington he failed to obtain the support of the Presbyterians through his refusal to take the Covenant, and on the 25th was totally defeated at Wigan, being severely wounded and escaping with difficulty. He joined Charles at Worcester, after the battle he accompanied him to Boscombe, and while on his way north alone was captured near Nantwich and given quarter. He was tried by court martial at Chester on Sept. 29, his quarter was disallowed and he was condemned to death. When his appeal for pardon to parliament was rejected, though supported by Cromwell, he endeavoured to escape, but was recaptured and executed at Bolton on Oct. 15, 1651. He was buried in Ormskirk church. According to Clarendon Derby was "a man of great honour and clear courage," and his defects the result of too little knowledge of the world. Lord Derby left in ms. "A Discourse concerning the Government of the Isle of Man" (printed in the *Stanley Papers* and in F. Peck's *Desiderata Curiosa*, vol. II) and several volumes of historical collections, observations, devotions (*Stanley Papers*) and a commonplace book. He married on the 26th of June 1626 Charlotte de la Trémoille (1599-1664), daughter of Claude, duc de Thouars, and granddaughter of William the Silent, prince of Orange, by whom besides four daughters he had five sons, of whom the eldest, Charles (1628-1672), succeeded him as 8th earl.

Charles's two sons, William, the 9th earl (c. 1655-1702), and James, the 10th earl (1664-1736), both died without sons, and consequently, when James died in February 1736, his titles and estates passed to Sir Edward Stanley (1689-1776), a descendant of the 1st earl. From him the later earls were descended, the 12th earl (d. 1834) being his grandson.

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The 14th earl is noticed separately (see below).

EDWARD HENRY STANLEY, 15th earl of Derby (1826-1893), eldest son of the 14th earl, was educated at Rugby and Trinity college, Cambridge, where he took a high degree and became a member of the society known as the Apostles. In March 1848 he unsuccessfully contested the borough of Lancaster and then made a long tour in the West Indies, Canada and the United States. During his absence he was elected member for King's Lynn, which he represented till October 1869, when he succeeded to the peerage. He delivered his maiden speech in May 1850 on the sugar duties. Just before, he had made a very brief tour in Jamaica and South America. In 1852 he went to India, and while travelling in that country he was appointed under secretary for foreign affairs in his father's first administration. From the outset of his career he was known to be a most Liberal Conservative, and in 1855 Lord Palmerston offered him the post of colonial secretary. He was much tempted by the proposal, and hurried down to Knowsley to consult his father, who called out when he entered

the room, "Hallo, Stanley! what brings you here?—Hullo. Do you cut his throat, or are you going to be married?" The offer was declined. In his father's second administration Lord Stanley held, at first, the office of secretary for the colonies, but became president of the Board of Control on the resignation of Lord Ellenborough. He had the charge of the India Bill of 1858 in the House of Commons, became the first secretary of state for India and left behind him in the India Office an excellent reputation. When the Greeks were looking round for a king after the death of King Otho, and the crown was refused by Queen Victoria for her son Alfred, there was some idea of inviting Stanley to take the vacant throne, but the offer was never formally made. After the fall of the Russell government in 1866 he became foreign secretary in his father's third administration. He compared his conduct in that great post to that of a man floating down a river and fending off from his vessel, as well as he could, the various obstacles it encountered. He thought that that should be the normal attitude of an English foreign minister, and probably under the circumstances of the years 1866-1868 it was the right one. He arranged the collective guarantee of the neutrality of Luxemburg in 1867, negotiated a convention about the "Alabama," which, however, was not ratified, and refused to take any part in the Cretan troubles. In 1874 he again became foreign secretary in Disraeli's government. He acquiesced in the purchase of the Suez canal shares, he accepted the Andrássy Note, but declined to accede to the Berlin Memorandum. His part in the later phases of the Russo-Turkish struggle has never been fully explained, for he declined to gratify public curiosity at the cost of some of his colleagues. He resigned, and was prepared to explain in the House of Lords the course he had taken if those whom he had left challenged him to do so, but from that course they consistently refrained. By Oct. 1879 it was clear enough that he had thrown in his lot with the Liberal party, but it was not till March 1880 that he publicly announced this change of allegiance. He did not at first take office in the second Gladstone government, but became secretary for the colonies in Dec. 1881, holding this position till the fall of that government in the summer of 1885. In 1886 Derby joined the Liberal Unionists, and took an active part in the general management of that party, leading it in the House of Lords till 1891, when Lord Hartington became duke of Devonshire. In 1892 he presided over the labour commission. He died at Knowsley on April 21, 1893.

During a great part of Derby's life he was deflected from his natural course by the accident of his position as the son of the leading Conservative statesman of the day. From first to last he was at heart a moderate Liberal. In one of the highest qualities of a statesman, "aptness to be right," he was surpassed by none of his contemporaries, or—if by anybody—by Sir George Cornewall Lewis alone. His chief defect as a statesman was that in his anxiety to arrive at the right conclusions he sometimes turned and turned and turned a subject over till the time for action had passed. Although he cared but little for what is commonly known as society—the society of crowded rooms and fragments of sentences—he very much liked conversation. During the many years in which he was a member of "The Club" he was one of its most assiduous frequenters, and his loss was acknowledged by a formal resolution. His talk was generally grave, but every now and then was lit up by dry humour. The late Lord Arthur Russell once said to him, after he had been buying some property in southern England "So you still believe in land, Lord Derby?" "Hang it," he replied, "a fellow must believe in something!" He did much work outside politics. He was lord rector of the University of Glasgow from 1868 to 1871, and later held the same office in that of Edinburgh. From 1875 to 1893 he was president of the Royal Literary Fund, and attended most closely to his duties there. He succeeded Lord Granville as chancellor of the University of London in 1891, and remained in that position till his death. He lived much in Lancashire, managed his enormous estates with great skill, and did a great amount of work as a local magnate. He married in 1870 Maria Catharine, daughter of the 5th earl de la Warr, and widow of the 2nd marquess of Salisbury.

The best account of the 15th Lord Derby is that which was prefixed by W. E. H. Lecky, who knew him very intimately, to the edition of his speeches outside parliament, published in 1894.

The earl left no children and he was succeeded as 16th earl by his brother **FREDERICK ARTHUR STANLEY** (1841-1908), who had been made a peer as Baron Stanley of Preston in 1886. He was secretary of state for war and for the colonies and president of the board of trade, and was governor-general of Canada from 1888 to 1893. He died on June 14, 1908.

EDWARD GEORGE VILLIERS STANLEY, 17th earl of Derby (1865-1948), was educated at Wellington college and served in the Grenadier Guards from 1885 to 1893. During the South African War he acted first as press censor, then as A.D.C. to Lord Roberts. He sat in the house of commons for West Houghton, was a lord of the treasury (1895-1900), financial secretary to the war office (1900-03) and postmaster general (1903-05). He was the recipient of many honours, including the Garter (1914). In Oct. 1915 he became director of recruiting for the army, and as such was responsible for a new scheme for a final effort on behalf of voluntary service known as the Derby scheme. In Feb. 1916 Lord Derby became chairman of the naval and military air service joint committee but resigned in April, becoming under secretary for war in July. On the formation of D. Lloyd George's government in Dec. 1916 he became secretary for war. From April 1918 to Nov. 1920 he was British ambassador to France. In Oct. 1922 he became secretary for war in Bonar Law's cabinet, retaining this position under Stanley Baldwin until Jan. 1924. He died on Feb. 4, 1948, at Knowsley, near Prescot, Lancashire, Eng.

DERBY, EDWARD GEOFFREY SMITH STANLEY, 14th earl of Derby (1799-1869), the "Rupert of debate," born at Knowsley in Lancashire on March 29, 1799, grandson of the 12th earl and eldest son of Lord Stanley, subsequently (1834) 13th earl of Derby (1775-1851). He was educated at Eton and at Christ Church, Oxford, and in 1819 he obtained the chancellor's prize for Latin verse, the subject being "Syracuse." As a boy he practised elocution under the instruction of Lady Derby, his grandfather's second wife, the actress, Elizabeth Farren. In 1820 he was returned for Stockbridge in Hampshire, one of the nomination boroughs whose electoral rights were swept away by the Reform Bill of 1832; Stanley being a warm advocate of their destruction.

His maiden speech was delivered early in the session of 1824 in the debate on a private bill for lighting Manchester with gas. On May 6, 1824 he delivered a vehement and eloquent speech against Joseph Hume's motion for a reduction of the Irish Church establishment, maintaining in its most conservative form the doctrine that church property is as sacred as private property. From this time he was acknowledged to be one of the most powerful speakers in the House. In the autumn of 1824 Stanley went on an extended tour through Canada and the United States with Henry Labouchere, afterwards Lord Taunton, and Evelyn Denison, afterwards Lord Ossington. In 1825 he married the second daughter of Edward Bootle-Wilbraham, created Baron Skelmersdale in 1828, by whom he had a family of two sons and one daughter who survived.

At the general election of 1826 Stanley was returned for borough of Preston, where the Derby influence was paramount. The change of seats left him free to speak against the system of rotten boroughs with great force during the Reform Bill debates, without laying himself open to the charge of personal inconsistency as the representative of a place where, according to Gay, cobblers used to "feast three years upon one vote." In 1827 Derby and other Whigs made a coalition with Canning on the defection of the more unyielding Tories, and he became under-secretary for the colonies. The coalition was broken up by Canning's death in August. During the administration of the duke of Wellington (1828-1830), Stanley and those with whom he acted were in opposition. His robust and assertive Liberalism about this period seemed curious afterwards to a younger generation who knew him only as the very embodiment of Conservatism.

On the advent of Lord Grey to power in Nov. 1830, Stanley was appointed to the chief secretaryship of Ireland. On accepting office he had to vacate his seat for Preston and seek re-election,

and he had the mortification of being defeated by the Radical, "Orator" Hunt. The contest was a peculiarly keen one, and turned upon the question of the ballot, which Stanley refused to support. He re-entered the House as one of the members for Windsor, Sir Hussey Vivian having resigned in his favour. In 1832 he again changed his seat, being returned for North Lancashire.

Stanley was one of the most ardent supporters of the Reform Bill. Reference may be made especially to his eloquent speech on March 4, 1831 on the adjourned debate on the second reading of the bill. Apart from his connection with the general policy of the government, Stanley had a difficult task in his own office. Ireland was in a very unsettled state. The concession of Catholic emancipation had excited the people to make all sorts of demands, reasonable and unreasonable. "Scorpion Stanley," as O'Connell called him, discharged with determination the ungrateful task of carrying a coercion bill through the House. It was generally felt that O'Connell, powerful though he was, had fairly met his match in Stanley, who, with invective scarcely inferior to his own, evaded no challenge, ignored no argument, and left no taunt unanswered. The title "Rupert of debate" is peculiarly applicable to him in connection with the fearless if also often reckless method of attack he showed in his parliamentary war with O'Connell. It was first applied to him, however, 13 years later by Sir Edward Bulwer Lytton in *The New Timon*—

One after one the lords of time advance,
Here Stanley meets—here Stanley scorns the glance!
The brilliant chief irregularly great,
Frank, haughty, rash,—the Rupert of debate.

The best answer, however, to the attacks of the great agitator was the beneficial legislation which Derby secured for Ireland. He introduced and carried the first national education act for Ireland, one result of which was the remarkable and to many almost incredible phenomenon of a board composed of Catholics, Episcopians and Presbyterians harmoniously administering an efficient education scheme. In 1833, just before the introduction of the Irish Church Temporalities Bill, Stanley had been appointed secretary for the colonies, with a seat in the cabinet. In this capacity he introduced the bill for freeing the slaves in the West Indies, on May 14, 1833, in one of his most eloquent speeches.

The Irish Church question determined more than one turning-point in his political career. In 1834 the proposal of the government to appropriate the surplus revenues of the church to educational purposes led to his secession from the cabinet, and, as it proved, his complete and final separation from the Liberals. Sir James Graham, the earl of Ripon and the duke of Richmond, also left the cabinet on the same issue. O'Connell, speaking in the House, described the secession in a couplet from Canning's *Loves of the Triangles*—

Still down thy steep, romantic Ashbourne, glides
The Derby dilly carrying six misdeeds.

Stanley spoke against the bill and against its authors with a bitterness that he himself is understood to have afterwards admitted to have been unseemly towards those who had so recently been his colleagues. The course followed by the government was "marked with all that timidity, that want of dexterity, which led to the failure of the unpractised shoplifter." His late colleagues were compared to "thimble-riggers at a country fair," and their plan was "petty larceny, for it had not the redeeming qualities of bold and open robbery."

In the end of 1834, Lord Stanley, as he was now styled by courtesy, his father having succeeded to the earldom in October, was invited by Peel to join the short-lived Conservative ministry which he formed after the resignation of Melbourne. Though he declined the offer for reasons stated in a letter published in the Peel memoirs, he acted from that date with the Conservative party, and on its next accession to power, in 1841, he accepted the office of colonial secretary, which he had held under Lord Grey. His position and his temperament alike, however, made him a thoroughly independent supporter of any party to which he attached himself. When, therefore, consideration of health

arising from the late hours in the Commons led him in 1844 to seek elevation to the Upper House in the right of his father's barony. Peel was rid of a too candid friend in the Commons and was assured of strong debating power in the Lords. But when Peel accepted the policy of free trade in 1846, the breach between him and Stanley was, as might have been anticipated, instant and irreparable. Stanley at once became the recognized leader of the Protectionist party, having Lord George Bentinck and Disraeli for his lieutenants in the Commons. They did all that could be done when the logic of events was against them, though Protection was never to become more than their watchword.

Lord Derby, who had succeeded to the earldom on the death of his father in June 1851, was called upon to form his first administration in Feb. 1852. He was in a minority, but the circumstances were such that no other than a minority government was possible, and he resolved to dissolve parliament and appeal to the country at the earliest opportunity. The election did not materially alter the position of parties. Parliament met in November and in December the ministry had resigned in consequence of their defeat on Disraeli's budget. For the next six years, during Lord Aberdeen's "ministry of all the talents" and Lord Palmerston's premiership, Lord Derby led the opposition, whose policy gradually became more generally Conservative and less distinctively Protectionist as the hopelessness of reversing the measures adopted in 1846 made itself apparent. In 1855 he was asked to form an administration after the resignation of Lord Aberdeen, but failing to obtain sufficient support he declined the task. After the defeat of Lord Palmerston on the Conspiracy Bill in Feb. 1858, he formed his second ministry. Though he still could not count upon a working majority, defeat was avoided for a whole session, owing chiefly to the dexterous management of the Commons by Disraeli. During the session of 1858 the government carried two important measures, one a bill to remove Jewish disabilities, and the other a bill to transfer the government of India from the East India Company to the crown. Next year the question of parliamentary reform had to be faced, and the government introduced a bill at the opening of the session, which was rejected by the House, and, on a dissolution, rejected also by the country. After a vote of no confidence (June 10) in the new parliament Derby at once resigned.

He now devoted much of the leisure the position afforded him to congenial classical studies. It was his reputation for scholarship as well as his social position that had led in 1852 to his appointment to the chancellorship of the university of Oxford, in succession to the duke of Wellington. His *Translations of Poems Ancient and Modern* (1862) was privately printed. Its reception by those to whom it was circulated encouraged him to proceed with his *magnum opus*, the translation of the whole of the *Iliad*, which appeared in 1864.

During the seven years that elapsed between Lord Derby's second and third administrations the terrible industrial crisis in Lancashire caused by the stoppage of the cotton supply in consequence of the American Civil War, absorbed much of his time and thought. Derby worked unceasingly for its relief. His personal subscription, munificent though it was, represented the least part of his service. His noble speech at the meeting in Manchester in Dec. 1862, where the movement was initiated and his advice at the subsequent meetings of the committee, were of the very highest value in stimulating and directing public sympathy. His relations with Lancashire had always been cordial, after the cotton famine period the cordiality passed into a warmer and deeper feeling among the factory operatives.

On the rejection of Russell's Reform Bill in 1866, Derby formed his third cabinet. It was destined to be short-lived, but lasted long enough to settle on a permanent basis the question that had proved fatal to its predecessor. The passing of the Reform Bill was the main business of the session 1867. The chief debates were, of course, in the Commons, and Derby's failing powers prevented him from taking any large share in those which took place in the Lords. His description of the measure as a "leap in the dark" was eagerly caught up, because it exactly represented the common opinion at the time,—the most expe-

rienced statesmen, while they admitted the granting of household suffrage to be a political necessity, being utterly unable to foresee its effect on the constitution and government of the country.

Declining health compelled Derby to resign office in Feb. 1868. He yielded the entire leadership of the party as well as the premiership to Disraeli. His subsequent appearances in public were few and unimportant. His last speech in the House of Lords, denunciation of Gladstone's Irish Church Bill, was marked by much of his early fire and vehemence. A few months later, on Oct. 23, 1869, he died at Knowsley.

Lord Aberdeen was reported by *The Times* to have said that no one of the giants he had listened to in his youth, Pitt, Fox, Burke or Sheridan, "as a speaker, is to be compared with our own Lord Derby, when Lord Derby is at his best." (G. Saintsbury, *Lord Derby*, 1906.)

DERBY (dar bi), a county and parliamentary borough and the county town of Derbyshire, England, 60 mi SE of Manchester on the LMSR and LNER. Pop. (1938) 139,000. Area 12.7 sq mi. Occupying a position almost in the centre of England, the town is situated on the Derwent, at the southern end of the Pennines. It is the centre of an important network of routes since early times and more especially since the Industrial Revolution. A title to the NE is Littlechester which was the site of a Roman fort or village. Under the heptarchy Derby was known as Northwotung, receiving its present name from Deoraby as it was known to the Danes after the Treaty of Wedmore. It was reconquered by Aethelstan in 917, and prospered during the 10th century, but much of the land was waste at the time of Domesday. The first charter was granted in 1206 giving it all the privileges which Nottingham had in the time of Henry I and Henry II. The charter provides that no one shall dye cloth within ten leagues of Derby except in the borough. A charter of Henry III in 1260 granted that no Jew should be allowed to live in the town. Edward III granted the petition of the burgesses for two bailiffs. In 1745 the young pretender marched as far south as Derby, where it was decided that he should return to Scotland instead of going on to London.

Among interesting buildings are St. Peter's church, a fine building of Perpendicular date but with earlier portions, St. Alkmund's and St. Andrew's, in the Decorated style, and All Saints' with a beautiful choir screen and good stained glass. The church tower was built 1509-17, and is one of the finest in the midland counties. Derby grammar school was placed in 1159 under the administration of the chapter of Darley abbey. It now occupies St. Helen's house. Derby possesses a municipal technical college, schools of science and art, a public library, museum and art gallery, an agricultural institute, and Liversage's almshouses, a foundation inaugurated by Robert Liversage in 1529. A town planning scheme was adopted in 1929, while under a central improvement plan a covered market, a bus station, police buildings and riverside gardens were constructed. Further improvements to the river were also carried out.

Derby is celebrated for its porcelain. This manufacture was introduced about 1750, and although partially abandoned, it has been revived. The manufacture of silk, hosiery, lace and cotton formerly employed large numbers, and there are still numerous silk mills and elastic webworks. Silk "throwing" or spinning was introduced into England from Piedmont in 1717 by John Lombe, who set up machinery in Derby. In the 19th century the principal centre of the Midland railway was established at Derby. It is still a leading centre under LMS control. Other industries include the manufacture of aircraft, motor cars, especially the Rolls Royce car, as well as of electrical apparatus, paint, shot, white and red lead and varnish, and there are sawmills and tanneries. The manufacture of hosiery profited greatly by the inventions of Jedediah Strutt about 1750. In Littlechester there are chemical and steam boiler works. Derby was a bishopric suffragan in the diocese of Southwell but in 1927 became a separate bishopric. The parliamentary borough returns two members.

DERBY, a city of New Haven county, Connecticut, U.S.A., 10 mi W of New Haven, on the Housatonic river at the mouth of the Naugatuck, just below Ansonia and opposite the borough

of Shelton. The population was 10,259 in 1950 and 10,287 in 1940 by the federal census. Derby was settled in 1643 as an Indian trading post called Pugasaset, and received its present name in 1675. It was chartered as a city in 1893. In the 18th century it had a thriving commerce with the West Indies.

It was the birthplace of David Humphreys (1752-1818), Washington's aide and military secretary from 1780 to the end of the war, first minister of the United States to Portugal (1790-97) and minister to Spain (1797-1802), and one of the 'Hartford Wits', and of Commodore Isaac Hull (1773-1843), commander of the U.S. frigate "Constitution" ("Old Ironsides") during the War of 1812.

DERBYSHIRE, a north midland county of England, bounded north and northeast by Yorkshire, east by Nottinghamshire, southeast and south by Leicestershire, south and southwest by Staffordshire, and west and northwest by Cheshire. The area of the geographical county is 1,006 sq mi with a population of 826,336 (1951 census).

The county may be divided into two sections—the northern upland region culminating in the High Peak, and the southern lowland area around Derby.

The north is made up of Carboniferous limestone, millstone grit and the coal measures, while the lowland south is mainly underlain by red Triassic rocks.

Geology.—The Carboniferous or "Mountain" limestone in the northwest of the county is the oldest formation, its thickness is over 2,000 ft. It is well exposed in the numerous narrow gorges cut by the Derwent and its tributaries and by the Dove on the Staffordshire border.

The limestone uplands are bleak and dry generally with smooth outlines cut by deep ravines. Many of these glens are richly wooded. Volcanic rocks, locally known as "Toadstone" are represented in the limestones by intrusive sills and flows of dolerite and by necks of agglomerate notably near Tideswell, Millersdale and Matlock.

The highest ground in the extreme north of the county is capped by shales and sometimes by the millstone grit. In this region are Bleaklow hill (2,056 ft.), Shelf Moss (2,046 ft.), Kinder Scout (2,088 ft.) and other summits of the Peak itself. A series of black shales with nodular limestones, the Pendlewise series rests upon the mountain limestone on the east, south and northwest, much of the upper course of the Derwent has been cut through these soft beds. Main tor (1,700 ft.) is made of these shales. Then follows a thick mass of sandstones, grits and shales—the millstone grit series. On the west side these extend from Blacklow hill to Axe Edge, on the east, from Derwent Edge to near Derby. A patch of millstone grit and limestone occurs in the south of the county about Melbourne and Tickvane.

The coal measures rest upon the millstone grit, the largest area of these rocks lies on the east, where they are coterminous with the coalfields of Yorkshire and Nottingham. A small tract, part of the Leicestershire coalfield, lies in the south of the county, and in the northwest corner a portion of the Lancashire coalfield appears about New Mills and Whaley Bridge. The coal measure country is gently moulded. East of Bolsover the coal measures are covered unconformably by the Permian breccias and magnesian limestone. South of a line through Ashbourne, Quarndon and Stanford, the land is at a much lower level. Flanking the hills between the former towns are red beds of Bunter, sandstone and conglomerate, they also appear at Morley, east of the Derwent, and again round the small southern coalfield. Most of the south part of the county is covered superficially by glacial drift and alluvium of the Trent. Local boulders as well as northern erratics are found in the valley of the Derwent. The bones of Pleistocene mammals—the rhinoceros, mammoth, bison, hyaena, etc., have been found at numerous places, often in caves and fissures in the limestones, e.g., at Castleton, Wirksworth and Cresswell. At Doveholes the Pleistocene *Mastodon* has been reported.

The rivers of the county radiate from the northern hills. Those of the northwest belong to the Mersey and those of the north east to the Don, but all the others to the middle Trent which forms part of the southern county boundary with Leicestershire.

The tributary streams of the Trent, of which the Derwent, Dove and Erewash are the most important, flow from north northwest to south-southeast over the Carboniferous, but turn almost west northwest to east southeast on the newer rocks before they enter the middle Trent, flowing roughly east-northeastwards. The Dove flows as the boundary between Derbyshire and Staffordshire for nearly its entire course. The Derwent rising in the High Peak flows southward, almost bisecting the county. The Erewash is the boundary stream between Nottinghamshire and Derbyshire. The Goyt rises a little farther north than the junction of the three counties—Staffordshire, Cheshire and Derbyshire, and flows north-northeastward dividing Derbyshire from Cheshire and finally falls into the Mersey.

Climate.—The winters in the uplands are generally severe, and the rainfall heavy. At Buxton (1,000 ft.) the mean temperature in January is 34.9° F., and in July 57.5°, at Derby, in the southern lowland, the figures are respectively 37.5° and 61.2°, intermediate conditions are found at Belper where the figures are 36.3° and 59.9°.

The contrasts shown by the mean annual rainfall are similarly marked, ranging from 52.03 in at Woodhead in the north of the county through 35.2 in at Matlock and 24.35 in at Derby in the south.

History.—Important traces of the cultures of the late Palaeolithic age in Cresswell crags have been discovered.

The early settlement of Derbyshire was confined almost entirely to the well drained Carboniferous limestone lands of the Peak. The marked Derbyshire group of Beaker pots indicates an important settlement of the dawn of the age of metals around the Peak district. It is thought that the Beaker folk came from the continent via the east coast, and groups apparently from the East Riding of Yorkshire reached the Derbyshire Peak district, others penetrated from the East Anglian coasts inland over the English plain. There are numerous Megalithic remains in the same area, the stone circle being much in evidence. The largest circles are those of Arbor Low, near Hartington, which retains most of its stones, and the "Bull Ring," at Dove Holes, near Chapel-en-le-Frith. Finds of bronze age weapons and implements are not so numerous as in the neighbouring counties. Many defensible sites, especially in the north of the county, are capped by ancient camps. Mam tor, near Castleton, and Carl's Wark, near Hathersage, are good examples. It is impossible to assign a date to these structures as they were probably in use over a great length of time. Structures of this type were important in Romano-British and post-Roman times. The Romans were the first to utilize the lowlands to any great extent. At this period Littlechester, a camp to the northeast of Derby, became a focus of ways, receiving Rykfield street in particular. Aquae (Buxton), Anavio (near Castleton) and Melandra (west of Glossop) were sites in the north of the county.

The post-Roman centuries revived interest in the north until the conquests of the West Angles in the 6th century brought them up the valleys of the Derwent and the Dove.

Later the district formed the northern division of Mercia, and in 848 the Mercian witenagemot assembled at Repton. In the 9th century the district suffered frequently from the ravages of the Danes, who in 874 wintered at Repton and destroyed its famous monastery. Derby under Guthrum was one of the five Danish burghs, but in 918 was recovered by Aethelflaed. In 924 Edward the Elder fortified Bakewell, and in 941-942 Edmund regained Derby from the Danes. Saxon barrows are numerous in Wirksworth hundred and the Bakewell district, among them being White-low near Winstan and Bower's-low near Tissington. There are Saxon cemeteries at Stapenhill and Foremark Hall.

Derbyshire probably originated as a shire in the time of Aethelstan, but for long it maintained a close connection with Nottinghamshire, and Domesday gives a list of customs affecting the two counties alike. The two shire-courts sat together for the Domesday inquest, and the counties were under one sheriff until the time of Elizabeth. The villages of Appleby, Oakthorpe, Donisthorpe, Stretton-en-Field, Wilsley, Chicote and Measham were reckoned as part of Derbyshire in 1086, although separated from it by the Leicestershire parishes of Over and Nether

Seat Early divisions of the county were known as wapentakes, five being mentioned in Domesday while 13th century documents mention seven corresponding with the six present hundreds, except that Repton and Gresley were then reckoned as separate divisions. In the 14th century the divisions were described as hundreds, and Wirksworth alone retained the designation wapen take until modern times. Ecclesiastically the county constituted an archdeaconry in the diocese of Lichfield comprising the six deaneries of Derby, Ashbourne, High Peak, Castallur, Chesterfield and Repton. In 1884 it was transferred to the newly formed diocese of Southwell, but in 1927 was created a separate diocese of Derby, which includes the whole county except three parishes in the diocese of Peterborough. The assizes for Nottinghamshire and Derbyshire were held at Nottingham until the reign of Henry III, when they were held alternately at Nottingham and Derby until 1566, after which the Derbyshire assizes were held at Derby. The miners of Derbyshire formed an independent community under the jurisdiction of a steward and barmasters, who held two Barmote courts (q.v.) every year. The forests of Peak and Duffield had their separate courts and officers.

At the time of Domesday Henry de Ferrers owned almost the whole of the modern hundred of Appletree. The Ferrers estates were forfeited by Robert earl of Derby, in the reign of Henry III. Another Domesday landholder was William Peverel, the founder of Peak castle, whose possessions were known as the honour of Peverel. In 1155 the estates were forfeited to the crown. During the reigns of John and Henry III discontent was rife in Derbyshire and attacks were made on the central power. Riots occurred in 1443. In the 17th century the county first supported the king, but by 1643 Sir John Gell of Hopton had secured almost the whole county for the parliament. Derby, however, was always royalist and Romanist in sympathy, and in 1745 entertained the young pretender.

Agriculture and Industries.—Slightly over 67% of the total area of 639,120 ac was devoted to agriculture in 1936, but of this only 16% was arable land. Among the higher altitudes of north Derbyshire where the soil is poor and the climate harsh, grain is unable to flourish, while even in the more sheltered parts of this region the harvest is usually late. Such districts have heath pasture with sheep farming. Farther south are heavy crops of wheat and oats, while turnips and swedes and green crops are not uncommon. Some barley is cultivated about Repton and Gresley. Wheat (19,321 ac in 1939) is the most important crop in the county. A large part of the Trent valley is under permanent pasture, being devoted to cattle feeding and dairy farming. The National Trust owned 2,565 ac in the county in 1942.

Derbyshire has always been mainly a mining and manufacturing county, though the rich land in the south formerly produced large quantities of corn. The lead mines were worked by the Romans, and Domesday mentions lead mines at Wirksworth, Matlock, Bakewell, Ashford and Crich. Iron has also been produced in Derbyshire from an early date, and coal mines were worked at Norton and Alfreton in the beginning of the 14th century. The woollen industry flourished in the county before the reign of John, when an exclusive privilege of dyeing cloth was conceded to the burgesses of Derby. Thomas Fuller in 1662 mentions lead, malt and ale as the chief products of the county, and the Buxton waters were already famous in his day. The 18th century saw the rise of numerous manufactures. In 1718 Sir Thomas and John Lombe set up an improved silk-throwing machine at Derby, and in 1758 Jedediah Strutt introduced a machine for making stockings. In 1771 Sir Richard Arkwright set up one of his first cotton mills in Cromford, and in 1787 there were 22 cotton mills in the county. The Derby porcelain or china manufactory was started about 1750. The industrial districts, based on the coalfield, are in the east and extreme southwest. Silk, cotton, iron, papermaking, woollens, lace, malting and brewing are important. Derby, Belper and Duffield are the silk centres, while Derby has also its china, lace, braids, cords, chemical and motor (Rolls Royce) manufactures. Belper, Glossop, Ilkington and Cromford specialize in cotton-spinning and hosiery. The iron smelting focuses on Alfreton, Chesterfield, Derby, Dronfield and Eckington. Lead, gypsum,

zinc, iron ore, manganese and barytes are raised to some extent. The county is famous for its limestone and marble quarries, while the fluorspar of the limestone caverns is made into ornaments. The warm mineral springs at Buxton, Matlock and Bakewell are well known.

The chief railway serving the county is the LMS, which has one of its chief works at Derby, while a branch of the LNE serves Derby and other places in the south. The Trent and Mersey canal crosses the southern part of the county, and there is a branch canal (the Derby) connecting Derby with this and with the Erewash canal, which runs north from the Trent up the Erewash valley. From it there is a little used branch (the Cromford canal) to Matlock. There were 2,395 mi. of roads in the county in 1942.

Population and Administration.—The area of the administrative county, which contains six hundreds, is 992.9 sq mi., pop. (1938) 627,800. Wartime movements had little effect in Derby, the population rising only 1% between Sept. 1939 and Feb. 1941. Derby is a county borough, the municipal boroughs are Buxton, Chesterfield, Glossop and Ilkington. The urban districts are Alfreton, Ashbourne, Bakewell, Belper, Bolsover, Clay Cross, Dronfield, Heanor, Long Eaton, Matlock, New Mills, Ripley, Staveley, Swadlincote District, Whaley Bridge and Wirksworth. The county is in the Midland circuit, and assizes are held at Derby. It has one court of quarter sessions and is divided into 15 petty sessional divisions. The boroughs of Derby, Chesterfield and Glossop have separate commissions of the peace, and that of Derby has also a separate court of quarter sessions. The total number of civil parishes is 310. The county returned two members to parliament from 1295 until 1832, after which it returned four members in two divisions until 1868 when six members were returned for three divisions. After 1918 the county returned eight members, one each for the following divisions: Belper, Chesterfield, Clay Cross, High Peak, Ilkington, Northeastern, Southern and Western, while the county borough of Derby returned two members after 1275.

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DERBYSHIRE NECK. see GOTTFREY

DEREHAM, (properly East Dereham), market town and urban district in Norfolk, England, 122 mi NNE from London. Pop. (est. 1938) 5,730. Area, 8.9 sq mi. The church of St Nicholas is a cruciform perpendicular structure with a beautiful central tower and some portions of earlier date. It contains a monument to William Cowper, who came to live here in 1796, and the Congregational chapel stands on the site of the house where the poet spent his last days. Dereham is an important agricultural centre, and has a large Friday market. There is an annual harvest fair in September. The manufactures are agricultural steam engines and threshing machines, there is also a coach works.

DERELICT, in law, property thrown away or abandoned by the owner in such a manner as to indicate that he intends to make no further claim to it. The word is used more particularly with respect to property abandoned at sea (see WRECK). Land gained gradually and slowly from the sea belongs to the owner of the adjoining land by *dereliction*, but in England in the case of sudden or considerable reversion, the land belongs to the crown.

DERENBOURG, HARTWIG (1844-1903), French orientalist, son of the following, was born in Paris on June 17, 1844. He studied at Göttingen, Leipzig and at the École des Langues Orientales, Paris. In 1879 he was appointed professor of Arabic

at the École des Hautes Études in Paris. He collaborated with his father in the great edition of Seadiah (1893 etc.) and the edition of Abu-Ṭ-Wahid, and also prepared a number of important editions of other Arabic writers and a catalogue of the Arabic mss in the Escorial (2 vols 1884-93).

DERENBOURG, JOSEPH (1811-1895), Franco-German orientalist, was born at Mainz on Aug. 21, 1811, and settled in Paris in 1839. He was a considerable force in the revival of Jewish education in France. He made great contributions to the knowledge of Seadiah (q.v.), and planned a complete edition of Seadiah's works in Arabic and French. Among his numerous works is an *Essai sur l'histoire et la géographie de la Palestine* (Paris, 1867). This was an original contribution to the history of the Jews and Judaism in the time of Christ, and has been much used by later writers on the subject (e.g., Schurer). He became professor of Hebrew and rabbinical theology at the École des Hautes Études, Paris, in 1877. Derenbourg died on July 29, 1895, at Ems.

DERG, LOUGH, a lake of Ireland, on the boundary of the counties Galway, Clare and Tipperary. It is an expansion of the Shannon channel, 23 m long and from 1 to 3 m broad. The water appears to be dammed, as the Shannon flowing over the low lying central plain breaks through the narrow gorge between Sheve Bernagh and the Arra mountains. Ruined churches and fortresses are numerous on the eastern shore, and on Inisicaltra island are a round tower and the remains of five churches.

Another LOUGH DERG, near Pettigo in Donegal, is famous as the traditional scene of St Patrick's purgatory. In the middle ages its pilgrimages had a European reputation, and they are still observed. The hospice, chapels, etc., are on Statoun island, and there is a ruined monastery on Saints' island.

DE RIDDER, a city of south-western Louisiana, U.S.A., on the watershed between the Sabine and the Calcasieu rivers, the capital of Beauregard parish. It is on Federal highway 171, and is served by the Santa Fe, the Kansas City Southern and the Southern Pacific railways. The population was 5,776 m 1950 and 37,590 in 1940 by the federal census. It was founded in 1900 as a pine milling centre, and with the decline of that industry (about 1920) a study of the agricultural possibilities of the region was made, and the cultivation of satsuma oranges, grapefruit and lemons was introduced. By 1927 there were 400,000 citrus trees growing in the vicinity, of which 25,000 were already bearing full crops. De Ridder was organized as a city in 1912. It has a commission form of government.

D'ERLON, JEAN BAPTISTE DROUET, COUNT (1765-1844), marshal of France, was born at Reims on July 29, 1765. He entered the army as a private soldier in 1782, did good service in the campaigns of the revolutionary wars, and in 1799 attained the rank of general of brigade. He served in Switzerland under Masséna (1799), at Hohenlinden under Moreau (1800), at Jena (1806), and at Friedland (1807). After this last battle he was created count d'Erlon and received a pension. For the next six years d'Erlon was almost continuously engaged as commander of an army corps in the Peninsular War. At the pass of Maya in the Pyrenees he defeated (1814) Lord Hill's troops. After the first Restoration he was named commander of the 16th military division, but was arrested for conspiring with the Orleans party. He escaped, and joined Napoleon on his return from Elba. The emperor made him a peer of France, and gave him command of the 1st army corps. In the Waterloo campaign d'Erlon's corps formed part of Ney's command on June 16 but, in consequence of an extraordinary series of mis-underrstandings took part neither at Ligny nor at Quatre Bras (see WATERLOO CAMPAIGN, 1815).

He was in command of the right wing of the French army throughout the great battle of June 18 and fought in the closing operations around Paris. At the second Restoration d'Erlon fled into Germany, only returning to France after the amnesty of 1825. He was reinstated on the accession of Louis Philippe. As commander of the 12th military division (Nantes) he suppressed the legitimist agitation in his district and caused the arrest of the duc de Berry (1832). He was governor of Algiers from 1834 to 1836. D'Erlon was made marshal of France shortly before his

death in Paris on Jan. 25, 1844.

DERMAPTERA, an order of insects (q.v.), which includes the earwigs (q.v.).

DERMATOLOGY see SKIN DISEASES

DERMOT MAC MURROUGH (d. 1171), Irish king of Leinster, succeeded his father in the principality of the Hu Cin sellagh (1115) and eventually in the kingship of Leinster. About 1152 we find him engaged in a feud with O Ruairc, the lord of Breifne (Leitrim and Cavan). Dermot abducted the wife of O Ruairc more with the object of injuring his rival than from any love of the lady. The injured husband called to his aid Roderic, the high king (airdrigh) of Connaught, and in 1166 Dermot fled before this powerful coalition to invoke the aid of England. Obtaining from Henry II a license to enlist allies among the Welsh marchers, Dermot secured the aid of the Clares and Geraldines. To Richard Strongbow, earl of Pembroke and head of the house of Clare, Dermot gave his daughter Eva in marriage, and on his death was succeeded by the earl in Leinster. The historical importance of Dermot lies in the fact that he was the means of introducing the English into Ireland. Through his aid the towns of Waterford, Wexford and Dublin had already become English colonies before the arrival of Henry II in the island. To the credit of Dermot Mac Murrough must be put the compilation of the *Book of Leinster*, a valuable collection of early Gaelic tradition.

See *The Song of Dermot and the Earl, an old French Poem* (by M. Regan?), edit. with trans. by G. H. Orpen (1892); Kate Norgate, *England under the Angevin Kings*, vol. II.

DERNA, a town on the north coast of Cyrenaica, Africa (anc. *Darnus-Zarne*), 224 m E of Benghazi by road (railway as far as El Merg). Population (1938) 21,547. Situated below the eastern butt of Jebel Akhdar on a small but rich deltaic plain, watered by fine perennial springs, it has a growing population and trades in fruits grown in its extensive palm gardens, and in hides and wool brought down by the nomads from the interior. The bay is open from north-west round to south east and often inaccessible in winter and spring. A portion of the people is of Moorish stock, of Andalusian origin, which emigrated in 1493, the descendants preserve a fine racial type. It was the easternmost city of the Pentapolis of Cyrenaica. There is a highhouse west of the bay. The names Darnis and Zarne are philologically identical and probably refer to the same place. No traces are left of the ancient town except some rock tombs. Darnis continued to be of some importance in early Muslim times as a station on the Alexandria-Karouan road, and has served on more than one occasion as a base for Egyptian attacks on Cyrenaica and Tripolitania. In 1805 the government of the United States, in dispute with the dey of Tripoli on account of piracies on American shipping, landed a force under William Eaton (q.v.) to co-operate in the attack on Derna then being made by Sidi Ahmet, an elder brother of the dey. After 1835 Derna passed under direct Ottoman control, and subsequently served as the point whence the sultan exerted a precarious but increasing control over eastern Cyrenaica and Marmarica. It passed to Italy in 1912. There is a caravan route to Tobruk (115 mi.).

DERNBURG, HEINRICH (1829-1907), German legal scholar, was born on March 3, 1829, at Mainz, and died at Berlin on Nov. 23, 1907. He was made professor at Zurich (1854), at Halle (1862), at Berlin (1873) and from 1866 was in the Prussian Upper House. His chief publications are *Die Kompensation* (1854), *Das Pfandrecht* (2 vols, 1860), *Die Institutionen des Cynus* (1866), *Lehrbuch des preuss. Privatrechts* (3 vols, 1871-96), *Pandekten* (3 vols, 1884), and *Das bürgerliche Recht des Deutschen Reichs u. Preussens* (5 vols, 1898).

DÉROULEDE, PAUL (1846-1914) French author and politician, was born in Paris. His first published verse appeared in the *Revue nationale*, under the pseudonym of Jean Rebel, and in 1869 he produced at the Théâtre Français a one-act drama in verse entitled *Juven Strenner*. On the outbreak of the Franco-Prussian War he enlisted as a private, was wounded and taken prisoner at Sedan, and sent to Breslau, but effected his escape. He then served under Chauzy and Bourbaki, took part in the latter's disastrous retreat to Switzerland and fought against the Commune in Paris. After attaining the rank of lieutenant, he

was forced by an accident to retire from the army. He published in 1872 a number of patriotic poems (*Chants du soldat*), which enjoyed unbounded popularity. This was followed in 1875 by another collection, *Nouveaux Chants du soldat*. In 1877 he produced a drama in verse called *L'Esman*, which derived a passing success from the patriotic fervour of its sentiments. For the exhibition of 1878 he wrote a hymn, *Vive la France*, which was set to music by Gounod. In 1880 his drama in verse, *La Moabite*, which had been accepted by the Theatre Francais, was forbidden by the censor on religious grounds.

In 1882 M. Deroulde founded the *Ligue des patriotes*, with the object of furthering France's "revanche" against Germany. He was one of the first advocates of a Franco-Russian alliance, and as early as 1883 undertook a journey to Russia for the furtherance of that object. On the rise of General Boulanger, M. Deroulde attempted to use the *Ligue des patriotes*, hitherto a non-political organization, to assist his cause, but was deserted by a great part of the league and forced to resign his presidency. Nevertheless he used the section that remained faithful to him with such effect that the Government found it necessary in 1889 to decree its suppression. In the same year he was elected to the chamber as member for Angoulême. He was expelled from the chamber in 1890 for his disorderly interruptions during debate. He did not stand at the elections of 1893, but was re-elected in 1898. After the funeral of President Faure, on Feb. 23, 1899, he endeavoured to persuade Gen. Roget to lead his troops upon the Elysee. For this he was arrested, but on being tried for treason was acquitted (May 31). On Aug. 12 he was again arrested and accused, together with André Buffet, Jules Guerin and others, of conspiracy against the republic. After a long trial before the high court, he was sentenced, on Jan. 4, 1900, to ten years' banishment from France, and retired to San Sebastian. In Nov. 1905, however, the law of amnesty enabled him to return to France. He died near Nice on Jan. 30, 1914.

Besides the works already mentioned, he published *Le Sergent*, in the *Théâtre de campagne* (1880), *De l'éducation militaire* (1882), *Monsieur le Hulan et les trois couleurs* (1884), *Le Premier grenadier de France*, *La Tour d'Avvergue* (1886), *Le Livre de la ligue des patriotes* (1887), *Refrains militaires* (1888), *His toire d'amour* (1890), a pamphlet entitled *Désarmement?* (1891), *Chants du paysan* (1894), *Poèmes militaires* (1895) and *Messire du Guesclin, drame en vers* (1895), *La mort de Hoche* (1897), *La Plus belle fille du monde, conte dialogué en vers libres* (1898), 1870, *Feuilles de route* (1907), a volume of reminiscences.

DERRICK, a type of crane, the name is derived from that of a famous early 17th-century Tyburn hangman, and was originally applied as a synonym (see **CRANES**). The derrick of the petroleum industry is a skeleton framework or tower of wood or steel for hoisting or lowering from a fixed point. It is used to raise and drop the drilling tools and also to insert and remove the well casing or pipe.

DERRING-DO, valour, chivalrous conduct or "desperate courage." The word is a misconstruction of the verbal substantive *dorryng* or *durring*, "daring," and the present infinitive of "do." Edmund Spenser first adapted *derring-do* as a substantive meaning "manhood and chevalerie," and this use was revived by Sir Walter Scott.

DERRY, a town of Rockingham county, N.H., on Beaver brook, 10 mi. S.E. of Manchester, served by the Boston and Maine railroad. The population was 5,798 in 1950. It is a summer resort, and manufactures shoes.

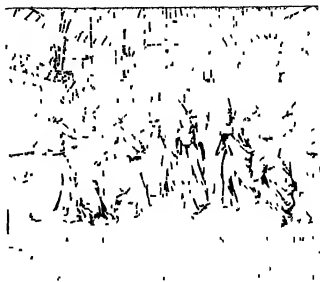
DE RUYTER, MICHAEL ADRIANZON (1607-1676), Dutch naval officer, was born at Flushing on March 24, 1607. In 1635 he was entrusted by the merchants of Flushing with the command of a cruiser against the French pirates. In 1640 he entered the service of the United Provinces, and, being appointed rear admiral of a fleet fitted out to assist Portugal against Spain, specially distinguished himself at Cape St. Vincent, Nov. 3, 1641. In the following year he left the service of the United Provinces to command a merchant vessel. In 1652 a squadron of seventy vessels was despatched against the English, under the command of Admiral Tromp. De Ruyter, who accompanied the admiral in this

expedition, seconded him with great skill and bravery in the three battles which were fought with the English off Plymouth, the Kentish Knock, and Dungeness. He was afterwards stationed in the Mediterranean, where he captured several Turkish vessels. In 1659 he received a commission to join the king of Denmark in his war with the Swedes. As a reward for his services, the king of Denmark ennobled him and gave him a pension. In 1661 he grounded a vessel belonging to Tunis, released forty Christian slaves, made a treaty with the Tunisians, and reduced the Algerine corsairs to submission. He recaptured English settlements on the west coast of Africa but was repulsed at Barkad and failed to recover New Amsterdam. He returned to take command of a large fleet which had been organized against England, and in May of the following year, after a long contest off the North Foreland, he compelled the English to take refuge in the Thames and burnt the "King Charles" and other warships in the Medway. On June 7, 1672, he fought a drawn battle with the combined fleets of England and France, in Southwold bay, and conveyed safely a fleet of merchantmen. In 1676 he assisted Spain against France in the Mediterranean, and receiving a mortal wound in the battle on April 22, off Messina died on the 29th at Syracuse. His body was carried to Amsterdam where a magnificent monument to his memory was erected by command of the States General. (See also **DUTCH WARS**.)

See *Life of De Ruyter* by Brandt (Amsterdam, 1687), and by Kloppe (2nd ed., Hinner, 1858).

DERVISH, a Persian word, meaning "beggar," generally in Islam a member of a religious fraternity, whether mendicant or not, but in Turkey and Persia more exactly a wandering begging religious, called, in Arabic speaking countries, a *faqir*. With important differences, the dervish fraternities may be compared to the regular religious orders of Roman Christendom, while the *Ulema* (*q.v.*) are, also with important differences, like the secular clergy. For the origin and history of the mystical life in Islam, which led to the growth of the order of dervishes see **ŠŪRĪSM**, here an account is given of (1) the dervish fraternities, and (2) the Sūfī hierarchy.

1. **The Dervish Fraternities**—In the earlier times, the relation between devotees was that of master and pupil. Those in-



clined to the spiritual life gathered round the reveled shaykh (*murshid*, "guide," *ustādih*, *pir*, "teacher"), lived with him, shared his religious practices and were instructed by him. In time of war against the unbelievers, they might accompany him to the threatened frontier, and fight under his eye. Thus *murābīt*, "one who pickets his horse on a hostile frontier," has become the *marabout* (*q.v.*) or dervish of Algeria, and *ribāt*, "a frontier fort," has come to mean a monastery. The relation, also, might be for a time only. The pupil might at any time return to the world, when his tell-

gious education and training were complete. Continuous corporations began to be formed in the 12th century. Many existing orders trace their origin to saints of the 3rd, 2nd and even 1st Muslim centuries, e.g., to either Ali or Abū Bkr, and in Egypt all are under the rule of a direct descendant of the latter, but such ascription is purely legendary.

Of these orders, 32 are commonly reckoned, but many have vanished or have been suppressed, and there are sub orders innumerable. Each has a "rule" dating back to its founder and a ritual which the members perform when they meet together in their convent (*khanqāh*, *adwānyā*, *tabkaryā*). This may consist simply in the repetition of sacred phrases, or it may be an elaborate performance, such as the whirling of the dancing dervishes, the Mawlawis, an order founded by Jalāl ud-Dīn ar Rūmī, the most broad-minded and tolerant of all. There are also the performances of the Rifāʾi or "howling dervishes." In ecstasy they cut themselves with knives, eat live coals and glass, handle red hot iron and devour serpents. They profess miraculous healing powers, and the head of the Sādīs, a sub order, used, in Cairo, to ride over the bodies of his dervishes without hurting them, the so called Döşek (*dausa*). Another division is made by their attitude to the law of Islam. Some neglect in general the ceremonial and ritual law, to such an extent that in Persia, India and Turkey dervish orders are classified as *bā shār*, "with law," and *bi-shār*, "without law." The latter are really antinomians, and the best example of them is the Baktāshī order, widely spread and influential in Turkey and Albania and connected by legend with the origin of the Janissaries. The Sānīs was the last order to appear, and is distinguished from the others by a severely puritanic and reforming attitude and strict orthodoxy, without any admixture of mystical slackness in faith or conduct. Each order is distinguished by a peculiar garb. Candidates for admission have to pass through a novitiate, more or less lengthy. First comes the *ahd*, or initial covenant, in which the neophyte or *murīd*, "seeker," repents of his past sins and takes the shaykh of the order he enters as his guide (*murshīd*) for the future. He then enters upon a course of instruction and discipline, called a "path" (*arīqa*), on which he advances through diverse "stations" (*maqāmāt*) or "passes" (*aqābat*) of the spiritual life. The Mawlawis have the most severe novitiate. Their aspirant has to labour as a lay servant of the lowest rank for 1,000 days before he can be received. For one day's failure he must begin again from the beginning.

But besides these full members there is an enormous number of lay adherents, like the tertiaries of the Franciscans. Thus, nearly every religious man of the Turkish Muslim world is a lay member of one order or another, under the duty of saying certain prayers daily. Certain trades, too, affect certain orders. Most of the Egyptian Qādirīs, for example, are fishermen and, on festival days, carry as banners nets of various colours. On this side, the orders bear a striking resemblance to lodges of Freemasons and other friendly societies, and points of direct contact have even been alleged between the more pytheistic and antinomian orders, such as the Baktāshī, and European Freemasonry. They are the only ecclesiastical organization that Islam has ever known, but it is a multifarious organization, unclassified internally or externally. They differ thus from the Roman monastic orders, in that they are independent and self developing, each going its own way in faith and practice, limited only by the universal conscience (*ʾimā*, "agreement" see ISLAMIC LAW) of Islam.

2. Saints and the Sūfī Hierarchy.—That an elaborate doctrine of wonder-working saints should have grown up in Islam may, at first sight, appear an extreme paradox. It can, however, be conditioned and explained. First, Muhammad left undoubted loop-holes for a minor inspiration, legitimate and illegitimate. Secondly, the Sūfīs, under various foreign influences, developed these to the fullest. Thirdly, just as the Christian church has absorbed much of the mythology of the supposed exterminated heathen religions into its cult of local saints, so Islam, to an even higher degree, has been overlaid and almost buried by the superstitions of the peoples to which it has gone. Their religious and legal customs have completely overcome the direct commands of

the Qurʾān, the traditions from Muḥammad and even the "Agreement" of the rest of the Muslim world (see ISLAMIC LAW). The worship of saints, therefore, has appeared everywhere in Islam with an absolute belief in their miracles and in the value of their intercession, living or dead.

Further, there appeared very early in Islam a belief that there was always in existence some individual in direct intercourse with God and having the right and duty of teaching and ruling all mankind. This individual might be visible or invisible, his right to rule continued. This is the basis of the Ismāʾīlī and Shīʾī position (see the article ISLAMIC INSTITUTIONS). The Sūfīs applied this idea of divine right to the doctrine of saints, and developed it into the Sūfī hierarchy. This is a single, great, invisible organization forming a samity board of administration, by which the invisible government of the world is supposed to be carried on. Its head is called the *Qutb* (Axis), he is presumably the greatest saint of the time, is chosen by God for the office and given greater miraculous powers and rights of intercession than any other saint enjoys. He wanders through the world, often invisible and always unknown, performing the duties of his office. Under him there is an elaborate organization of *walīs*, of different ranks and powers, according to their sanctity and faith. The term *wālī* is applied to a saint because of Kor x 63, "Ho! the *wālīs* of God, there is no fear upon them, nor do they grieve," where *wālīs* means "one who is near," friend or favourite.

In the fraternities, then, all are dervishes, cloistered or lay, those whose faith is so great that God has given them miraculous powers—and there are many—are *walīs*, begging friars are *fakīrs*. All forms of life—solitary, monastic, secular, celibate, married, wandering, stationary, ascetic, free—are open. Their theology is some form of Sūfism.

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DERWENT, the name of several English rivers (Celtic *Dwr* gent, clear water). (1) The Yorkshire Derwent drains North Yorkshire moors, rising in their eastern part. A southern head-stream, however, rises in the Yorkshire wolds near Filey, about a mile from the North Sea, but it flows inland owing to a coast moraine deposit. The early course of the Derwent lies through the flat open vale of Pickering between the Yorkshire moors and the Yorkshire wolds, the upper part of which is known as the Carrs, where the river follows an artificial drainage cut. It receives many tributaries from the moors, then breaches the low hills below Malton, and reaches the central plain of Yorkshire. Its direction hitherto westerly, now becomes southerly, roughly parallel to the Ouse, which it joins near Barnby on the-Marsh, after a course, of about 70 m. As a tributary of the Ouse it is included in the Humber basin. It is tidal up to Sutton-upon Derwent, 15 m. from the junction with the Ouse, and is locked up to Malton, but the navigation is little used. A canal leads east from the tidal water to the market town of Pocklington.

(2) The Derbyshire Derwent rises in Bleaklow hill north of the Peak and traverses a narrow dale, which, with the tributaries, the Noe, watering Hope valley, and the Wye, is famous for its beauty (see DERBYSHIRE). The Derwent flows south past Chatsworth, Matlock and Belper and then, passing Derby, debouches upon a low plain, and turns south eastward, to join the Trent, after flowing 60 m., near Sawley. It falls in all some 1,700 ft. (from Matlock 200 ft.), and no part is navigable, save certain reaches at Matlock and elsewhere for pleasure boats.

(3) The Cumberland Derwent rises below Great End in the Lake District, draining Spinkling and Sty Head tarns, and flows through Borrowdale, receiving a tributary from Lang Strath. It then drains the lakes of Derwentwater and Bassenthwaite, after

which its course, hitherto northerly becomes westerly past Cockermouth to the Irish Sea at Workington. The length is about 34 m, and the fall about 2,000 ft. (from Derwentwater 244 ft.), the waters are beautifully clear, and the river is not navigable. At a former period Derwentwater and Bassenthwaite formed one lake, but they have been separated by lacustrine deltas at the mouths of the river Greta, which now joins the Derwent immediately below Derwentwater, and the Newlands Beck, which enters Bassenthwaite.

(4) A river Derwent rises in the Pennines near the borders of Northumberland and Durham, and forming a large part of the boundary between these counties, takes a north easterly course of 30 m. to the Tyne, which it joins 3 m. above Newcastle.

DERWENT, the principal river of Tasmania, with a length of 130 miles. It rises in Lake St. Clair and flows south west, entering Storm Bay at Hobart by an estuary four miles wide. See TASMANIA.

DERWENTWATER, EARL OF, an English title borne by the family of Radclyffe or Radcliffe from 1688 to 1716, when the 3rd earl was attainted and beheaded, and claimed by his descendants, adherents of the exiled house of Stuart, from that date until the death of the last male heir in 1814. Sir Francis Radclyffe, 3rd baronet (1625-1697), was the lineal descendant of Sir Nicholas Radclyffe, who acquired the extensive Derwentwater estates in 1417 through his marriage with the heiress of John de Derwentwater, and of Sir Francis Radclyffe, who was made a baronet in 1619. In 1688 Sir Francis was created Viscount Radclyffe and earl of Derwentwater by James II, and dying in 1697 was succeeded as 2nd earl by his eldest son Edward (1655-1705), who had married Lady Mary Tudor (d. 1726), a natural daughter of Charles II. The 2nd earl died in 1705, and was succeeded by his eldest son James (1689-1716), who was born in London on June 28, 1689, and was brought up at the court of the Stuarts in France as companion to Prince James Edward, the old Pretender. In 1710 he came to reside on his English estates. Joining the Stuart rising of 1715, Derwentwater escaped arrest owing to the devotion of his tenantry, and in October, with about 70 followers, he joined Thomas Forster at Greening. When the rebels capitulated at Preston he was conveyed to London and impeached. Pleading guilty at his trial he was attainted, and was beheaded on Tower Hill on Feb. 24, 1716, declaring on the scaffold his devotion to the Roman Catholic religion and to King James III.

On the death of the 3rd earl's son, John Radclyffe, in 1731 his uncle Charles (1693-1746), son of the 2nd earl, took the title of earl of Derwentwater. Charles Radclyffe had fought at Preston and was condemned to death for high treason, but, more fortunate than James, he escaped from prison and went to live in Rome. He was captured by an English ship in Nov. 1745 whilst proceeding to join Charles Edward, the young Pretender, in Scotland. He was beheaded on Dec. 8, 1746. His eldest son, James Bartholomew (1725-1786), who had shared his father's imprisonment, then claimed the title of earl of Derwentwater, and on his mother's death in 1755 became 3rd earl of Newburgh. His only son and successor, Anthony James (1757-1814), died without issue in 1814, when the title became extinct *de facto* as well as *de jure*. The present representative of the Radclyffe family is Lord Petre, and in 1874 the bodies of the first three earls of Derwentwater were reburied in the family vault of the Petres at Thorndon, Essex.

See R. Patten, *History of the Late Rebellion* (London, 1717); W. S. Gibson, *Diston Hall, or Memoirs of James Radclyffe, earl of Derwentwater* (London, 1848-1850); G. E. C. (okayne), *Complete Peerage* (Exeter, 1887-1898), and *Dictionary of National Biography*, vol. xlvii (London, 1896).

DERWENTWATER, a lake of Cumberland, England, in the Lake District (qv). It is approximately oval in shape, about 3 m long and from $\frac{1}{2}$ m to $\frac{1}{4}$ m wide. The greatest depth is 70 feet. The lake is seen at one view, within an amphitheatre of mountains of varied outline, overlooked by others of greater height. Several elevations near the lake are famous view-points, e.g., Castle Head, Walla Crag, Ladder Brow and Cat Bells. The shores are well wooded, and the lake is studded with several islands, of which Lord's Island, Derwent Isle and St. Herbert's

are the principal. Lord's Island was the residence of the earls of Derwentwater. St. Herbert's Isle is so called because here lived St. Herbert, mentioned by Bede, in the 7th century. Derwent Isle (6 acres) contains a handsome residence surrounded by lawns, gardens and timber of large growth. The Falls of Lodore, at the upper end of the lake, consist of a series of cascades in the small Watendlath beck, which falls over crags from a height of nearly 200 feet. The "Floating Island" appears at intervals on the upper portion of the lake near the mouth of the beck, and is formed by the accumulation of decayed vegetable matter floating on the water. The river Derwent (qv) enters the lake from the south and leaves it on the north, draining it through Bassenthwaite lake, which is separated from Derwentwater by a lacustrine delta, to the Irish Sea. To the north east of the lake lies the town of Keswick.

DERZHAVIN, GAVRILA ROMANOVICH (1743-1816), Russian poet, was born at Kazan on July 14, 1743. He entered the army in 1762, was governor of Olonet (1784), Tambov (1785), and then secretary for petitions under Catherine II to whom many of his odes are addressed. Under Alexander I he was for a short time minister of justice, but in 1803 he retired to his estate at Zvanka, in the Novgorod Government, where he spent a serene and gay old age in the pursuit of letters. He died at Zvanka on July 21, 1816. Derzhavin, says Prince Mirsky "for sheer imaginative power is one of the small number of Russia's greatest poets." His *Ode to God* (Eng. trans. Sir John Bowring, 1861), was one of his most famous poems and was translated into many European languages.

His works were edited by Grot (7 vols., 1864-73), who also wrote his biography (2 vols., 1880-85). His poems were translated into German by Kotzebue (1793). For translations of several of Derzhavin's poems into English see L. Wiener, *Anthology of Russian Literature* (1902) and Sir John Bowring, *Specimens of the Russian Poets* (1821).

DES ADRETS, FRANÇOIS DE BEAUMONT, BARON (c. 1512-1587), French Protestant leader, was born in 1512 or 1513 at the château de La Frette (Isère). In 1561, he joined the Huguenots, probably from motives of ambition and personal dislike of the house of Guise, and waged a successful campaign against the Catholics. In June of that year Des Adrets was master of the greater part of Dauphiné. The reprisals he exacted from the Catholics after their massacres of the Huguenots at Orange have left a dark stain upon his name. The garrisons that resisted him were brutally butchered, and at Montbrison, in Forez, he forced 18 prisoners to precipitate themselves from the top of the keep. Having alienated the Huguenots by his pride and violence, he entered into communication with the Catholics and declared himself openly in favour of conciliation. On Jan. 10, 1563, he was arrested on suspicion by some Huguenot officers and confined for a time in the citadel of Nîmes. He died, a Catholic, on Feb. 2, 1587.

See J. Roman, *Documents inédits sur le baron des Adrets* (1878), and memoirs and histories of the time. See also Guy Allard, *Vie de François de Beaumont* (1675), l'abbé J. C. Martin, *Histoire politique et militaire de François de Beaumont* (1803), Eugene and Emile Haag, *La France protestante* (2nd ed., 1877) 599.

DESAIX DE VEYGOUX, LOUIS CHARLES ANTOINE (1768-1800), French general, was born at Saint Hilaire d'Ayat of noble parentage on Aug. 17, 1768, and was educated for the army. In 1789 he declared for the Revolution, and rose rapidly in the revolutionary army. By 1794 he had attained the rank of general of division. In the campaign of 1795 he commanded Jourdan's right wing, and in Moreau's invasion of Bavaria in 1796 he held an equally important command. In the retreat after the battles of Amberg and Würzburg (see FRENCH REVOLUTIONARY WARS) Desaix commanded Moreau's rearguard, and later the fortress of Kehl. He then obtained a mission to Italy, and met Bonaparte. Provisionally appointed commander of the "Army of England," Desaix was soon transferred by Bonaparte to the expeditionary force intended for Egypt. His division bore the brunt of the Mameluke attack at the battle of the Pyramids, and he defeated Murad Bey's army in Upper Egypt. Amongst the fellahs he acquired the significant appellation of the "Just Sultan." Desaix was one of the small party selected to accompany Bonaparte on his return to France, but the campaign of 1800 was well on its

way to the climax when Desaix was able to report himself for duty in Italy. He was in command of a corps of two infantry divisions when (June 14) he heard the cannon of Marengo on his right. He marched at once towards the sound, meeting Bonaparte's staff officer, who had come to recall him, half way on the route. He arrived with Boudet's division at the moment when the Austrians were victorious all along the line. Exclaiming, "There is yet time to win another battle!" he led his three regiments straight against the enemy's centre. At the moment of victory Desaix was killed by a musket ball. Napoleon erected the monuments to his memory on the Place Dauphine and the Place des Victoires in Paris.

See F. Marthe Beker, Comte de Mons, *Le Général L. C. A. Desaix* (1852).

DESARGUES, GERARD (1593-1662), French mathematician, was born at Lyons. By profession he was an engineer and architect, and was an army officer in the engineering section at the siege of La Rochelle. Between 1626 and 1630 he gave a series of lectures on mathematics at Paris, and influenced Descartes and Pascal. He died at Lyons in 1662. Most of his mathematical work is on geometry, and the theory of involution and transversals is due to him. Desargues' most important writings are *Traité de la section Perspective* (1636) and *Brouillon Project* (1639). The latter book deals with conics and embodies most of his researches.

DESAUGIERS, MARC ANTOINE MADELEINE (1772-1827), French dramatist and song writer, son of Marc Antoine Desaugiers, musical composer, was born at Fréjus (Var). At the Revolution he emigrated to St Domingo, and during the negro revolt he was made prisoner, barely escaping with his life. He took refuge in the United States, where he supported himself by teaching the piano. In 1797 he returned to his native country, and rapidly won fame as a writer of comedies, operas and vaudevilles, produced at the Théâtre des Variétés and the Vaudeville. He also wrote convivial and satirical songs, which, though different in character, can only worthily be compared with those of Beranger. He was at one time president of the *Caveau*, to which he introduced Beranger. In 1815 Desaugiers succeeded Pierre Yves Barré as manager of the Vaudeville. He died in Paris on Aug. 9, 1827.

An edition of Desaugiers' *Chansons et Poésies diverses* appeared in 1827. A new selection with a notice by Alfred de Bougy appeared in 1858. See also Sainte-Beuve's *Portraits contemporains*, vol. v.

DESAULT, PIERRE JOSEPH (1744-1795), French anatomist and surgeon, was born at Magny-Vernois (Haute Saône) on Feb. 6, 1744. He served as an apprentice in the military hospital of Belfort, and in 1782 he was appointed surgeon-major to the hospital *De la Charité*, and in 1788 to the Hôtel Dieu. The clinical school of surgery which he instituted at the Hôtel Dieu attracted great numbers of students, not only from every part of France but also from other countries, and he frequently had an audience of about 600. He died in Paris on June 7, 1795. Together with François Chopard (1743-95) he published a *Traité des maladies chirurgicales* (1770), and Bichat published a digest of his surgical doctrines in *Oeuvres chirurgicales de Desault* (1798-99).

DESBOROUGH, JOHN (1608-1680), English soldier and politician, son of James Desborough of Elmsley, Cambs., married in 1636 Elmsley Jane, daughter of Robert Cromwell of Huntingdon, and sister of the future Protector. He fought on the parliamentary side in the Civil War, but avoided all participation in the trial of the king in Jan. 1649, being employed in the settlement of the west of England. He fought at Worcester as major-general and nearly captured Charles II near Salisbury. During the Commonwealth he held many high offices and was a member of the parliaments of 1653, 1654 and 1656. In spite of his near relationship to the Protector's family, he violently opposed the assumption by Cromwell of the royal title, and after the Protector's death he was, with Fleetwood, the chief instigator and organizer of the hostility of the army towards Richard Cromwell's Administration, and forced him to dissolve his parliament in April 1659. He was chosen a member of the council of State by the restored Rump, but presenting with other officers a seditious

petition from the army council, on Oct. 5, was dismissed. On the return of the Rump, Desborough was ordered to quit London. The reign of the new military Government was brief and inglorious, and after the Restoration he escaped to Holland where he engaged in republican intrigues. He was ordered home, in April 1666, on pain of incurring the charge of treason, and was imprisoned in the Tower till Feb. 1667. Desborough's rough person and manners are the constant theme of ridicule in the royalist ballads, and he is caricatured in Butler's *Hudibras* and in the *Parable of the Lion and Fox*.

DESCANT or DISCANT, a musical term much employed in earlier centuries, when it had various meanings. Thus it was at one time a term for any kind of polyphony and even for musical composition in general. In a more special sense it signified the addition of one part to another and was thus the earliest term for counterpoint. In part music it meant the upper part or voice, especially the soprano or melody, while it also signified at a later period an instrumental piece consisting of what would be called nowadays a theme with variations. In modern usage, however, descant means primarily the early art of counterpoint, with its various rules and theories and successive forms, as practised from the 12th century onwards. What was known as the descant clef was the C, or treble, clef, with the sign placed on the lowest line of the staff. (See CLEF.)

DESCARTES, RENE (1596-1650), French philosopher and man of science. The name is sometimes given as Des Cartes, and sometimes in the Latinized form, Renatus Cartesius (whence the term *Cartesian*).

LIFE AND WRITINGS

Descartes was born at La Haye, in Touraine, on March 31, 1596. His grandfather, Pierre Descartes, was a doctor in Châtelleraut, in Poitou, who married the daughter of a medical colleague there, named Ferrand, who eventually became rector of the University of Poitiers. Pierre's son, Joachim, was councillor of the parliament of Rennes, and so a member of the lesser nobility. He married Jeanne Brochard, the daughter of a high law-officer of Poitiers. René was their third child. The house in which he was born at La Haye was his mother's property which she had inherited from her mother. She died in May 1597, when René was little more than a year old. About ten years later Joachim Descartes moved to Brittany, where he married a second time. Various members of the Descartes and Brochard families were men of learning, so that the scientific attainments of René Descartes were not really as exceptional as used to be supposed when it was thought that his ancestry was essentially military. The story of his military ancestry must be dismissed as a legend based on a confusion between his medical grandfather and an army officer of the same name.

Physically René Descartes was never robust. But already at an early age he displayed remarkable mental vigour, so that his father was wont to refer to him as his "little philosopher." In 1604, at the age of eight, he was sent to the Jesuit school at La Flèche, in Anjou. The school had only recently been founded and endowed by Henry IV in the hope of ingratiating himself with the Jesuits, one of whom had tried to assassinate him in 1594. The rector of the school, during the latter part of Descartes' stay there, was Father Charlet, a kinsman of his, who naturally took a special interest in him. The teacher to whose special care he was entrusted was Father Dinet, who subsequently became confessor to Louis XIII and Louis XIV. When Henry IV was assassinated in 1610 Descartes was one of the pupils selected to receive the heart of the dead monarch for burial in the church of La Flèche.

The first five years of Descartes' school life were devoted to the then usual school subjects, especially to the classical languages. The last three years were devoted to the study of logic and ethics, mathematics and physics and metaphysics respectively. His health called for some special indulgence, and he was allowed to stay in bed as long as he liked. Then, as afterwards, a considerable part of his work appears to have been done in bed. But he had no difficulties with his studies. He mastered them with ease, distinguishing himself especially in mathematics. Many years afterwards he criticized rather severely the studies he had pursued at school.

But it is difficult to say to what extent, if any, those criticisms express his actual feelings while he was still at school. They were probably after-thoughts. In any case, they were not especially directed against his school, but rather (like Bacon's criticisms in the *Advancement of Learning*) against the general state of contemporary studies. Towards his school he always retained a feeling of warm attachment. Later, during his controversies with Bourdin and Voetius, he turned to his former school teacher, Father Dinet, for advice. And throughout his life Descartes showed a special regard for Jesuits. It seems to have been his greatest ambition in after years to get his own philosophy introduced at La Flèche and in other Jesuit colleges. But no details are available about his school life and friends. In later life he had among his intimate friends some former pupils of La Flèche, notably Marin Mersenne, who was about seven years his senior. But there is no evidence of their acquaintance prior to 1622.

Descartes left school in 1612, and appears to have studied from 1613-16 at the university of Poitiers, where he graduated in law in Nov. 1616. His older brother was already a lawyer, but he himself was not attracted by the legal profession, and seems to have been contemplating a military career. So he devoted himself to riding and fencing, and actually wrote an essay on the art of fencing. But next to nothing is known of his doings during 1613-17. In 1618 he left France apparently in search of military experience in Holland. He served as a gentleman volunteer in the army of the stadtholder, Prince Maurice of Nassau, at Breda. Of any real soldiering there is no evidence. His stay at Breda was only remarkable for his chance meeting with a brother mathematician, Isaac Beeckman, rector of the college at Dort. Mathematics was useful for military engineering, so there were a number of mathematicians in the stadtholder's entourage at Breda. In the absence of more urgent business some of them passed the time in propounding problems which they posted on the city walls with a challenge to others to solve them. One day Descartes was trying to get at the gist of such a challenge, which was written in Dutch. He turned to a bystander with the request to translate it for him into French or Latin. It happened to be Beeckman, who did as requested, and jestingly asked the French cadet to solve the problem. Descartes brought him the solution in a couple of days, and the chance acquaintances became friendly. Descartes gave Beeckman a manuscript *Essay on Algebra*, also a *Compendium of Music* (dated Breda, Dec. 31, 1618) which he dedicated to Beeckman. Some of the scant information about Descartes relating to this period consists of entries in the diary of Beeckman, which has fortunately been discovered in recent years.

In April 1619 Descartes left Holland. He had planned an extensive journey from Amsterdam to Copenhagen, and thence via Poland, Hungary and Bohemia to Bavaria. This very roundabout route to Bavaria seemed necessary because of the insecurity of the direct route from Holland to Bavaria owing to military conditions in the intervening area. But there is no evidence that Descartes carried out his plan. What is known is that he was in Frankfurt a M. that summer, and there witnessed the festivities in connection with the coronation of the emperor Ferdinand. The following autumn and winter he seems to have passed in a village near Ulm on the Danube. Ostensibly he was taking part in the military campaigns which marked the opening of the Thirty Years' War. In reality he seems to have been occupied with problems of mathematics. Ulm was noted for its mathematicians, including Faulhaber (a reputed Rosicrucian) whom Descartes most probably met there. His stay near Ulm was chiefly remarkable for a certain illumination and certain dreams which he experienced there. He appears to have spent much of his time in solitary brooding over the problem of human knowledge. Moods of doubt and darkness assailed him, and he prayed for light. Of all his studies up to that point only one had really satisfied him, namely, mathematics. And he attributed the certainty of mathematics to the character of its method. On Nov. 10, 1619, the thought appears to have flashed upon him suddenly that the mathematical method, or, more precisely, the method of analytical geometry, might be extended to other studies. The thought dominated his mind like a divine revelation. Three dreams followed. In the first he ap-

peared to be lame, and forced by a tempest to seek shelter in a church. In the second dream he heard the sound of thunder, and saw sparks of fire round about him. In the third he opened at random the poem of Ausonius, and his eyes fell on the words *Quid vias sectabor iter?* (What way of life shall I follow?) The whole experience made such a deep impression on him that he vowed a pilgrimage to our Lady of Loretto. Whatever psycho-analytic interpretation one may put on the whole episode, there is no doubt of its profound effect on Descartes. He saw light. And it was probably at this period of his life that he arrived at his fundamental ideas relating to algebra, geometry and methodology. The years 1620-28 were no doubt devoted mainly to the elaboration and application of these ideas.

In 1620 Descartes visited Austria and Bohemia. He is reported to have served as a volunteer in the army of the duke of Bavaria against the protestant princes, and to have taken part in various battles, including that of the White Mountain, near Prague, which ended in the defeat of the Protestant princes and the downfall of Frederick V, father of the Princess Elizabeth of whom more will be said presently. But there is no reliable evidence for these dubious attempts to surround Descartes' head with a halo of military glory. Most probably he never smelled gunpowder. In April 1622 he was in France again, and stayed partly at Rennes and partly in Paris, until March 1623. He then went to Italy on certain family business. On May 16 (Ascension Day), 1624, he was in Venice and witnessed the symbolic ceremony of "the wedding of the sea" (the Adriatic). From Venice he went on his pilgrimage to our Lady of Loretto. Christmas 1624 saw him in Rome, where, in 1625, he witnessed the celebration of the Roman Catholic "Jubilee" (the Papal remission of the sins of the pilgrims). On his return he passed through Florence, but did not trouble to visit Galileo there. Indeed, in a subsequent letter, Descartes declared with emphasis that he had never learned anything from the writings of Galileo. The Loretto pilgrim could hardly have been expected to show sympathy for a semi heretic like Galileo.

It appears that about this time Descartes was seriously thinking of settling in Italy, but the heat was too much for him. So he returned to France, passing the next three years partly in the country and partly in Paris. His contact with learned men in Paris stimulated his philosophic and scientific ambitions. Cardinal Bérulle, Mersenne and Mydorge were particularly encouraging to him. For a time he carried on research in optics with the help of Fermier, a skilled maker of lenses. But the distractions of Paris were not conducive to fruitful work. Descartes consequently decided to move to some quiet place in Holland where he might devote his undivided attention to the problems of philosophy and science. He had seen enough of the bustle of the great world, and he longed for some quiet retreat where he might collect his

of a locality he always considered the opportunities they afforded of practising catholicism. His first home in Holland was at Franeker (near Groningen), where he stayed from 1628-30, and it was here that he wrote his *Rules for the Direction of the Mind*, in 1628 or 1629, though it was not published till 1701. It may be recalled that his earliest known compositions, namely, the *Essay on Algebra* and the *Compendium of Music*, were written in Breda in 1618. In fact nearly all the works of Descartes were written in Holland. From 1630-32, and again from 1633-34, he lived in Amsterdam. Amsterdam was the London of that time in many ways. Another Frenchman who lived there in the 17th century described Amsterdam as "the most beautiful city of Europe." And Descartes evidently enjoyed his life there. In one of his letters to Balzac, dated Amsterdam, May 15, 1631, Descartes expressed

his deep satisfaction with his life there, and some of his reasons for it

"In this great city where I now am," he wrote, "everybody but myself is in business and so engrossed with his profits that I could live here all my life without being noticed by anyone. I take my walk every day amid the Babel of a great thoroughfare with as much freedom and repose as you could find in your garden walks, and I observe the people whom I see just as I should the trees that you find in your forests or the animals that graze there, even the noise of their bustle does not disturb my reveries more than would the murmuring of a stream. When I consider their activities I derive the same pleasure which you have in watching the peasants till your fields, for I see that all their toil helps to adorn the place of my abode, and supplies all my wants. If there be pleasure in seeing the fruit grow in your orchard, think you there is not as much in seeing the vessels arrive which bring an abundance of all the produce of the Indies and all that is rare in Europe? What other place could you choose in all the world where all the comforts of life and all the curiosities that can be desired are so easy to find as here? What other country where you can enjoy such perfect liberty, where you can sleep with more security, where there are always armies afoot for our protection, where poisoning, treacheries, calumnies are less known, and where there has survived more of the innocence of our forefathers?"

In 1632 Descartes moved to Deventer. Here apparently he met a certain Hildene who, in 1635, bore him a child, which was christened Francine Descartes, and died at the age of five. It was during his stay in Deventer that Descartes heard of the Inquisition's condemnation of Galilei, in 1633, for supporting the Copernican hypothesis that the earth moves round the sun. Descartes had already written the greater part of a treatise, called *The World*, in which the Copernican hypothesis had been adopted. He at once abandoned the idea of completing and publishing the book, in the hope of discovering some more orthodox form of Copernicanism. This he eventually discovered in his vortex theory. Part of 1633 and 1634 was spent in Amsterdam. Descartes then moved to Utrecht in order to be near his first disciple, Renier, who was professor at the university there.

From Utrecht Descartes went to Leyden, where he lived during 1636 and 1637, and again in 1640 and 1641. It was during his first stay here that he published, in 1636, the volume of essays containing the *Discourse on Method*, the *Dioptrics*, *Meteors* and *Geometry*, and during his second stay here he published, in 1641, his *Meditations on First Philosophy*, together with *Objections* by Arnauld, Gassendi, Hobbes and others, and his *Replies* to them. From 1637-40 Descartes lived at Santpoort. After his second residence at Leyden he moved, in 1641, to Endgeest, near Leyden, where he remained till 1643. Here, in 1642, he was visited by Sorbière, the French courtier, traveller and gossip, whose *Voyage to England* subsequently caused so much annoyance to the Royal Society of London. And we are indebted to Sorbière for an interesting sketch of Descartes' life and surroundings at Endgeest. This is what he has written: "I was delighted with the civility of this gentleman, his retreat, and his household. He lived in a small château, beautifully situated, near a great and fine university (Leiden), three leagues from the court, and hardly two hours from the sea. He had a sufficient staff of servants all well chosen and comely people, a nice garden with an orchard beyond it, and all around there were pastures from which stood out many steeples of various heights, until in the far horizon they appeared as mere points. He could go in a day by canal to Utrecht, Delft, Rotterdam, Dordrecht, Haarlem or Amsterdam. He could spend half his day at The Hague and return in the evening, making this excursion by the most beautiful road in the world through meadows and houses of pleasure, then through a great wood bordering this village, which is not inferior to the forest towns of Europe, and boasted at that time the residence of three courts. That of the prince of Orange was quite military. That of the States-General was composed of deputies from the united provinces and of burghmasters. The court of the queen of Bohemia, widow of King Frederick V, the elector palatine, might be compared to that of the Graces, where all the fashionable world of The Hague

went almost daily, to pay their homage to the talent, virtue and beauty of her four princesses, the eldest of whom (Elizabeth) had a fancy for the discourse of M. Descartes."

In the meantime Descartes was having his share of trouble too. His leading ideas were known to various scholars several years before they were published in book-form. Already in 1634 some of his doctrines were taught in the university of Utrecht by Renier. It was in order to help Renier in this work that Descartes had removed to Utrecht in 1635. The publication of the *Discourse*, etc., in 1636 soon involved Descartes in numerous controversies with mathematicians in Belgium, Holland and France, notably with Fermat. And for the rest of his life Descartes was frequently involved in controversies which sometimes embittered him, and which probably had something to do with his decision to go to Stockholm in 1649. Perhaps the most unpleasant of these controversies was that with G. Voetius, a Protestant divine and zealot, and rector of the university of Utrecht. When Renier died in 1639 the funeral oration delivered by Emilius, lauded the dead scholar's friendship with Descartes, and incidentally Descartes himself. Voetius, a protagonist of ancient philosophy as allied with his theology, became alarmed and took an early opportunity to hunt at the atheism of the new philosophy. In 1641 Regius, another Utrecht professor who for a time was an enthusiastic follower of Descartes, openly advocated certain Cartesian theses which so alarmed Voetius that he persuaded the magistrates of Utrecht, as well as the university, to pass judgment in favour of the old philosophy against the new. In 1642 Descartes brought out the second edition of his *Meditations*, with an introductory *Lettre au P. Dmet*, containing an attack on Voetius, who was so furious that he not only complained again to the magistrates, but also instigated the publication of a violent attack on Descartes in a pamphlet entitled *Admiranda Methodus sive Philosophia Cartesianae*, ostensibly written by M. Schoeck, who subsequently disowned it. Descartes replied in *Epistola ad Celeberrimum Virum Gisbertum Voetium* (May 1643). Thereupon the magistrates of Utrecht summoned Descartes to appear before them. Descartes did not appear, but sent them a letter. He was summoned a second time, and judgment was passed against him by default. Thanks to the intervention of influential friends at The Hague, the matter went no farther. The Utrecht magistrates simply decreed, in 1645, that nothing should be published either for or against the new philosophy. Descartes was also attacked by some of the professors at Leyden. And to crown it all he was soon involved also in a quarrel with Regius, whose aggressive advocacy of Cartesianism (as he understood or misunderstood it) had been the chief cause of the trouble with Voetius. The results of this quarrel were a *Programma* by Regius, and a reply by Descartes, *Notae in Programma*, in 1647.

However, if Descartes had some enemies in Holland among people like Gisbert Voetius, he also had many friends and admirers, and among these was the Princess Elizabeth to whom Sorbière referred in the passage cited above. As has already been mentioned above, Frederick V, the father of Elizabeth, had met with disaster at the battle of Prague (Nov. 1620). He lost the crown of Bohemia, and fled to the Netherlands. He was in the Netherlands for the last years of his life, and it was of great interest, as also subsequently his *Meditations* (1641), and made his personal acquaintance about 1640. Descartes dedicated to her his *Principles of Philosophy*, in 1644, and the dedicatory letter which he addressed to her shows what a deep impression she had made on him.

"The greatest advantage (Descartes wrote) I have derived

from my writings is the honour of becoming acquainted with your highness, and of being permitted at times to converse with you, and thus becoming a witness of your rare and estimable qualities, and I am sure that I shall render a service to posterity by holding them up as an example. It would be foolish of me to flatter, or to state what I am not convinced of, on the first page of a book in which I seek to expound the fundamental principles of knowledge. I have met no one who has such a thorough

of knowledge. I have met no one who has such a thorough and comprehensive understanding of my writings as you have. Even among the best and most cultivated minds, there are many who find them very obscure, and nearly always those who are familiar with mathematics cannot comprehend metaphysics, while those conversant with metaphysics cannot understand mathematics. The only mind, as far as my experience goes, to which both alike are easy, is yours, and so I am compelled to regard it as incomparable. And what increases my admiration is that it is not an aged man, who has given many years to study, in whom such wide and scientific knowledge is found, but a young princess whose charms resemble the Graces, as the poets describe them, rather than the Muses or the wise Minerva. I see in your highness all those excellences that are requisite to pure and sublime wisdom on the part, not only of the mind, but of the will and character, magnanimity and gentleness are united with a disposition which an unjust fortune with its persistent persecutions has not been able to embitter or discourage. It is this high-minded wisdom that I reverence in you, and I dedicate to it not only this work, because it treats of philosophy or the study of wisdom, but myself and my services." Apparently Descartes met the Princess Elizabeth fairly frequently during the years 1641: till 1643 when they lived near one another, but they do not seem to have met again after Elizabeth left The Hague in that year, though various letters passed between them almost to the time of his death, including one letter in which he condoled with her on the execution of her uncle, Charles I. Elizabeth lived for a time in Berlin, then in Heidelberg with her brother, and eventually she became abbess of the abbey of Herford (in Westphalia), where she died on the 30th anniversary of the death of Descartes (Feb. 11. 1680).

Descartes left Endgeest in 1643, and lived at Egmond-op den Hoef till 1644. His next, and last, place of residence in Holland was at Egmond-Binnen, near Alkmaar. Here he wrote his *Treatise on the Passions of the Soul* in 1649.

During the 21 years that Descartes lived in Holland (1628-49) he visited France on only three occasions, namely, in 1644, 1647 and 1648. The last of these visits was in connection with a royal pension, and in the hope of securing a congenial and important post in Paris. But he arrived in Paris at an unpropitious moment. It was on the eve of the civil war (the Fronde). So he hurried back to Holland empty handed.

In the meantime Chanut, the French resident at Stockholm, was trying to interest Christina, the queen of Sweden, in the philosophy of Descartes. Some correspondence followed, and in Feb. 1649, Descartes was invited to Stockholm. After his experience of royal patronage in Paris the year before, Descartes held back. A Swedish admiral was then sent to fetch him. But he hesitated still. Finally, however, he left Holland in Sept. 1649, for the Swedish court. Queen Christina received him in two audiences. He figured in various court functions, which did not appeal to him, and he regretted he had left Holland. P. 161-162

[illegible]

THE PHILOSOPHY OF DESCARTES

Methodology.—I am disappointed that the editors did not spend less time on the question of the determination of the right method for obtaining real knowledge by the natural light of reason. Like numerous thinkers before him, Descartes was thoroughly dissatisfied with the method of scholasticism then still in vogue.

The scholastic method, on which Descartes had been nurtured at La Fleche, consisted mainly in attempting to solve problems by citing the views of more or less eminent writers or "authorities," instead of dealing with the problems themselves. It called for much book-learning, as well as much ingenuity in reconciling or harmonizing conflicting authorities, but it did not encourage independent research or thought. Now Descartes was not a book worm by nature, and his early acquired habit of spending much time in bed was also more conducive to thinking than to much reading. Moreover, his genius was essentially mathematical, and in mathematics the question of "authority" did not arise even at his Jesuit school, where it counted in most other studies. Accordingly, we find Descartes engaged in questions of method already at an early stage in his career, and returning to them again and again subsequently. They are dealt with in his unfinished *Rules for the Direction of the Mind* (1625), in his fragmentary dialogue *The Search after Truth* (probably written either in 1628 or in 1641), in his *Discourse on the Method of Rightly Conducting the Reason* (published in 1637), in his *Meditations on First Philosophy* (published in 1641), and in *The Principles of Philosophy* (published in 1644).

In his autobiographical *Discourse*, Descartes relates how his dissatisfaction with book learning came upon him "I have been nourished on letters since my childhood, and since I was given to believe that by their means a clear and certain knowledge could be obtained of all that is useful in life, I had an extreme desire to acquire instruction. But so soon as I had achieved the entire course of study, at the close of which one is usually received into the ranks of the learned, I entirely changed my opinion. For I found myself embarrassed with so many doubts and errors that it seemed to me that the effort to instruct myself had no effect other than the increasing discovery of my own ignorance. And yet I was studying at one of the most celebrated schools in Europe. I learned there all that others learned, and I did not feel that I was esteemed inferior to my fellow-students

And this made me take the liberty of judging all others by myself and of coming to the conclusion that there was no learning in the world such as I was formerly led to believe it to be." And in his *Rules* he promptly demands that the investigation of any problem should not be dominated by what others have thought about, but by what we ourselves can see clearly or infer with certainty. "For" (he explains) "we shall not, for instance, become mathematicians, even if we know by heart all the proofs that others have elaborated, unless we have an intellectual talent that fits us to resolve difficulties of that kind. Neither, though we have mastered all the arguments of Plato and Aristotle, if we have not the capacity for forming a solid judgment on these matters, shall we become philosophers."

The one study which gave him real satisfaction was mathematics, "because of the certainty of its demonstrations and the evidence of its reasoning." He felt that there must be something about mathematics which made it a model for other studies. And he recalled with some satisfaction that "the earliest pioneers of philosophy in bygone ages refused to admit to the study of wisdom anyone who was not versed in mathematics, evidently believing that this was the easiest and most indispensable mental exercise and preparation for laying hold of other more important sciences." Now Descartes did not exaggerate the importance of mathematics after the manner of Pythagoras, as did even some of the most eminent astronomers of the 16th and 17th centuries. On the contrary, he speaks rather contemptuously of pure mathematics as such, remarking that "there is nothing more futile than to busy one's self with bare numbers and imaginary figures in such a way as to appear to rest content with such trifles." It was only the *method* of mathematics that appealed to him. And gradually the conviction grew on him that the method of mathematics could be extended to other sciences. Reference has already been made above to his experience on Nov. 10, 1619, for which he went on a pilgrimage to our Lady of Loretto. In course of time he formed the idea of "a species of mathematics," or a kind of "universal mathematics," that shall be applicable to all kinds of investigations. What he was thinking of was what may be called a Meth-

odology, or a study of scientific method, calling it a "species of mathematics" simply because "mathematics" literally means science. Methodical procedure in research was regarded by Descartes as of first rate importance. Random search for knowledge and trust in some chance luck he condemned as at once fruitless and intellectually demoralizing.

Now the method of mathematics consists in beginning with the simplest notions and then proceeding cautiously to deduce inferences from them. Similarly in all scientific investigations one should begin with the simplest and surest notions, and advance logically to more complex truths by a progressive synthesis of the simpler factors, that is, by deduction. Descartes realized, of course that knowledge is derived from experience as well as from deduction. But, in striking contrast with Bacon (whose *Novum Organum* he praised and commended to those who wished to follow the empirical path), he put more faith in deduction than in experience. Experience begins with very complex objects, and so our inferences from it are frequently fallacious, whereas deduction, according to Descartes, cannot be erroneous if carried out with moderate understanding. "This" (he says) "furnishes us with an evident explanation of the great superiority in certitude of arithmetic and geometry to other sciences. The former alone deal with an object so pure and uncomplicated, that they need make no assumptions at all which experience renders uncertain, but wholly consist in the rational deduction of consequences." The moral he draws is that "in our search for the direct road towards truth, we should busy ourselves with no object about which we cannot attain a certitude equal to that of the demonstrations of arithmetic and geometry."

The first problem of method turns on the starting-point, the simple notions or principles which furnish the material for the subsequent deduction. If the initial premises are false even the soundest deduction cannot lead to knowledge. How then do we come by our simplest notions or principles? "The first principles," says Descartes, "are given by intuition alone." And by intuition he means "the undoubting conception of an unclouded and attentive mind, which springs from the light of reason." Such intuitions are not uncommon. "Thus each individual can have intuition of the fact that he exists, and that he thinks, that a triangle is bounded by three lines only, a sphere by a single superficies, and so on. Facts of such a kind are far more numerous than many people think who disdain to direct their attention to such simple matters." Intuition and deduction, then, "are the most certain routes to knowledge." If any complex problem presents itself, the proper course is to analyse it into its simplest elements or notions, enumerate these carefully (this enumeration Descartes calls *induction*), make sure of each of them by intuition, and reason from them by deduction.

In the *Rules* Descartes made no attempt to get behind intuition as described and exemplified above. The *Discourse on Method*, however, is much more sophisticated. It begins with a methodical doubt which is intended to serve as a severe test for whatever may claim to serve as the sure starting-point of knowledge. Everything must be questioned (*de omnibus dubitandum*) so that we may discover something that is beyond doubt. At first everything seems to succumb to it—traditional beliefs, commonly accepted ideas, the very facts of direct observation may all be but illusions and dreams. Eventually, however, something is discovered that is beyond cavil; namely, doubt itself. He who doubts cannot doubt the reality of his doubting. But what is doubt? It is an act of thinking. And thinking implies a thinker. And so, says Descartes triumphantly, *Cogito, ergo sum*—"I think, therefore, I am." This, then, is an ultimate certainty. But why is it accepted as certain? Because it is so clearly and distinctly realized—it is an ultimate intuition that cannot be denied. Thus, however, implies that whatever is apprehended as clearly and distinctly is true. In this way Descartes found a philosophical basis for the acceptance of intuitions, and deduction from intuitions must at each step be as clearly and distinctly apprehended as the initial intuitions, though the connection between the final stage of a series of deductions and the initial intuitions may be a matter of memory rather than of immediate apprehension. Among the

ultimate intuitions Descartes evidently included the principle of universal causation, otherwise he could never have passed from *Cogito, ergo sum* to the existence of God, and from the existence of God to the reality of things that are clearly and distinctly apprehended. But these questions pertain to his metaphysics.

Metaphysics—Descartes once compared himself to Archimedes. This Greek founder of mechanics had said that if he could only find a fixed point in space to serve as a fulcrum for a suitable lever, he could lift the whole earth. Similarly, Descartes, in his stage of methodical doubt, said that if he could only discover something undoubted he would rear on it a whole system of real science. And, as was explained above, Descartes found the required bedrock in the activity of doubt itself, in thought—*Cogito, ergo sum*. By "thought" he meant not only what is commonly meant by that term (the reflective solution of difficulties), but almost every kind of mental experience. "By the word thought I understand all that of which we are conscious as operating in us. And that is why not only understanding, willing, imagining, but also feeling are here the same thing as thought." But, even if we substitute the term "consciousness" for Descartes' "thought," what exactly is the extent of the knowledge furnished by the certainty that "I think"? It seems to be extremely limited, and to amount to no more than "I think" or "I am a thinking (or conscious) being," or "I experience certain mental processes or ideas." It does not warrant the reality of the apparently material objects of our perceptions, it does not prove the reality even of the body of the thinker. For in dreams such experiences occur although admittedly there are no such material objects corresponding to them. And, adds Descartes, "the same thing, perhaps, might occur if I had not a body at all." If so, thought might be a purely subjective matter, and throw no light at all on the question of the reality of an external world. There would be little comfort in the certainty that "I think, therefore I am" if the world of which I am conscious is but my dream-world, and "I" am but a solitary dreamer. It seems evident that Descartes' line of thought might end in so-called subjective idealism, or even in solipsism. It would be no great exaggeration to say that modern idealism and solipsism are the direct offspring of Descartes' thought. Thus, no doubt, may be regarded as a measure of his influence on modern philosophy, it may also be regarded as a measure of the mischief which he has wrought. Descartes did not consider sufficiently the claims of our waking consciousness to a direct apprehension of real external objects, his argument about dreams is not convincing, for, after all, it is easy enough to distinguish between dreaming and waking consciousness, and people are sometimes mistaken about what they think that they really think. He was probably betrayed partly by a bias common among mathematicians from the days of Pythagoras and Plato onwards, and partly by the early Christian tendency (under Platonic and Neo-Platonic influence) to belittle the material world. The former was probably the more important influence. Mathematicians as a class are so preoccupied with ideal or mental constructions that they are apt to exaggerate the powers of pure thought. Descartes clearly betrays this tendency already at the very beginning of his *Rules for the Direction of the Mind*, where he speaks of knowledge as though it were a kind of illumination which streams forth from the mind in the same way, without regard to differences in the objects studied. "The sciences," he says, "are identical with human wisdom, which always remains one and the same, however applied to different subjects, and suffers no more differentiation proceeding from them than the light of the sun experiences from the variety of the things which it illumines."

Descartes himself, however, was not a solipsist or even an idealist, his religion and his science saved him from that. He had, therefore, to bridge the gulf between the mere *cogito* and the external world. Thus he endeavoured to do by making his "I think, therefore I am" an argument for the existence of God, and then making God's being the ground for his belief in the existence of an external world. Descartes offers three proofs for the existence of God, one of them is a *a priori*, based on the implication of the very notion of God, the others are a *posteriori* and argue from effect to cause. The *a priori*, or ontological proof, adapted more

or less from St. Anselm, and most in accordance with Descartes' mathematical method, runs as follows "When the mind considers the diverse conceptions which it has, it discovers the idea of a Being who is omniscient, omnipotent and absolutely perfect, which is far the most important of all, and in this idea it recognizes not merely a possible and contingent existence, as in all the other ideas it has of things which it clearly perceives, but one which is absolutely necessary and eternal. For just as when it perceives that it is necessarily involved in the idea of a triangle that it should have three angles equal to two right angles, it is absolutely persuaded that a triangle really has three angles equal to two right angles, so from the fact it perceives that necessary and eternal existence is comprised in the idea of an absolutely perfect Being, it must clearly conclude that this absolutely perfect Being exists." Of the *a posteriori* proofs the more important one is the so called anthropological one based, not on the mere implication of the concept God, but on the existence of the idea in an existing but imperfect mind or minds. Descartes formulates it as follows "As we find in ourselves the idea of a God, or a supremely perfect Being, we can investigate the cause which produces this idea in us. But considering the immensity of the perfection it possesses, we are constrained to admit that it can only emanate from an all perfect Being, that is, from God who really exists. For it is not only made manifest by the natural light that nothing cannot be the cause of anything whatever, and that the more perfect cannot proceed from the less perfect as its efficient and total cause, but also that it is impossible for us to have any idea of anything whatever, if there is not within us or outside us an original which actually possesses all the perfections. But as we do not in any way possess all these absolute perfections of which we have the idea, we must conclude that they reside in some other nature different from ours, that is, in God." The other *a posteriori* argument infers the existence of God from the thinker's own existence, and his continued existence. These imply a Creator who has not only created the thinker, but maintains him in existence. For existence at one moment is itself no reason for existence at a subsequent moment, so that the conservation of whatever exists is really a continued creation.

The combined effect of all these arguments, taken in conjunction with his doctrine of innate ideas, of which the idea of God is one, may have been to give Descartes the conviction that he had in some way a direct intuition of God revealing Himself to Descartes through his innate idea of Him. But Descartes does not make himself clear on this point.

Having proved the existence of God as the supremely perfect Being, Descartes argues in the next place that God would not deceive the thinking beings He has created. So our sense-perceptions cannot be mere illusions, and there must exist an external world of Beings which we apprehend in perception. In this way, whereas his predecessors were wont to prove the existence of God from the existence of the world, Descartes inferred the existence of the world from the existence of God. But now he seems to have proved too much. Undoubtedly there are such experiences as illusions and errors. How shall we distinguish the real from the illusory? Descartes meets the difficulty by reverting to one of the main points in his methodology—we can only be sure of what we apprehend clearly and distinctly. Error is the result of the neglect of this precaution. It arises when our will goes beyond our understanding, as it often does. For our will has no limits, whereas our understanding is severely limited. And judgment, according to Descartes, is a decision of the will.

Clear and distinct apprehension must also be our guide in determining what these external material things essentially are. The sense-qualities, the so-called secondary qualities of things, such as colour, smell, etc., are not clearly and distinctly thinkable. Extension in three dimensions, and motion are the only features of material bodies that are clear and distinct to thought, and so they alone are the real essential features of material things, the so-called secondary qualities being but the subjective experiences of the perceiver. In this way Descartes helped to lay the foundations of a mechanical interpretation of physical Nature. On the other hand the essential feature of minds is thought or conscious-

ness. Minds are essentially thinking substances, just as bodies are essentially extended substances. For Descartes, accordingly, Reality consists of God, the perfect Being and Creator, and His Creations, namely, thinking substances, or minds, and extended substances, or bodies. And, prompted by his religious training, Descartes endeavoured to set bodies and minds in extreme opposition to one another—whatever mind is, body is not. One result of this is that because mind is active, body is not, and so he conceives of motion, not as a property of bodies, but as something put into them by God. Another result is that there can be no interconnection between body and soul. Lower animals are consequently conceived by Descartes as mere automata, cleverly constructed mechanisms without soul. And the undeniable conjunction and apparent interaction of mind and body in human beings is in the last resort explained by the constant intervention of God.

The philosophy of Descartes has undoubtedly exercised a potent influence on modern thought, and to that extent the usual designation of Descartes as the father of modern philosophy is justified. But the intrinsic merits of his philosophy have been grossly exaggerated, and the exaggeration is itself due to a misinterpretation of Descartes' mentality. Descartes was a dual personality. Two tendencies struggled within him. On the one hand, there was the mathematical genius with a passion for clear and distinct ideas, and for logical deduction. On the other hand, there was the loyal Catholic, genuinely attached to a certain traditional theology. So long as he pursued problems of a purely scientific character, especially problems pertaining to pure or applied mathematics, he was in his element and showed his master mind. But the moment he attacked problems of general philosophic orientation, he was the traditional theologian rather than the revolutionary philosopher. Historians of philosophy have tried to save the philosophic reputation of Descartes by treating his theology as mere camouflage. But that is a mistake. Mersenne had a keen scent for heresy, yet he defended Descartes' orthodoxy, and Mersenne was well informed about Descartes. It is not very unusual even in the 20th century, it was certainly not unusual in the 17th century, for the same person to be a detached scientist when dealing with one set of problems, and a conservative theologian when dealing with another set of problems. And Descartes was of that type. In the same breath with which he asserted that the mind should admit no other methods than intuition and deduction, he also asserted "but this does not prevent us from believing matters that have been divinely revealed as being more certain than our surest knowledge, since belief in these things is an act, not of our intelligence, but of our will." His abandonment of the idea of the earth's motion and his substitution of the vortex theory was probably due to his genuine regard for the authority of the Catholic Church, not to fear. Saumaise, who visited Descartes at Leyden in 1637, reports that he was a Catholic "des plus zélés." His whole orientation was essentially that of popular Christian theology, with its supernatural God, who created souls and bodies. And when he went the length of regarding distinctions between good and evil, between truth and falsehood as depending on the arbitrary decisions of the Divine Will, he really abandoned altogether the realm of rational philosophy for that of a particularly narrow mediaeval theology. Descartes' methodical doubt has misled people into supposing that he was a revolutionary philosopher. But in the history of human thought real "believers" have posed as sceptics almost as often as real sceptics have posed as believers.

DESCARTES' CONTRIBUTIONS TO SCIENCE

From what has already been said above about Descartes' Methodology, one almost expects that his endeavour would be to reduce all science to a kind of applied mathematics. And that is what he really did attempt. "I do not accept or desire," he wrote, "any other principle in physics than in geometry or abstract mathematics, because all the phenomena of nature may be explained by their means." Another way of expressing the same thing is to say that Descartes tried to reduce every science of natural phenomena to a branch of mechanics. But it must be remembered that for Descartes mechanics was essentially kinetics, not dynamics—a

calculus of changes of position, not a calculus of "forces" The progress of the physical sciences during the 17th and 18th centuries was due in large measure to the adoption of a mechanical interpretation of physical phenomena This method of interpretation was initiated by Galileo and extended by Descartes Its merits can only be appreciated when one recalls the "substantial forms," "hypostactical principles," "real accidents," and other mystifying conceptions of the pseudo-science which preceded the Cartesian attempt to interpret all natural phenomena by means of clear and distinct mechanical concepts It was left to a later age to discover the inadequacy of an exclusively mechanical interpretation of natural phenomena But this must not be allowed to detract from the merits of Descartes in the history of science

Physics and Cosmology—Descartes, by refusing to attribute to matter any sense qualities, which are not reducible to clear and distinct ideas, reduced matter to extension in three dimensions Matter thus coincided for him with space One consequence of this was that he denied the existence of a vacuum For the same reason he also rejected the existence of "atoms" in the literal sense of the term, for any minute part of space or extension remains theoretically divisible But how does this apparently continuous extension come to assume the form of those detached material bodies with which we are familiar? Descartes explains this by reference to motion, which he regards as a separate creation of God, who also conserves its quantity It is motion that leads us to distinguish separate bodies or parcels of matter Any part of extension that moves together or simultaneously is regarded as such a body Since, however, matter is extension and there is no vacuum, the motion of one body must be followed immediately by the motion of certain other bodies, so that the circle of extension may remain complete, without gaps This idea of a circular motion of matter eventually suggested to him his theory of vortices "All natural motions" (Descartes explains in *Le Monde*) "are in some way circular When a body leaves its place, it enters that of another, and this enters that of yet another, and so on to the final one which occupies at the same instant the place left by the first There is thus no vacuum between bodies when they move, any more than when they are at rest To this end it is not at all necessary that all the moving parts should be arranged in a true circle, or be of like size or shape, for inequalities in these respects may be compensated for by other inequalities We do not commonly observe these circular motions in the air, because we are accustomed to regard the air as an empty place But if we observe fishes swimming in a basin we see that, if they do not approach too near it, they do not stir the surface, although they pass under it at a great speed It is clear, therefore, that the water which they push before them does not push indifferently all the water in the basin, but only that which can best serve to complete the circle of their motion and enter the place which they have vacated"

Another consequence of Descartes' identification of matter with extension or space was his insistence on the unity of physical nature, which must be a *universe* because space is one and continuous Both in his early work *The World* and in his *Principles of Philosophy*, Descartes attempted to give an account of the genesis or formation of the physical world The account was intended to be purely hypothetical or speculative, not a rival theory to *Genesis*—just a flight of fancy based on Cartesian principles "Give me extension and motion," he said in his earlier book, "and I will construct the world" Assuming that God has created a uniform matter (or extension) and endowed it with a fixed quantity of motion, which follows certain laws (namely, the laws of motion formulated by Descartes), how might a world (like the existing world) have come into being "by natural and gradual means"? Descartes answers the question somewhat as follows

In a world closely packed with matter so that there is no vacuum in it the only kind of motion possible is that described above as circular motion or vortex (whirlpool) motion Consequently when motion was imparted (by God) to matter, such vortices were set in motion—innumerable more or less circular eddies of material parts of all sorts of shapes, sizes and velocities The friction set up by this vortex motion of closely packed material bodies

results in the mutual rubbing off of their corners And so we get, to begin with, two main kinds of material particles—the original particles rendered smooth and globular by the friction which rubbed their corners off, and the inner particles composed of the rubbings or filings These fine particles Descartes calls "first matter", the larger, globular particles he calls "second matter" There is yet a "third matter," namely, the most massive and heavy of the original particles that suffer no fracture or rubbing off in the vortex motion, and such other original particles as, thanks to their peculiar shapes, combined into larger, stronger combinations that similarly resisted all damage The first kind of matter the finest sort, tends towards the centre of each vortex, where it forms self luminous suns and fixed stars The second kind of matter, consisting of globular particles, tends to move away from the centre of the vortices in straight lines towards the circumference It constitutes the transparent heavens, and transmits the light of the radiating stars The third and grossest kind of matter is that of which the earth, the other planets, and the comets are composed—these are all opaque bodies

In the *Principles* Descartes explains the formation of the comets and planets in this way Sometimes as the smaller particles in a vortex pass through the interstices between the revolving globular particles, they get caught and become twisted and channelled, and when they finally reach the stellar matter at the centre of the vortex they form crusts or "sun spots" on it This may cause a diminution in the expansive force of the star, which is then caught up by a neighbouring vortex If the velocity of the crusted star is greater than that of the encroaching vortex, the star will soon pass out of that vortex into another, and continue to wander from vortex to vortex It is then known as a comet But if the crusted star has a velocity equal to that of some part of the encroaching vortex, it will stay there and continue to revolve in that vortex In that case it is known as a planet The planets of the solar system are the crusted stars and their several vortices that have been swept up by the vortex of the sun

The vortex theory enabled Descartes to reconcile Copernican with Biblical doctrine In *The World* Descartes had embraced the Copernican theory of the earth's motion round the sun The condemnation of Galileo, in 1633, made him drop the idea in the Copernican form But by supposing the earth to be carried in its vortex round the sun, Descartes believed that he left the earth at rest in its vortex, and so satisfied the dogma of a stationary earth, while he also satisfied the Copernican theory inasmuch as he represented the earth's vortex as circling round the sun

Descartes' *Principles* contains a detailed account of practically all the natural phenomena that had been investigated up to his time It contains, of course, many errors Even his fundamental laws of motion are mostly inaccurate But it was an amazing attempt to reduce all natural phenomena to one system composed of one ultimate kind of matter and governed by the same laws of motion One of its incidental results was the explanation of weight without recourse to gravitation Bodies tend to fall towards the earth, according to Descartes, because the particles of the second kind of matter which move round the earth push those bodies towards the earth, and so give them what we call their weight The popular conception of gravitation makes more or less an occult power of it Newton's intention was merely to describe certain tendencies to movement without any attempt to explain them at all Again, Descartes' rejection of the existence of a vacuum not only undermined the idea of Nature's abhorrence of a vacuum (*horror vacui*) which was wont to serve as an explanation of the action of water pumps, but prepared the way to the correct explanation, namely the pressure of the air on the surface of the water In fact Descartes claimed that he had anticipated Torricelli (the inventor of the barometer) and that, during his visit to Paris in 1647, he had suggested to Pascal the idea of the barometric experiment which the latter carried out on the Puy de Dôme on Sept. 19, 1648 Another important consequence of Descartes' rejection of a vacuum was that he was thereby led to give up the old corpuscular or emission theory of light, and to conceive of the transmission of light as a transmission of pressure from the luminous body through the intervening particles of secondary

matter to the sensitive eye. This view prepared the way for the undulatory theory of light which was soon afterwards formulated by Christiaan Huygens, the son of Descartes' friend and correspondent, Constantijn Huygens.

Descartes was deeply interested in optics, devoting to it not only his *Dioptrics* (1636), but also parts 3 and 4 of his *Principles* (1644). He compares the transmission of light to the eye with the way in which a blind man feels his way with a stick. The resistances or pressures of the different objects (such as stones, trees, water, etc.) are transmitted along the stick to his hand and thence to his brain, so that he can distinguish them. Similarly no corpuscles actually pass from the visible objects to the eye, only a pressure through the fine particles which constitute the transparent medium. Rays of light are the line along which the pressure is transmitted. When they pass through a transparent medium they are straight, otherwise they are deflected or even stopped just like a moving ball when it encounters some obstruction. If the obstruction is hard, the ball rebounds in another direction, if soft, its movement will be arrested. Similarly, when a ray of light impinges obliquely on certain kinds of surfaces, it is reflected, and its angle of reflection is equal to the angle of incidence. But if the medium allows the ray to pass through with diminished speed, then it is refracted. In the *Dioptrics* the law of refraction was published for the first time. Snell had discovered it in 1621, but did not publish it, and Descartes has sometimes been suspected of plagiarism. Most likely, however, Descartes discovered it independently.

Physiology—*The World*, as originally planned by Descartes, was to have contained an hypothetical account of the development of the universe from chaos to man. Referring to this book, in June 1633, he said "I shall treat of man to a greater extent than I proposed, I intend to explain the principal functions of his body, and I have already given an account of some of them, such as digestion, the beating of the pulse, the distribution of nutritious matter, the action of the five senses, etc. I have dissected the heads of various animals, in order to ascertain in what memory, imagination, etc., consist." The book was not published as it was then planned, but the results of Descartes' studies in this field are contained in his *L'Homme* (published in 1662), the first text book on physiology. In accordance with the whole spirit of *The World*, of which the treatise on *Man* was originally meant to be the concluding part, the human body and its functions were treated by Descartes mechanically, like "an earthly machine." In this view he was greatly encouraged by the views of Vesalius (1515-64), the father of modern anatomy and physiology, and by Harvey's demonstration of the mechanical nature of the circulation of the blood (his *Exercitatio* was published in 1628), though Descartes did not entirely agree with Harvey. Descartes explains that blood is formed in the liver from the chyle of the food. This blood flows drop by drop into the right cavity of the heart, which is so hot that the blood expands and is exhaled into the lung, whence it passes into the left cavity of the heart, and is thence distributed over the whole body. He describes the valves in the arteries which secure that the blood shall flow only drop by drop. Now of the blood which flows through the direct arteries from the heart to the brain, "the most agitated and vivified parts" are called "animal spirits." They are like "a very subtle air." By dilating the brain they enable it to receive impressions of external objects, and so give rise to sensation, imagination and retentive memory, by flowing from the brain through the nerves into the muscles, they enable the nerves to function as organs of the external senses, and by distending, and so contracting, the muscles, they effect the movements of the limbs. For Descartes the "animal spirits" were just a subtle fluid, the nerves were just tubes through which they flowed in a mechanical way.

He illustrates his strictly mechanical conception of the bodily machine as follows "You may have seen in the grottoes and fountains which are in our royal gardens that the simple force with which the water moves when issuing from its source is enough to set in motion various machines, and to make various instruments play or utter words, according to the different arrangements of the tubes which convey the water. And so one may well

compare the nerves of the machine which I am describing with the tubes of the machines of these fountains, the muscles and tendons with the other engines and springs which move the machines, and the animal spirits, the source of which is the heart and of which the cavities of the brain are the reservoirs, with the water which puts them in motion. Moreover, breathing and similar acts, which are natural and usual to the machine, and which depend on the flow of the spirits, are like the movements of a [water] clock or of a mill which the ordinary flow of water keeps going continually. External objects, which by their presence act on the sense organs of the machine and so determine it to move in different ways according to the disposition of the parts of the brain, may be compared to strangers who, entering one of the grottoes containing many fountains, themselves cause unwittingly the movements they witness. For on entering they tread on certain tiles or plates which are so arranged that if they approach a bathing Diana they cause her to hide in the rose bushes, and if they try to follow her they cause a Neptune to come towards them threatening them with his trident. Or if they pass in another direction they make a sea monster spring forward and spout water in their faces, or things of a like kind according to the caprice of the engineers who constructed them.

"In order to understand how the brain can be excited by external objects which affect the organs of sense, so that all the members can be moved in a thousand different ways, imagine that the delicate threads which arise from the inside of the brain and form the marrow of the nerves, are so disposed in all those parts which serve as the organs of any sense that they can be easily set in motion by the objects of the senses, and that whenever they are so set in motion, even ever so little, they pull upon the parts of the brain whence they originate, and so open certain pores on the internal surface of the brain. Through these pores the animal spirits in the ventricles pass into the nerves and then into the muscles which carry out movements like those to which we are incited when our senses are affected in that way. If, e.g., fire comes near the foot, the minute particles of the fire set in motion the skin of the foot, and by thus pulling the delicate thread attached to the skin there, they open the pore against which the thread ends, just as by pulling at one end of a rope one rings a bell at the other end."

In this way Descartes tried to explain physiological phenomena mechanically, and to banish from biology such conceptions as those of "vegetative" and "sensitive" souls, much in the same way as he and Boyle, and others, tried to banish from physics and chemistry such notions as those of "substantial forms," and occult qualities, etc. To this extent he rendered a service to biology in spite of his excessive proneness to follow the high *a priori* road, and to be satisfied with any fancies that seemed "clear and distinct" to him. He may be credited to some extent with the anticipation of the conception of "reflex movements," though these are not interpreted now in his purely mechanical fashion. He may also be regarded as the forerunner of modern "behaviourism," at all events as applied to the lower animals, for he would certainly have condemned a "soulless" human psychology, as will be seen presently. His view of the lower animals as mere automata rather alarmed some people. But Descartes' main object was to vindicate the superiority of man over animals, even over his own animal body, in virtue of his "rational soul" or mind.

Body and Mind—In Descartes' philosophy, as already explained, the human mind is "a thinking substance" *totio coelo* different from any "extended substances," including human bodies. Yet a human being seems to be an intimate association of a mind and a body, each influencing the other. How can the "extended substance" or "earthly machine" of the human body come into such intimate relation with unextended "thinking substance"? Descartes' ultimate solution of these, as of all other problems, lies in God, who graciously does all that Descartes thinks ought to be done. But as a more immediate, scientific solution of the problem, Descartes suggests that the mind comes into contact with the body in the conation "whence it radiates through the rest of the body by means of the animal spirits, nerves and even the blood." The pineal gland "in the middle of the substance of the

brain" is the primary reservoir of animal spirits, the central cavity of the brain being the secondary reservoir. Reverting to the above-mentioned comparison with the mechanical inventions in the royal gardens, Descartes likens the function of the rational soul or mind presiding at the conation to that of "the fountainmaster who has to take his place in the reservoir whence all the different tubes of the machines proceed whenever he wants to start them, to stop them, or to change them in any way." Descartes thought he surmounted the difficulty of explaining the mutual influence of mind and body by supposing, on the one hand, that the conation requires but a minimum of influence to incline it one way or another, and, on the other hand, that the "animal spirits" are such a subtle kind of air that they are on the verge of ceasing to be material. But according to his own philosophy the material remains material however fine it may be, and so remains entirely alien from the mental or spiritual.

Psychology.—The mind being, according to Descartes, a thinking substance entirely different from, and independent of, extended or material things, it "can work independently of the brain." Thus, at all events, is true of the most characteristic activities of the rational soul, "for clearly there can be no use of the brain for pure intelligence," says Descartes. Ideas in which pure intelligence expresses itself are innate, not derived from without, but from the rational soul itself. For Descartes, as for Plato, experience can only be the occasion for the recall of such ideas to consciousness. These ideas are not always explicit in our consciousness, rather they are latent in the "thinking substance," but they are not originated by experience, though experience may occasion their explicit recall. Among such innate ideas Descartes includes our "clear and distinct" ideas of God, of the self as a thinking thing, the axioms of mathematics and other so-called "common notions" like those of space, time and motion. Above all, perhaps, he finds the mind expressing itself most fully in acts of will, under which heading he includes all judgments and beliefs, as well as voluntary decisions. But then the mind is conjoined with a body, and they do somehow influence each other through the mediation of the conation and the animal spirits, as already explained. One result of this is that in addition to the mind's own innate ideas, we have also "adventitious ideas" which come to us through the influence of external bodies, and also "fictitious ideas" of merely imaginary objects which the mind puts together out of simpler "adventitious" and "innate" ideas. Descartes is not very clear or consistent in dealing with these problems. The idea of God, e.g., is treated at once as "innate," and also as produced in us by God Himself and therefore, in a sense, "adventitious." And his treatment of images is rather bewildering. Sometimes he treats images, in contrast with ideas, as something physical, and says "no corporeal image is received in the mind, pure thinking is carried out without corporeal images, imagination, however, which can only arise in the case of corporeal things, needs an image, which is a truly corporeal thing, to thus the mind applies itself, though the image is not received into the mind." At other times, however, he includes images, and even sensations and perceptions, under "thought" and distinguishes them from innate ideas, or pure thoughts, and volitions in so far as "imagination and sensation" need the brain as well as the mind, that is to say, in so far as they express not the pure activity of mind, but rather its passivity, the effect upon it of physical things, including the body with which it is united. Hence he calls all such experiences "passions," under which heading he includes not only the feelings and emotions, but also sensation, reflection, perception, and all adventitious ideas. The feelings are passions caused by the agitation of the animal spirits, but are not referred to any objects outside the body, whereas sensations are "passions" that are referred to external stimuli. Descartes' account of the emotions anticipates to some extent the James-Lange theory, inasmuch as it gives primary to the physical or physiological processes. Our perception of certain animals, e.g., causes fear and flight immediately without the mediation of reason or volition, which only come into play afterwards. Since, however, the brain is the organ of the passions and also the seat of the rational soul, the passions can be brought under the control of the reason and the will. In fact,

Descartes is quite Socratic in his insistence on the competence of right reason to conduce to right feeling and action.

The power which Descartes attributes to reason and will may seem to be little in harmony with his naturalistic, mechanical account of such large tracts of human experience. But, as already remarked, his great aim was really to vindicate the supremacy of the human mind or spirit. There was a marked tendency in his day, and long before him, to efface the sharp distinction between man and the lower animals by crediting the lower animals with human powers, including intelligence, which they were sometimes said to use more humanly than man. This tendency was mainly supported by the results of comparative anatomy, which showed essential similarity between the structures of human and animal bodies, including the central nervous system. Descartes tried to save the situation by regarding even the human body as a machine, and treating mechanically all such human experiences as might conceivably also be credited to lower animals, but claiming unique privileges for the rational soul, which he regarded as the *differentia* of man, and as absolutely independent of all that is material.

Mathematics.—Descartes has been described as the first modern mathematician. He was certainly one of the pioneers of modern mathematics. His only treatise on mathematics is the *Geometry* (1637) in which he laid the foundations of analytical or algebraic geometry. Descartes was not the first to apply algebra to geometry, or to conceive a line as generated by a moving point, or to solve geometrical problems by regarding them as solved and analysing the result ("analytic geometry" in the older sense). These things were already known to ancient and mediæval mathematicians. But he applied these methods much more systematically and fruitfully.

He knew that a point in a plane can be fully determined if we know its distances from two given straight lines in the same plane (allowing for the sign-conventions relating to their different sides, and taking not perpendicular distances but distances parallel to given lines). If the distances be represented by x and y respectively, we can get an equation of the form $f(x, y) = 0$. And although such an equation is indeterminate in the sense that it can be satisfied by an infinite number of sets of values of x and y , yet these values determine the co-ordinates of a series of points which form a curve such that the equation in question is true of every point on it. He realized, moreover, that the properties of a curve can be ascertained by choosing as a definition any specific geometrical property, and expressing it as an equation by means of the co-ordinates of any point on the curve. Such an equation contains by implication all the properties of that curve. And any such property can be deduced from the equation by purely algebraic processes, and without direct reference to the geometry of the curve.

Descartes was the first to attempt a systematic classification of curves. First, he distinguished between "geometric" and "mechanical" curves, according as they could or could not be precisely expressed in equations. (These terms were subsequently displaced by Newton's terms "algebraic" and "transcendental.") Confining himself to "geometric" curves, Descartes classifies these into a series of classes of increasing complexity as follows. Class I consists of curves (the circle, the parabola, the hyperbola and the ellipse) whose equations contain no term of higher degree than the multiple of two unknown quantities or the square of one. Class II includes any curve whose equation contains one or more terms of the third or fourth degree in one or both of the two unknown quantities. Class III contains curves whose equations include a term of the fifth or sixth degree in either or both of the unknown quantities, and so on. The curves are paired in each class in the way indicated because there are methods of reducing a curve of the fourth to one of the third degree, a curve of the sixth to one of the fifth degree, and so on. The straight line he regarded as an exceptional case of a curve of the second degree (Class I).

In algebra Descartes's systematic application of it to geometrical measurement involved important consequences. It involved the geometrical interpretation of negative quantities. It also led to the idea of continuity, which in its turn led to the theory of function.

and to the theory of limits. Descartes, moreover, made important contributions to the theory of equations, to which the third and last book of his *Geometry* is devoted, and to which he appears to have been led by his (successful) efforts to solve the problems of doubling the cube and of trisecting an angle. It is also worth noting that we are indebted to Descartes for the convention of using the first letters of the alphabet to represent known quantities, and the last letters for unknown quantities. He also introduced our system of indices (although he frequently used x^2 instead of x^2). On the other hand, he used the sign ∞ instead of ∞ — which Recorde had already introduced with its present meaning.

Descartes' general rule for solving equations is this: Write the equation in the zero form, and try to factorize the L.H.S. so as to reduce the equation to two or more equations of lower degree. If this is impossible, higher methods must be used. If the equation is of the third or fourth degree, the solution depends on the intersection of a circle with a conic. To solve equations of still higher degree, Descartes proposes the use of intersections of circles with the successive classes of geometric curves — conics being used to generate curves of Class II. and these again to generate curves of Class III. and so on. He thought that equations of any order could be solved in this way, but he was mistaken.

What is still known as Descartes' Rule of Signs is to the effect that an equation can have no more "true" (i.e., positive) roots than its coefficients have changes of sign from + to —, and no more "false" (i.e., negative) roots than the number of times two plus or two minus signs occur in succession.

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(A. Wo)

DESCHAMPS, ÉMILE (1791–1871), French poet and man of letters, was born at Bourges. In 1814 he collaborated with Henri de Latouche in two verse comedies, *Silvain et de Florian* and *Le Tour de fauvier*. He and his brother were among the most enthusiastic disciples of the *École gauloise* of Victor Hugo, and in July 1823 Emile founded with his brother the *Muse française*, which during the year of its existence was the special organ of the romantic party. His *Études françaises et étrangères* (1828) were preceded by a preface which may be regarded as one of the manifestos of the romanticists. The version of *Alceste* as *Roméo et Juliet* (1839) and *Wacchet* (1841), important as they were in the history of the romantic movement, were never staged. He was

the author of several libretti, among which may be mentioned the *Roméo et Juliette* of Berlioz. His works include two volumes of stories, *Contes physiologiques* (1854) and *Réalités fantastiques* (1854). He died at Versailles on April 23, 1871. His *Oeuvres complètes* were published in 1872–74 (6 vols.).

His brother, Antoine François Marie, known as ANTOINE DESCHAMPS, was born in Paris on March 12, 1800, and died at Passy on Oct. 29, 1866. Like his brother, he was an ardent romanticist, but his production was limited by a nervous disorder, which has left its mark on his melancholy work. He translated the *Drama Commedia* in 1829, and his poems, *Derrière Paroles* and *Résignation*, were republished with his brother's in 1841.

DESCHAMPS, EUSTACHE, called MOREL (1346?–1406?), French poet, was born at Vertus, Champagne. He studied at Reims, where he is said to have received some lessons in the art of versification from Guillaume de Machault, who is stated to have been his uncle. From Reims he proceeded c. 1360 to the University of Orleans to study law and the seven liberal arts. He entered the king's service as royal messenger c. 1367, and was sent on missions to Bohemia, Hungary and Moravia. In 1372 he was made *huissier d'armes* to Charles V. He received many other important offices, was *bailli* of Vlores, and afterwards of Senlis, squire to the Dauphin, and governor of Fismes. In 1380 his patron, Charles V., died, and in the same year the English burnt his house at Vertus. In his childhood he had been an eye-witness of the English invasion of 1358, he had been present at the siege of Reims and seen the march on Chartres, he had witnessed the signing of the treaty of Brétigny, he was now himself a victim of the English fury. His violent hatred of the English found vent in numerous appeals to carry the war into England, and in the famous prophecy that England would be destroyed so thoroughly that no one should be able to point to her ruins. His own misfortunes and the miseries of France embittered his temper. He complained continually of poverty, railed against women and lamented the woes of his country. His last years were spent on his *Mirour de mariage*, a satire of 13,000 lines against women, which contains some real comedy. The mother in law of French farce has her prototype in the *Mirour*.

The historical and patriotic poems of Deschamps are of much greater value. He does not, like Froissart, cast a glamour over the miserable wars of the time but gives a faithful picture of the anarchy of France, and inveighs ceaselessly against the heavy taxes, the vices of the clergy and especially against those who enrich themselves at the expense of the people. The terrible brillad with the refrain *Sà, de l'argent, sa, de l'argent* is typical of his work. Deschamps excelled in the use of the ballade and the chant royal. In ballade form he expressed his regret for the death of Du Guesclin, who seems to have been the only man except his patron, Charles V., for whom he ever felt any admiration. One of his ballades (No. 285) was sent with a copy of his works to Chaucer, whom he addresses with the words

Tu es d'amours mondains deux en Albie
Et de la Rose en la terre Anglie

Deschamps was the author of an *Art poétique*, with the title of *L'art de d'acier et de fere chansons, balades, virelles et rondeaux*. He lays immense stress on the harmony of verse, because, as was the fashion of his day, he practically took it for granted that all poetry was to be sung.

The work of Deschamps marks an important stage in the history of French poetry. With him and his contemporaries the long, formless narrations of the *trouvères* give place to complicated and cutting kinds of verse. He was perhaps by nature a moralist and a satirist rather than a poet, and the force and truth of his historical pictures gives him a unique place in 14th-century poetry. Raynaud fixes the date of his death in 1406, or at latest, 1407. Two years earlier he had been relieved of his charge as *bailli* of Senlis, his plain-spoken satires making him many enemies at court.

His *Oeuvres complètes* were edited (10 vols., 1878–1902) for the *Société des anciens textes français* by Queux de Saint-Hilaire and Gaston R. and the supplementary vol. ii (1903) consists of an introduction by G. Raynaud. See also E. Hoepfner *Eustache Deschamps* (Strasbourg, 1904).

DESCHANEL, PAUL EUGENE LOUIS (1856-1922), French statesman, son of Émile Deschanel (1819-1904), professor at the Collège de France and senator, was born at Brussels, where his father was living in exile (1851-59), owing to his opposition to Napoleon III. Paul Deschanel studied law, and began his career as secretary to Deshayes de Marcere (1876), and to Jules Simon (1876-77). In Oct. 1885 he was elected deputy for Eure and Loire. He was one of the most notable orators of the Progressist Republican group. In Jan. 1896 he was elected vice president of the chamber. In June 1898 he was elected president of the chamber, and was re-elected in 1901, but rejected in 1902. In 1904 and 1905 he supported the law on the separation of Church and State. After presiding over the commission of foreign and colonial affairs (1905-09) and acting as reporter of the foreign office estimates committee, Deschanel filled many responsible positions. In Jan. 1920, he was elected president of the Republic, as being a "safer" candidate than Clemenceau, though the latter's popularity spoke strongly in his favour. In the autumn of the same year, however, failing health obliged him to resign office. He died in Paris on April 28, 1922, from the effects of a fall from a railway carriage. Deschanel was elected a member of the French Academy in 1899, his most notable works being *Orateurs et hommes d'état* (1888), *Figures de femmes* (1889), *La Décentralisation* (1895), *La Question sociale* (1898).

DESCLOZITE, a rare mineral species consisting of basic lead and zinc vanadate, crystallizing in the orthorhombic system and isomorphous with olivenite. It occurs as small prismatic or pyramidal crystals, usually forming drusy crusts and stalactitic aggregates, also as fibrous encrusting masses with a mammillary surface. The colour is deep cherry red to brown or black, and the crystals are transparent or translucent with a greasy lustre, the streak is orange yellow to brown, specific gravity 5.9 to 6.2, hardness $3\frac{1}{2}$. A variety known as cuprodesclozite is dull green in colour, it contains a considerable amount of copper replacing zinc and some arsenic replacing vanadium. Desclozite occurs in veins of lead ores in association with pyromorphite, vanadinite, wulfenite, etc. Localities are the Sierra de Cordoba in Argentina, Lake Valley in Sierra county, New Mexico, Arizona, Phoenixville in Pennsylvania, Kappel (Eisen Kappel) near Klagenfurt in Carinthia, and Broken Hill, Rhodesia.

DESCLOT, BERNAT (♂ 2nd half of 13th century), Catalan historian, is known through his chronicle of the life of Peter III of Aragon. It was printed in Barcelona 1616, at Paris in 1840 in *Chroniques étrangères relatives aux expéditions françaises pendant le XIII^e siècle*, and edited by J. Coroleu at Barcelona in 1885.

DESCRIPTION, in the strict sense, means an account of the perceptible qualities or characteristics of objects or events. In this sense it is commonly contrasted with explanation (*q.v.*), which usually seeks to account for what is perceptible by means of factors and processes which are not open to observation. Extreme empiricists maintain that science should confine itself to bare description and keep clear of any attempt at explanation. It is very easy, however, to smuggle what is really explanation into a so called description. In the popular use of the term it is clear that a complete description of any object or event would include its explanation.

See A. Wolf, *Foundations of Scientific Method* (1928).

DESCRIPTIVE GEOMETRY is concerned with the method of making accurate drawings to represent completely any object and to solve, by instrumental precision problems relative to the position and shape of the object. It forms the theoretical basis of all architectural and mechanical drawing, and its practical applications are found in the drawing of machinery, buildings, bridges, vessels, in the representation of shadows and halftones, in the construction of maps, and in the graphical solution of spherical trigonometry. It is the means by which the designer conveys his ideas to the builder or mechanic, and has been called the universal language of the engineer.

By the methods of descriptive geometry the solution of any problem concerning three dimensional objects involves the following steps: (1) representation of the lines, surfaces, or solids in

space by corresponding plane figures, (2) solution of the problem by means of the plane figures, (3) interpretation of this solution as a relation between the objects in space. In order to carry out these steps it is necessary to have a definite scheme by which it is possible to pass without ambiguity from the object in space to its representation by drawings in a plane, and also without ambiguity from the drawings to the object in space again. The scheme now universally used for this purpose was devised about the end of the 18th century by G. Monge (1746-1818).

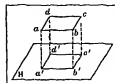


FIG 1

on a plane is the point where a line from a perpendicular to the plane meets the plane. The orthographic projection of a point *a* in a room upon the floor is the point on the floor directly under the given point *a*. The projection upon a plane of any object in space is the figure on the plane made by projecting each point of the given object. For example (fig. 1) the plane, the square *abcd* is parallel to the

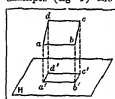


FIG 2

plane *H* and the projection of *abcd* upon *H* is an equal square *a'b'c'd'*. If (fig. 2) the edge *ab* is parallel to *H* but the plane *abcd* is not parallel to *H*, the projection of the square *abcd* on *H* is the rectangle *a'b'c'd'* in which *a'b' = ab* but *b'c'* is less than *bc*. If (fig. 3) the edge *ab* is parallel to *H* and the plane of *abcd* is perpendicular to *H*, the projection of the square *abcd* upon *H* is the straight line *a'b' = ab*. In fig. 4 the plane *abcd* is perpendicular to *H* and the diagonal *ac* is parallel to *H*. In this case the projection of the square is the line *a'c' = ac*.

The line *aa'* which projects a point *a* upon a plane is called a projecting ray, or projector. In orthographic projection the projecting rays are perpendicular to the plane of projection, consequently all projecting rays are parallel. An oblique projection is obtained when all projecting rays are parallel but are not perpendicular to the plane of projection. Oblique projection is used in the construction of shades and shadows. When the projecting rays are parallel the size of the projection does not depend upon the distance of the object from the plane of projection.

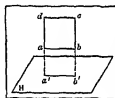


FIG 3

A *scenographic projection*, or *perspective* (see PERSPECTIVE) is obtained when all of the projecting rays converge to a single point, the *point of sight* (fig. 5). This method produces a picture or representation of an object, or group of objects, as it appears to the eye. The size of the scenographic projection of an object depends upon the distances from it to the point of sight and to the plane of projection.

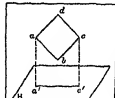


FIG 4

Unless otherwise specified, projection usually means orthographic projection.

Monge's method of representation of an object consists in making orthographic projections of the object on two (or more) planes and establishing a definite relation between the different projections. The two principal planes are the *vertical* (denoted by *V*) and the *horizontal* (denoted by *H*). The line of intersection of these planes is called the *ground line* (denoted by *GL*). Except for special cases *H* and *V* are sufficient for the solution of the problems of descriptive geometry. When a third plane, the *profile plane* (denoted by *P*), is desirable it is taken perpendicular to *GL* and is therefore perpendicular to both *H* and *V*.

The projection of an object on the vertical plane is called the *V projection* or *elevation*, the projection on the horizontal plane is the *H projection* or *plan*. In commercial terminology the elevation is called also the *front view*, or *rear view*, or *sectional elevation*, as the case may be. The plan is called also the *top view*, *bot-*

tom view, or sectional plan Similarly, we have the *profile or end view*

Notation—A systematic notation is necessary for work in descriptive geometry but, unfortunately, no one system has been adopted by a majority of writers on the subject. In this article a point in space is denoted by a small letter, as a, b , the V-projection of a point a is denoted by a^v and the H-projection by a^h . A straight line is denoted by two points on it, the two end points if the line is of limited length, as ab (The ground line is denoted by capital letters, GL.) A plane is denoted by a single capital letter, or may be designated by three points in it or by two lines in it

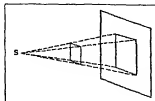


FIG 5

Representation of a Point—The position of a point a in space is determined if we know its V projection and its H-projection. In fig 6 imagine that H represents the floor of a room and V a wall. The V projection of the point a is a^v , this determines the distance xa^v or height of the point above the floor. The H projection, a^h , determines the length xa^h , or distance of the point from the wall. The position of the point from right to left is not given absolutely by this method, but its position with respect to other points of the object is determined

The two principal planes of projection are supposed to be unlimited in extent and divide space into four compartments called

quadrants or angles. In order to distinguish among these quadrants imagine an observer looking at the planes as they appear in fig 6. He is above H and in front of V. This is the first quadrant. The second is above H and behind V. The third is below H and behind V. The fourth is below H and in front of V. An end view is shown in fig 7.

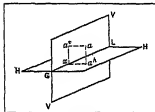


FIG 6

The method of Monge for representing the position of a point in space by a plane drawing consists in turning the V plane about GL as an axis until it coincides with the H plane. The direction of rotation (fig 7) is such that the upper part of V is made to coincide with the part of H which is behind GL.

It is one of the fundamental relations of orthographic projection that, in space, the two projections of any point together with the point itself must always be in a plane which is perpendicular to GL. After revolving V, the two projections of any point will lie in a straight line which is perpendicular to GL. The relation between a point in space and its plane representation is shown for each quadrant by figs 8-11.

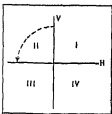


FIG 7

Representation of a Line—The orthographic projection of a straight line upon a plane is a straight line, and a straight line in space is represented on the drawing plane by its V-projection and its H-projection. The truth of the three following statements can be made apparent by holding a pencil in various positions with respect to the floor and a wall. In each statement the letters H and V may be interchanged.

1 If a line of definite length is parallel to V alone, its V projection is parallel and equal to the line, and its H projection is parallel to GL.

2 If a line is perpendicular to V, its V-projection is a point, and its H-projection is perpendicular to GL.

3 If a line is parallel to H and V, both of its projections will be parallel to GL.

The projection of a line ab in space will be the lines joining the projections of a and b , that is (fig 12), the V projection of ab is $a^v b^v$ and the H projection is $a^h b^h$.

In general, any two lines assumed as projections in the plane drawing will determine a line in space. There are, however, excep-

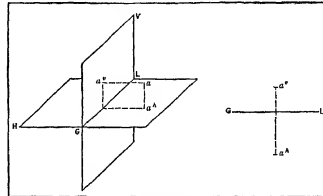


FIG 8

tions when one or both of the projections are perpendicular to the ground line.

A line of indefinite length, which is parallel to neither principal plane, will pierce H in a point called its *horizontal trace* and will

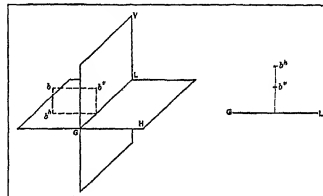


FIG 9

pierce V in its *vertical trace*. These special points are sometimes used to represent the line in the drawing.

Representation of a Plane—A plane of unlimited extent cannot be represented by its projections because, in general, the pro-

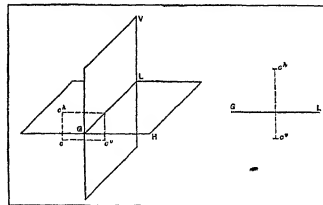


FIG 10

jections of all of its points would completely cover both of the principal planes. Hence a plane is represented by its *traces*, that is, the lines in which it cuts the principal planes. The truth of the three following statements can be made apparent by holding a piece of cardboard in various positions with respect to the floor

and a wall. In each statement the letters H and V may be interchanged.

- 1 If a plane is parallel to V, it has no V trace and its H trace is parallel to GL.
- 2 If a plane is perpendicular to V, but oblique to H, its H trace is perpendicular to GL.
- 3 If a plane is parallel to neither principal plane, its traces will

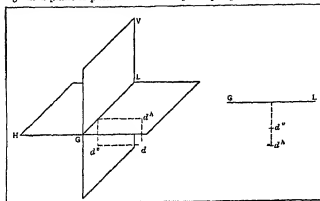


FIG 11

intersect (a) both be parallel to GL, or (b) intersect GL in the same point.

A profile plane is perpendicular to both H and V. If a plane contains GL, it is represented by its trace on a profile plane.

In the plane drawing (fig. 13) any two lines which meet GL at the same point may be taken as the traces of a plane, and they completely determine the position of the plane in space.

The solution of a problem by the methods of descriptive geometry may be illustrated by the following simple example.

Problem.—To find the true length of a line joining two given points in space.

Solution.—The end points a, b of the line are given, and hence their projections are known.

Theory.—Fig. 14 represents the line ab in space and shows the projection $a'b'$ on the H-plane. Imagine the plane figure $abb'a'$ to be revolved about the line $a'b'$ as an axis into the H-plane. Point a will fall at a' and b will fall at b' . Moreover $a'a$ is perpendicular to $a'b'$ and is equal to $a'a'$, $b'b$ is perpendicular to $a'b'$ and is equal to $b'b'$.

Construction.—Fig. 15 is the plane drawing representing the given points a, b by their projections. From a' lay off $a'a'$ perpendicular to $a'b'$ and equal to $a'a$. From b' lay off $b'b'$ perpendicular to $a'b'$ and equal to $b'b$. Then $a'b'$ is the true length of ab .

The scope of the operations involving points, lines, and planes in descriptive geometry is indicated by the following partial list of standard problems.

- 1 To find the plane which contains two given intersecting or parallel lines.
- 2 To find the plane which contains a given line and is perpendicular to a second given line.
- 3 To find the plane which contains a given point and is parallel to each of two given lines.
- 4 To find the plane which contains a given point and is parallel to a given plane.
- 5 To find the plane which contains a given point and is perpendicular to a given line.
- 6 To find the plane which contains a given line and is perpendicular to a given plane.

- 7 To find the line of intersection of two planes.
- 8 To find the point in which a straight line intersects a plane.
- 9 To find the shortest distance from a point to a plane.
- 10 To find the perpendicular distance between two parallel planes.

11 To find the projections of a line making given angles with H and V.

12 To find the angles which an oblique plane makes with H and V.

13 To find the angle between two intersecting lines.

14 To find the angle between two planes.

15 To find the angle between a line and a plane.

16 To find the shortest distance from a point to a line.

17 To find the shortest distance between two lines not in the same plane.

18 At a given point in a plane, to draw a line which shall be perpendicular to the plane and of given length.

Surfaces.—The methods of descriptive

geometry are applicable to the study of curved surfaces in space and of the curves of intersection of such surfaces. The process consists in examining various sections and projections of the figures involved. Of particular interest are those surfaces which can be formed by bending a plane surface without stretching, crumpling, or tearing. Such a surface is called a *developable* surface. Examples are a cylindrical surface (stove pipe) and a conical surface (funnel). A spherical surface is not developable. An important problem in descriptive geometry is to find the development of a given surface. This means to find the shape of the plane figure which would be obtained by rolling out a given developable surface. The result is illustrated by figs. 16, 17, 18. Fig. 16 represents a truncated right circular cylinder, which means that the lower base is a circle, the elements of the curved surface are perpendicular to the lower base, and the upper base is not parallel to the lower base. Fig. 17 is the development of the curved surface.

Fig. 18 represents the development of the spout of a teapot. The problem involves the intersection of two conical surfaces. The development furnishes a pattern for cutting the metal from which the spout is made.

Shades and shadows are studied by the methods of descriptive geometry. The technical meaning of the terms is shown by fig. 19. The rays of light are supposed to come from a source at a great distance, like the sun, and are regarded as parallel. In conventional drawings the rays are supposed to pass over the left shoulder of the observer at such an angle that their H and V projections make angles of 45° with GL. The *illuminated part* of an object is that part upon which rays of light fall. *Shade* is that part of an object not exposed to the rays of light. *Line of shade* is the line between the illuminated and shaded parts of an object. The part of unlighted space behind an object in light

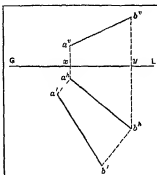


FIG 13

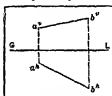


FIG 14

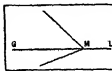


FIG 15

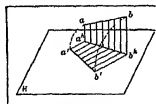


FIG 16



FIG 17

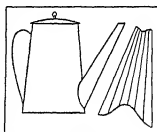


FIG 18

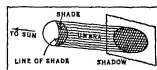


FIG 19

is called the *umbra* or *indefinite shadow*. *Shadow* is the part of a surface in light from which rays of light are excluded by an opaque object. Problems of shades and shadows involve finding the shaded parts of given objects in given positions and the shadows cast by given objects upon other objects.

Descriptive geometry is a regular study in the curriculum of engineering students, and books on the subject are to be found in the list of every prominent publisher of educational texts for technical schools.

(W R L.)

DESCRIPTIVE POETRY, the name given to a class of literature which may be defined as belonging to the 16th, 17th and 18th centuries in Europe. From the earliest times, all poetry which was not subjectively lyrical was apt to indulge in ornament which might be named descriptive. But the critics of the 17th century formed a distinction between the representations of the ancients and those of the moderns. We find Boileau emphasizing the state ment that, while Virgil paints, Tasso describes. This may be a useful indication in defining not what should be, but what in practice has been, called "descriptive poetry." It is poetry in which the landscape, or architecture, or still life, or whatever may be the object of the poet's attention, is not used as an accessory, but is itself the centre of interest. It is, in this sense, not correct to call poetry in which description is only the occasional ornament of a poem, and not its central subject, descriptive poetry. The landscape or still life must fill the canvas, or, if human interest is introduced, that must be treated as an accessory. Thomson's *Seasons*, in which landscape takes the central place, and Drayton's *Polyolbon*, where everything is sacrificed to a topographical progress through Britain, are strictly descriptive.

It will be obvious from this definition that the danger ahead of all purely descriptive poetry is that it will lack intensity, that it will be frigid, if not dead. Boileau was naturally the first to see this and in verses of brilliant humour he mocked the writer who, too full of his subject, and describing for description's sake, will never quit his theme until he has exhausted it.

Fuyez de ces auteurs l'abondance stérile
Et ne vous chargez point d'un détail inutile

But Boileau's humorous sallies do not quite meet the question whether such purely descriptive poetry as he criticizes is legitimate at all.

In England had appeared the famous translation (1592-1611), by Joshua Sylvester, of the *Divine Weeks and Works* of Du Bartas, containing such lines as those which the juvenile Dryden admired so much:

But when winter's keener breath began
To crystallize the Baltic ocean,
To glaze the lakes, and bridle up the floods,
And perrwig with wool the bald pate woods

There was also the curious physiological epic of Phineas Fletcher, *The Purple Island* (1633). But on the whole it was not until French influences had made themselves felt on English poetry, that description, as Boileau conceived it, was cultivated as a distinct art. The *Cooper's Hill* (1642) of Sir John Denham may be contrasted with the less ambitious *Penshurst* of Ben Jonson, and the one represents the new no less completely than the other does the old generation. If, however, we examine *Cooper's Hill* carefully, we perceive that its aim is after all rather philosophical than topographical. The Thames is described indeed, but not very minutely, and the poet is mainly absorbed in moral reflections. Marvell's long poem on the beauties of Nunappleton comes nearer to the

lengthy poem, generally written in heroic or blank verse. This species of writing had been cultivated to a considerable degree through the preceding century, in Italy and (as the remarks

of Boileau testify) in France, but it was in England that it reached its highest importance. The classic of descriptive poetry, in fact, the specimen which must be considered as the most important and the most successful, is *The Seasons* (1726-30) of James Thomson (q.v.). In Thomson, for the first time, a poet of considerable eminence appeared, to whom external nature was all sufficient, and who succeeded in conducting a long poem to its close by a single appeal to landscape, and to the emotions which it directly evokes. Coleridge, somewhat severely, described *The Seasons* as the work of a good rather than of a great poet, and it is an indisputable fact that, at its very best, descriptive poetry fails to awaken the highest powers of the imagination. A great part of Thomson's poem is nothing more or less than a skilfully varied catalogue of natural phenomena. Yet Thomson succeeds, as few other poets of his class have succeeded, in producing nobly-massed effects and comprehensive beauties such as were utterly unknown to his predecessors. He was widely imitated in England, especially by Armstrong, by Akenside, by Shenstone (in *The Schoolmistress*, 1742), by the anonymous author of *Albana*, 1737, and by Goldsmith (in *The Deserted Village*, 1770). No better example of the more pedestrian class of descriptive poetry could be found than the last-mentioned poem, with its minute and Dutch-like painting.

How often have I paused on every charm
The sheltered cot, the cultivated farm,
The never-failing brook, the busy mill,
The decent church that topped the neighbouring hill
The hawthorn-bush, with seats beneath the shade
For talking age and whispering lovers made.

On the Continent of Europe the example of Thomson was almost immediately fruitful. Four several translations of *The Seasons* into French contended for the suffrages of the public, and J. F. de Saint Lambert (1716-1803) imitated Thomson in *Les Saisons* (1760), a poem which enjoyed popularity for half a century, and of which Voltaire said that it was the only one of its generation which would reach posterity. Nevertheless, as Madame du Defland told Walpole, Saint-Lambert is *frond, fade et faux*, and the same may be said of J. A. Roucher (1745-94), who wrote *Les Mois* in 1779, a descriptive poem, famous in its day. The Abbé Jacques Delille (1738-1813), perhaps the most ambitious descriptive poet who has ever lived, was treated as a Virgil by his contemporaries; he published *Les Géorgiques* in 1769, *Les Jardins* in 1782, and *L'Homme des champs* in 1801, but he went furthest in his brilliant, though artificial, *Trois règnes de la nature* (1809), which French critics have called the masterpiece of this whole school of descriptive poetry. Delille, however, like Thomson before him, was unable to avoid monotony and want of coherency. Picture follows picture, and no progress is made. The satire of Marie Joseph Chénier, in his famous and witty *Discours sur les poèmes descriptifs*, brought the vogue of this species of poetry to an end.

In England, again, Wordsworth, who treated the genus of Thomson with unmitigated severity, revived descriptive poetry in a form which owed more than Wordsworth realized to the model of *The Seasons*. In *The Excursion* and *The Prelude*, as well as in many of his minor pieces, Wordsworth's philosophical and moral intentions cannot prevent us from perceiving the large part which pure description takes, and the same may be said of much of the early blank verse of S. T. Coleridge. Since their day, however, purely descriptive poetry has gone more and more completely out of fashion, and its place has been taken by the richer and freer effects of such prose as that of Ruskin in English, or of Fremont and Pierre Loti in French.

DESERT, a term used for those lands which produce insufficient vegetation to support a human population. Deserts are classified according to the causes which give rise to them. In "cold deserts" the absence of vegetation is consequent on the prevailing low temperature, while in "hot deserts" the causes are high temperatures and deficient rainfall. Cold deserts accordingly occur in high latitudes or high altitudes. Hot deserts are primarily found along the hot, dry tropical belts of high atmospheric pressure, and on their equatorial sides, but the zonal arrangement is considerably modified in some regions by the influence of ele-

vated land. The northern hemisphere provides examples of this type in the African Sahara, the Asiatic deserts of Arabia and Iran, and in the Great Basin of North America. The southern hemisphere has the Kalahari in Africa, the deserts of Western Australia, and the Atacama in South America. Where a line of elevated land runs east and west in this zone as in Asia, the desert belt tends to occur eastwards in higher latitudes but where the line runs north and south, as in Africa, America and Australia, the desert zone weakens on the windward side of the elevation and the arid conditions are accentuated on the lee side. Desert conditions occasionally arise from somewhat obscure local causes, but the Indian desert (*q.v.*) seems to be situated in a region inaccessible to either of the two main branches of the wet south-west monsoon.

Although permanent rivers rising in wetter regions may traverse deserts (*eg.*, the Nile) the fundamental physical condition of an arid area is that it contributes nothing directly to oceanic waters. The rainfall chiefly occurs during violent cloud-bursts (*q.v.*) and the soluble matter in the soil is carried down by intermittent streams to salt lakes around which deposits of economic value are found on evaporation. Surface erosion is caused by rapid and extreme changes of temperature, while wind action often forms dunes resembling waves. Dry valleys with precipitous sides, and cirque-like heads are probably caused by occasional cloud bursts. Natural springs in some deserts give rise to oases which make trans desert routes possible. When a desert-river has low banks (*eg.*, the Nile) irrigation is made possible.

See *Das Gesetz der Wüstenbildung* by Walther, Berlin, 1900 for a general account of deserts.

DESERTION, the act of forsaking or abandoning, more particularly, the wilful abandonment of an employment, office or duty, in breach of a legal or moral obligation. For naval or military desertion, see **MILITARY LAW**, for desertion from the merchant service, see **LAWs RELATING TO SEAMEN**, for desertion of husband, see **DIVORCE**, for the desertion of children, see **CHILDREN—PROTECTIVE LAWS AND INFANT**.

DESERT WILLOW (*Chilopsis linearis*), a small North American tree of the Bignonia family (Bignoniaceae), native to stream banks and the vicinity of springs in deserts from western Texas to southern California, and southward to northern Mexico. It grows usually from 8 ft to 25 ft high, with stems from 2 in to 10 in in diameter, slender, ascending branches, and narrow, willow-like leaves. During summer it bears a succession of showy, funnel-shaped, pink flowers, about 1½ in long and 1½ in across, in profuse terminal clusters, followed in autumn by narrow seed-pods about 8 in long. It is a characteristic plant of southwestern deserts, in appearance suggestive of a slender willow with catalpa-like flowers.

DESFORGES, PIERRE JEAN BAPTISTE CHODARD (1746-1806), French dramatist and man of letters, natural son of Dr Antoine Petit, was born in Paris on Sept. 15, 1746, and educated at the Collège Mazarin and the Collège de Beauvais. After appearing on the stage of the Comédie Italienne in Paris he joined a troupe of wandering actors whom he served in the capacity of playwright. He married an actress, and the two spent three years in St. Petersburg, where they were well received. In 1782 he produced at the Comédie Italienne an adaptation of Fielding's novel with the title *Tom Jones à Londres*. His first great success was achieved with *L'Épouse villageoise* (1785) to the music of Gretry. *La Femme jilouse*, a five act comedy in verse (1785), *Jocoré* (1790) for the music of Louis Jaden, *Le Poux divorcé* (1799), a comedy, and other pieces followed. He has left a record of his own early indiscretions in *Le Poète ou mémoires d'un homme de lettres écrits par lui-même* (1 vol., 1798). He died in Paris on Aug. 13, 1806.

DESGARINS, MAGDELEINE MARIE (LOUISE) (1760-1797), French actress, was born at Mont Dauphin (Hautes Alpes). In her short career she became one of the greatest of French tragédiennes, the associate of Talma, with whom she nearly always played. She made her début at the Comédie Française on May 24, 1788, in *Bayazet*, and was at once made

socétaire. She left the Comédie Française in 1791 for the house in the Rue Richelieu, soon to become the Théâtre de la République, and there her triumphs were no less—in *King Lear*, *Othello*, *La Harpe's Melanc et Virgine*, etc. She died insane, in Paris, on Oct. 27, 1797.

DESHAYES, GÉRARD PAUL (1795-1875), French geologist and conchologist, born at Nancy on May 13, 1795, was professor of natural history in the Muséum d'Histoire Naturelle. Deshayes examined the fossil Mollusca of the Paris Basin and of other Tertiary areas. His studies on the relations of the fossil to the recent species led him as early as 1820 to conclusions somewhat similar to those arrived at by Lyell, whom Deshayes assisted in the classification of the Tertiary system into Eocene, Miocene and Pliocene. His chief work, *Mollusques de l'Algérie*, the result of collections made in Algeria, where he was sent by the French Government in 1839, was issued (incomplete) in 1848. He died at Boran, Oise, on June 9, 1875.

DESHOULIÈRES, ANTOINETTE DU LIGIER DE LA GARDE (1638-1694), French poetess, was born in Paris on Jan. 1, 1638. At the age of 13 she married Guillaume de Boisguern, seigneur Deshoulières, who followed the prince of Condé to the wars. Madame Deshoulières returned for a time to the house of her parents, where she wrote poetry and studied the philosophy of Gassendi. She rejoined her husband at Rocroi, near Brussels, and was imprisoned in the chateau of Wilvorde because of her insistence that her husband's arrears of pay should be met. After a few months she was freed by her husband, who attacked the chateau at the head of a small band of soldiers. They were amnestied, and returned to France, where Madame Deshoulières soon became a conspicuous personage at the court of Louis XIV and in literary society, some of her more zealous flatterers even going so far as to style her the tenth muse and the French Calliope. Voltaire pronounced her the best of French poetesses, and she was elected a member of the Academy of the Ricovrati of Padua and of the Academy of Arles. In 1688 she was patronised by the king. She died in Paris on Feb. 17, 1694. Complete editions of her works were published at Paris in 1695, 1747 and 1882 (edit. Lescure). These include a few poems by her daughter, Antoine Thérèse Deshoulières (1656-1718), who inherited her talent.

See Sainte-Beuve, *Portraits de femmes* (1892).

DESICCATION, the operation of drying or removing water from a substance. It is of particular importance in practical chemistry. If a substance admits of being heated to say 100°, the drying may be effected by means of a steam bath, which is simply an oven heated by steam, an air bath may be used for higher temperatures. Otherwise a desiccator must be employed, this is essentially a closed vessel in which a hygroscopic substance is placed together with the substance to be dried. The process may be accelerated by exhausting the desiccator, this so-called vacuum desiccation is especially suitable for the concentration of aqueous solutions of readily decomposable substances. Hygroscopic substances in common use are phosphoric anhydride, concentrated sulphuric acid, potassium and sodium hydroxides, soda lime, anhydrous sodium sulphate and calcium chloride.

Two common types of desiccator are in use. In one the absorbent is placed at the bottom, and the substance to be dried above, in the other, this arrangement is inverted. Liquids are dried either by means of the desiccator, or, as is more usual, by shaking with a substance which removes the water. Fused calcium chloride is the commonest absorbent, but it must not be used with alcohols and certain other liquids with which it forms compounds. Quicklime, barium oxide and dehydrated copper sulphate are especially applicable to alcohol and ether, the last traces of water may be removed by adding metallic sodium and distilling. Gases are dried by leading them through towers or tubes containing an appropriate drying material. The experiments of H. B. Baker on the influence of moisture on chemical combination have shown the difficulty of removing the last traces of water—see **DRYNESS, CHEMICAL**.

In chemical technology, important on the principle of the

laboratory air bath is mainly used. Crystals and precipitates, deprived of as much water as possible by centrifugal machines or filter-presses, are transported by means of a belt, screw or other form of conveyor, on to trays staged in brick chambers heated directly by flue gases or steam pipes, the latter are easily controlled, and if the steam be superheated a temperature of 300° and over may be maintained. In some cases the material traverses the chamber from the coolest to the hottest part on a conveyor or in wagons. Rotating cylinders are also used, the material to be dried is placed inside, and the cylinder heated by a steam jacket or otherwise.

DESIDERIO DA SETTIGNANO (1428-1464), Italian sculptor, was born at Settignano, near Florence, and was for a short time a pupil of Donatello, whom, according to Vasari, he assisted in the work on the pedestal of David, and he seems to have worked also with Mino da Fiesole, with the delicate and refined style of whose works those of Desiderio seem to have a closer affinity than with the perhaps more masculine tone of Donatello. It does not appear that Desiderio ever worked elsewhere than at Florence, for there are to be found there his few surviving decorative and monumental works, though a number of his delicately carved marble busts of women and children are to be found in the museums and private collections of Germany and France. The most prominent of his works are the tomb of the secretary of state, Marsuppini, in Santa Croce, and the great marble tabernacle of the Annunciation in San Lorenzo, both of which belong to his later period, and the cherubs' heads which form the exterior frieze of the Pazzi chapel. Vasari mentions a marble bust, by Desiderio, of Manetta degli Strozzi, which has been identified as a marble portrait bust acquired by the Berlin museum in 1842. The Berlin museum also owns a coloured plaster bust of an Urbino lady, by Desiderio. Other important busts by the master are in the Bargello, Florence, the Louvre in Paris and in private collections.

See Wilhelm Bode, *Die italienische Plastik* (Berlin, 1893).

DESIDERIUS, the last king of the Lombards, is chiefly known through his connection with Charlemagne. He was duke of Tuscany and became king of the Lombards in 756. Seeking to extend the Lombard power, he came into collision with the papacy, and about 772 Adrian I. implored the aid of Charlemagne against him. Other causes of quarrel already existed between the Frankish and the Lombard kings. In 770 Charlemagne had married a daughter of Desiderius, but he soon sent her back to her father. Moreover, Gerberga, Charlemagne's sister in law, had sought the protection of the Lombard king after her husband's death in 771; Desiderius had recognized her sons as the lawful Frankish kings, and had attacked Adrian for refusing to crown them. Such was the position when Charlemagne took the Lombard capital, Ticinum, the modern Pavia, in June 774, and appropriated the kingdom of Lombardy. Desiderius was carried to France, where he died, and his son, Adalgis, spent his life in futile attempts to recover his father's kingdom.

See S. Abel, *Untergang des Langobardenreichs* (Göttingen, 1859), and *Jahrbücher des Historischen Reichs unter Karl dem Grossen* (Leipzig, 1865); Paulus Diaconus, *Historia Langobardorum*, ed. by L. Bethmann and G. Waltz (Hanover, 1878); L. M. Hartmann, *Geschichte Italiens im Mittelalter* (Gotha, 1903).

DESIGN is the arrangement of lines or forms which make up the plan of a work of art with especial regard to the proportions, structure, movement and beauty of line of the whole. A design may be naturalistic or wholly the abstract conception of the artist. Its structure is related to the structure of the frame and the rendering of the subject, but not to the structure or anatomy of the subject itself. A design may be successful which is incorrect in every detail of anatomy. Design in one sense is synonymous with composition, and has to do with all the arts, though more pronounced in the applied arts than in the fine arts.

The Japanese artist Korin arrived at much of his design through the selection of certain parts of purely natural arrangements which were simplified and selected as typical, but which were rendered in a naturalistic manner. Much of modern design is not so made up, but consists of gross distortion for the over-

stressing of structure or movement, with a complete loss of other characteristics. This type of design is so close to caricature that it often detracts rather than adds to the beauty of a work of art.

Design is concerned not only with typical movement but also with typical rhythms. Through the medium of parallel master strokes or accenting of repeating movements, rhythms are set

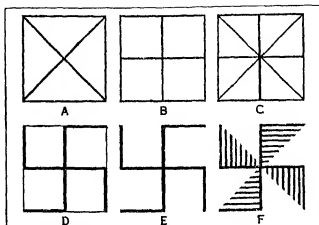


FIG 1—PROGRESSIVE STEPS IN THE FORMING OF A SWASTIKA WITHIN A SQUARE

up which should, like the rhythms of great poetry, accent the meaning and express a crystallization of the personality of the artist, and at the same time of his subject as seen through his eyes. Just as in "The Raven" by Poe, we have the summing up of all of Poe's mood in his work and at the same time have the summing up of the expression of all human despair in the bird's recurring "Never more," so in the design of a master of the graphic arts will be found accents and rhythms which build the mood he wishes to establish. Design is to the graphic arts what verse form and rhyme are to poetry: the ladder up which it climbs to the heights. Design can exist without colour, but just as there can be design in line and mass so there can also be design in colour, based upon the distribution of harmoniously blending or contrasting tones, when design is present in both line and colour the two must work together to further the effect of the conception. Every element of art can be designed separately and in relation to the other elements. Thus there can be structural design, movement design, outline design. (See DRAWING.)

Teaching—In the teaching of design it is often helpful to have the student cut out various pieces of paper representing

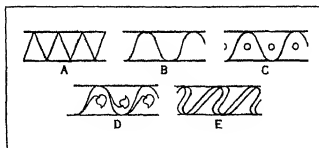


FIG 2—DEVELOPMENT OF WAVE OR VINE DESIGN WITHIN PARALLEL LINES FROM SIMPLE GEOMETRICAL FORM

the main areas to be used and move them about within the size area, cut out of the centre of another piece of paper, upon which he is to work. When these have been arranged to his satisfaction, lines should be thrown in which tie the whole together, and finally, with these established areas and lines to guide him, work can be begun. The Chinese artist does this mentally as he sits contemplating the silk upon which he is to paint, for he has trained his mind to remember the arrangement once he has de-

cided upon it. The student can teach himself to do this, but it is well to begin with the more objective method.

It is interesting to note that in given areas only a certain number of effective designs are possible, and that man has hit upon them in every part of the world without intercommunication. Scientists have tried to prove a common origin for the race because of the almost universal use of the swastika, but many

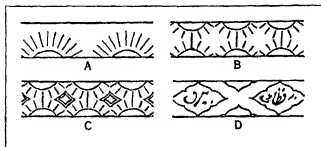


FIG. 3—PROBABLE EVOLUTION OF TYPICAL PERSIAN OGGEE DESIGN FROM OLD ZOROASTRIAN MOTIF

children who have never seen this sign arrive at it spontaneously, when left to decorate squares. The steps are simple (see fig. 1).

(1) The corners, which catch the eye quickest for a starting point, are joined, (2) the sides, (3) both are combined and before long, in the age old attempt to represent movement, the spurs are discovered and all sorts of variations follow. The "wave" or "vine" or "running" border is developed in like manner, because it is the most obvious way to decorate a narrow space between parallel lines. We usually find (A) the geometrical treatment (fig. 2), (B) the curve with open areas which are soon (C) filled with spots assuming the shape of leaves on a vine as time goes on (D), and an excuse for their being is demanded. Finally, as in (E), the movement is increased and it becomes on many Tzu Chow vases of China a leaping rather than a running border, representative of waves from which the fiery dragon ascends.

Development.—The typical Persian ogee design has an interesting origin which is demonstrable on existing vases. In fig. 3 (A) is shown the old Zoroastrian motif of the rising sun which only loosely filled the border, other suns were introduced at a still earlier period. In a further attempt to build the border together a design was inserted between them, which sometimes held written characters and finally, as the region is developed, the suns disappear and ogee patterns are fitted together, becoming a typical national motif.

Design is, therefore, old and has been thought of for many thousand years, and the student does well to acquaint himself with early examples found in various parts of the world. It is almost as difficult to create a new design as it is to discover a new geometric principle, but another element enters design, and once having learned it as one would learn geometry, there is available, instead of a cold, mathematical deduction, a vehicle for the expression of one's personal sense of beauty. (W. E. Cx.)

ORIGINALITY

Modern use has tended to associate design with the word "original" in the sense of new or abnormal. But the end of design is utility, fitness and delight. If a discovery, it should be a discovery of what seems inevitable, an inspiration arising out of the conditions, and parallel to invention in the sciences. The faculty of design has best flourished when an almost spontaneous development was taking place in the arts, and while certain classes of arts, more or less noble, were generally demanded and the demand copiously satisfied, as in the production of Chinese porcelain, Greek vases, Byzantine mosaics, Gothic cathedrals and Renaissance paintings. Thus where a "school of design" exists there is much general likeness in the products but also a general progress. The common experience—"tradition"—is a part of each artist's stock in trade, and all are carried along in a stream of continuous exploration. Some of the arts writing for instance have been little touched by conscious originality in design all has been progress, or, at least, change, in response to conditions. Under

such a system, in a time of progress, the proper limitations react as intensity, when limitations are removed the designer has less and less upon which to react, and unconditional liberty gives him nothing at all to lean on. Design is response to needs, conditions and aspirations. The Greeks so well understood this that they appear to have consciously restrained themselves to the development of selected types, not only in architecture and literature, but in domestic arts, like pottery. Design with them was less the new than the true.

For the production of a school of design it is necessary that there should be a considerable body of artists working together, and a large demand from a sympathetic public. A process of continuous development is thus brought into being which sustains the individual effort. It is necessary for the designer to know familiarly the processes, the materials and the skilful use of the tools involved in the productions of a given art, and properly only one who practises a craft can design for it. It is necessary to enter into the traditions of the art, that is, to know past achievements. It is necessary, further, to be in relation with nature, the great reservoir of ideas, for it is from it that fresh thought will flow into all forms of art. These conditions being granted, the best and most useful meaning we can give to the word design is exploration, experiment, consideration of possibilities. Putting too high a value on originality other than this is to restrict natural growth from vital roots, in which true originality consists. To take design in architecture as an example, we have rested too much on definite precedent (a different thing from living tradition) and, on the other hand, hoped too much from newness. Exploration of the possibilities in arches, vaults, domes and the like, as a chemist or a mathematician explores, is little accepted as a method in architecture at this time, although in antiquity it was by such means that the great master works were produced: the Pantheon, Santa Sophia, Durham and Amiens cathedrals. The same is true of all forms of design. Of course the genius and inspiration of the individual artist is not here ignored, but assumed. What we are concerned with is a mode of thought which shall make it most fruitful. (See ARTS AND CRAFTS, RENDERING, ARCHITECTURAL (W. R. L.))

DESK, any kind of flat or sloping table for writing or reading. Its earliest shape was probably that with which we are familiar in pictures of the monastic *scriptorium*—rather high and narrow with a sloping slab. The primitive desk had little accommodation for writing materials, and no storage room for papers, drawers, cupboards and pigeonholes were the evolution of periods when writing grew common, and when letters and other documents requiring preservation became numerous. It was long the custom to secure papers in chests or cabinets, whereas the modern desk serves the double purpose of a writing-table and a storehouse for documents. The first development from the early stall like desk consisted of the addition of a drawer, then the table came to be supported upon legs or columns. Eventually the legs were replaced by a series of superimposed drawers forming pedestals—hence the familiar pedestal writing-table.

For a long period there were two distinct contemporary forms of desk—the table and the bureau or escrítoire. The latter shape attained a popularity so great that it was found even in houses in which there was little occasion for writing. The English-speaking people of the 18th century were amazingly fond of pieces of furniture which served a double or triple purpose. The bureau took its name from the French generic appellation for a desk—describes its name from the material with which it was originally covered (Fr. *bureau*, woollen cloth). It consists of an upright panel sloping in and at the top and provided with long drawers below. The upper part is fitted with small drawers and pigeon holes, and often with secret places, and the writing space is formed by a hinged slab supported on runners, when not in use the slab closes up the sloping top. During the 18th century innumerable thousands of these bureaux were made on both sides of the Atlantic—indeed, in the 19th century, desks and chairs no piece of old furniture is more common. In the first part of that period they were usually of oak, but when mahogany was introduced into Europe it speedily ousted the heavier looking wood. Its deep rich colour and the

high polish of which it was capable added appreciably to its ornamental appearance. While the pigeon-holes and small drawers were used for papers, the long drawers were often employed for purposes other than literary. In time the bureau-secretaire became a bureau bookcase, the glazed shelves, which were often a separate erection, resting upon the top of the bureau. The cabinet makers of the second half of the 18th century, the period of the greatest *floraison* of this combination, competed with each other in devising elegant frets for the glass fronts. Solid and satisfying to the eye, if somewhat severe in form, the mahogany bureau was usually an exceedingly presentable piece of furniture. Occasionally it had a *bombé* front which mitigated its severity, this was especially the case in the Dutch varieties, which were in a measure free adaptations of the French Louis Quinze *commode*. These Dutch bureaux, and the English ones made in imitation of them, were usually elaborately inlaid with floral designs in coloured woods, but whereas the Batavian marquetry was often rough and crude, the English work was usually of considerable excellence. Side by side with this form of writing apparatus was one variety or another of the writing-table proper. In so far as it is possible to generalize upon such a detail it would appear that the bureau was the desk of the yeoman and what we now call the lower middle class, and that the slighter and more table like forms were preferred by those higher in the social scale.

Just about the time when the flat table with its drawers in a single row was finally assuming its familiar modern shape, an invention was introduced which was destined eventually to supersede all other forms of desk. This was the cylinder top writing-table. Nothing is known of the originator of this device, but it is certain that if not French himself he worked in France. The historians of French furniture agree in fixing its introduction about the year 1750, and we know that a desk worked on this principle was in the possession of the French crown in the year 1760. Even in its early days the cylinder took more than one form. Its some-



A SCRIBE OF THE XVIIth CENTURY WORKING AT HIS DESK

and to the facility with which the closing of the cylinder can cease all papers, and automatically locks every drawer. To France we owe the construction of many of the finest and most historic desks that have survived—the characteristic marquetry writing tables of the Boule period, and the gilded splendours of that of Louis XV have never been surpassed in the history of furniture. Indeed, the “Bureau du roi” which was made for Louis XV is the most famous and magnificent piece of furniture that, so far as we know, was ever constructed. This desk, which is now one of the treasures of the Louvre, was the work of several artist artificers, chief among whom were Oeben and Riesener—Oeben, it may be added here as a matter of artistic interest, became the grandfather of Eugene Delacroix. The bureau is signed *Riesener fa 1769 à l’Arsenal de Paris*, but it has been established that, however great may have been the share of its construction which fell to him, the conception was that of Oeben. The work was ordered in 1760, it would thus appear that nine years were consumed in perfecting it, which is not surprising when we learn from the detailed account of its construction that the work began with making a perfect miniature model followed by one of full size. The “bureau du roi” is a large cylinder desk elaborately inlaid in marquetry of woods, and decorated with a wonderful and ornate series of mounts consisting of mouldings, plaques, vases and statuettes of gilt bronze cast and chased. These bronzes are the work of Duplessis, Winant and Hervieux. The desk, which shows plainly the transition between the Louis XV and Louis XVI styles, is as remarkable for the boldness of its conception as for the magnificent finish of its details. Its lines are large, flowing and harmonious, and although it is no longer exactly as it left the hands of its makers (Oeben died before it was finished) the alterations that have been made have hardly interfered with the general effect. For the head of the king for whom it was made, that of Minerva in a helmet was substituted under his successor. The ciphers of Louis XV have been removed and replaced by Sèvres plaques, and even the key which bore the king’s initial crowned with laurels and palm leaves, with his portrait on the one side, and the *flair de lys* on the other, has been interfered with by an austere republicanism. Yet no tampering with details can spoil the monumental nobility of this great conception. (J. P. B.)

DESMARETS or DESMARETZ, JEAN, SEIGNEUR DE SAINT-SORLIN (1595–1676), French dramatist and miscellaneous writer, was born in Paris in 1595. The success of his romance *Arsène* in 1611 led to his admission to the circle that met at the house of Valentin Conrart and later developed into the Académie Française. Desmarets was its first chancellor. He began to write for the theatre at the request of his patron Richelieu. In this kind he produced a comedy long regarded as a masterpiece, *Les Visionnaires* (1637), a prose-tragedy, *Erigone* (1638), and *Sapphon* (1639), a tragedy in verse. His success brought many official preferments. His long epic *Clovis* (1657) is noteworthy because Desmarets rejected the traditional pagan background and maintained that Christian imagery should supplant it. With this standpoint he contributed several works in defence of the moderns in the quarrel between the Ancients and the Moderns. In his later years Desmarets wrote religious poems. He was a violent opponent of the Jansenists, against whom he wrote a *Réponse à l’insolente apologie de Port Royal* (1666). He died in Paris on Oct. 25, 1676.

See also H. Rigault, *Histoire de la querelle des anciens et des modernes* (1856), pp. 80–103; and R. Kerviler, *Desmarets* (1899).

DESMARETS, NICOLAS, SEIGNEUR DE MAILLEBOIS (1648–1721), French statesman, was born in Paris, Sept. 10, 1648. He was a nephew of J. B. Colbert, rose rapidly in the financial administration, and was disgraced after Colbert’s death. In 1686 he was recalled, and during the next ten years presented to the controllers general a series of remarkable memoirs exposing the desperate economic situation of France. He held office under Chamillart from 1699 onwards, and in 1708 succeeded him as controller general. The situation was exceedingly grave. The ordinary revenues of the year 1708 amounted to 81,977,007 livres, of which 57,833,233 livres had already been anticipated, and the expenses to meet were 200,251,447 livres. In 1709 a famine reduced still more the tax



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

AN XVIIIth CENTURY CYLINDER DESK IN LOUIS XVIIIth STYLE

times consisted of a solid piece of curved wood and sometimes of a tambour frame—that is to say, of a series of narrow jointed strips or wood mounted on canvas, the revolving shutter of a shop front: an adaptation of the idea. For a long period, however, the cylinder was most often solid, and reminded so much of the latter part of the 19th century when the “American roll top desk” began to be made in large numbers. This is indeed the old French form with a tambour cylinder and it is now the desk that is most frequently met with all over the world for commercial purposes. Its popularity is due to its large accommodation

returns. Emission of paper money, and an improved collection of taxes tided over the years of 1709 and 1710. Then Desmarts decided upon an income tax. His "tenth" was based on Vauban's plan, but the privileged classes managed to avoid it. After the death of Louis XIV Desmarts was dismissed by the regent and withdrew to his estates. He was certainly, after Colbert, the greatest finance minister of Louis XIV's reign. See *Fornbonnais, Recherches et considérations sur les finances de la France* (2 vols Basel, 1758), *Montyon, Particularités et observations sur les ministres des finances de la France* (1812), *De Bousille, Correspondance de contrôleurs-généraux des finances* (3 vols 1873-97), and the same author's "Desmarts et l'affaire des pièces de quatre sols" in the appendix to the seventh volume of his edition of the *Mémoires de Saint Simon*.

DES MOINES, the capital and largest city of Iowa, U.S., in the south central part of the state, on the Des Moines river, at the mouth of the Racoon, a port of entry and the county seat of Polk county. It is on federal highways 6, 65 and 69, has municipal and commercial airports and is served by the Burlington, the Chicago and North Western, the Chicago Great Western, the Chicago, Milwaukee, St. Paul and Pacific, the Fort Dodge, Des Moines and Southern, the Minneapolis and St. Louis, the Rock Island and the Wabash railways, by air lines and interurban motorbus and trolley lines and additional railways for freight only.

The population in 1950 was 176,954, and in 1940 was 159,819, of which 89.4% were native white and 6.5% foreign-born white.

The city lies on both banks of the river, at an altitude of 861 ft., and has an area of 55.91 sq mi. The state capitol (completed in 1882 at a cost of \$3,000,000) stands on an eminence in a park of 80 ac. Near by is the State Historical, Memorial and Art building and the state library. Des Moines was one of the first among U.S. cities to plan on a relatively generous scale for beauty in its development. A comprehensive city plan was adopted in 1924 and considerable progress was made in carrying it out. Along the river front, through the heart of the city, extends the civic centre, with a city hall (\$500,000), a municipal courthouse (\$600,000), a federal building and a post office. The city's system of parks and playgrounds covers 1,400 ac, and the grounds of the state fair, which has an attendance of around 500,000 each year, have an area of 600 ac. The Des Moines Art centre in Greenwood park, designed by Eliel Saarinen, was opened in 1948. It comprises a museum, library, auditorium and school.

Drake university, a privately endowed educational institution founded in 1881, is located in northwest Des Moines and covers 34 ac in the metropolitan area of the city. The university has eight colleges and a graduate division. It operates the Drake-Des Moines observatory, located in Waveland park. The Drake-Des Moines symphony orchestra is another co-operative undertaking at the city and the "school 'The Drake relay', founded in 1910, attracts thousands of spectators and athletes each April.

Adjoining the city on the south is Ft. Des Moines, formerly an important army post, where almost a full regiment of cavalry was stationed besides various other troops. During World War II it was the first training centre for the women's army corps. It was later converted into a veterans' housing centre. At Camp Dodge, 11 mi. N., now used by the national guard, thousands of soldiers were trained during World Wars I and II.

In 1907 the city adopted a commission form of government known as the "Des Moines plan," which was superseded in 1950 by a city-manager plan.

In the heart of the corn belt, and surrounded by a coal field which has produced as much as 3,000,000 tons in a year, Des Moines is an important commercial centre. The jobbing business of more than 300 wholesale houses amounted to more than \$559,766,000 annually at mid-20th century.

Incoming and outgoing freight totals 2,500,000 tons in a year, and 200 package-freight cars leave the city daily. Manufactures also are important, with an output in 1949 valued at \$340,000,000. Chief among them are meat products, flour, clothing, foundry products, brick and tile, aircraft parts and farm machinery. The printing and publishing of newspapers and periodicals is one of

the leading industries. The city is the principal centre for the publication of farm journals. It is the home of *Better Homes and Gardens*, and *Look* magazines.

A number of insurance companies, with aggregate assets of \$1,165,000,000 at mid century, have their home offices there.

In 1843 a military post called Ft. Des Moines was established on the site of the city to protect the rights of the Sacs and Foxes, and in the same year the district was opened to settlement by the whites. The town was incorporated in 1851. In 1857 it was chartered as a city and was made the State capital, superseding Iowa City. The population in 1860 was 3,965, which grew to 12,035 in 1870, 22,408 in 1880, and 50,093 in 1890. Between 1890 and 1920, without any annexations of territory, the population increased 152%. The fort was re established in 1900. The name of city and fort was taken from that of the river, which is supposed to be a corruption of the original Indian name, *Momonga*, by the French, who at first, using the abbreviation *mom*, called it *la rivière des moms*, and later, through its association with the Trappist monks, changed it to *la rivière des monnes*.

DESMOND, EARLS OF ^{see} FITZGERALD, DESMOND, GERALD FITZGERALD, 15TH EARL OF

DESMOND, GERALD FITZGERALD, 15TH EARL OF (d. 1583), Irish leader, was son of James, 14th earl, by his second wife More O'Carroll. Young Gerald was to have been educated in England as the companion of the young king, Edward VI. Unfortunately for the subsequent peace of Munster these projects were not carried out. Claims on the Desmond estates were made by the Butlers, the hereditary enemies of the Geraldines, but temporary peace was made by Gerald's marriage with the daughter and heiress of the 11th earl of Desmond, who had previously married, first, the 9th earl of Ormonde and secondly, Sir Francis Bryan.

Gerald succeeded to the earldom in 1558, he was knighted by the lord deputy Sussex, and did homage at Waterford. He allied himself with his namesake Gerald Fitzgerald, 11th earl of Kildare (1525-1585), and with Shane O'Neill, and trouble was renewed between Ormonde and the Fitzgeralds. Desmond, summoned to appear in London to account for the misdeeds of his clan, delayed his appearance until May 1562. He was detained in London for two years, and after his return the death of his wife freed him from such restraint as had existed. Open war followed, and Desmond was defeated and taken prisoner. Desmond and his brother Sir John of Desmond were sent over to England, where they surrendered their lands to the queen after a short experience of the Tower.

Desmond was allowed to return to Ireland in 1573. He was detained for six months in Dublin, but in November slipped through the hands of the Government, and in a short time had reduced the province to a state of anarchy. On July 18, 1574, the Geraldine chiefs signed the "Combination" promising to support the earl unconditionally, shortly afterwards Ormonde and the lord deputy, Sir William Fitzwilliam, marched on Munster, and put Desmond's garrison at Derrinlaun Castle to the sword. Desmond submitted at Cork on Sept. 2, handing over his estates to trustees. Sir Henry Sidney visited Munster in 1575, and affairs seemed to promise an early restoration of order. But Fitzmaurice had fled to Brittany in company with other leading Geraldines. He intrigued at the French and Spanish courts for a foreign invasion of Ireland, and at Rome met the adventurer Stucley, with whom he projected an expedition which was to make a nephew of Gregory XIII king of Ireland. In 1579 he landed in Smerwick bay, where he was joined later by some Spanish soldiers at the Fort del Ore. His ships were captured on July 29, and he himself was slain in a skirmish while on his way to Tipperary. Desmond had perhaps been restrained before by jealousy of Fitzmaurice, his indecisions ceased when on Nov. 1 Sir William Pelham proclaimed him a traitor. The sack of Youghal and Kinsale by the Geraldines was speedily followed by the successes of Ormonde and Pelham acting in concert with Admiral Winter. In June 1581 Desmond had to take to the woods, on Nov. 11 he was seized and murdered by a small party of soldiers. His brother Sir John of Desmond had been caught and killed in Dec. 1581, and John Fitz-

Juan expedition (1779), then made governor of the Mosquito shore and the Bay of Honduras, and in 1782 commander of a successful expedition against the Spanish possessions on the Black river. In 1784 he took over the administration of Yucatan. Upon frivolous charges he was suspended by Lord Grenville, and recalled to England. From 1790 to 1792 these charges were held over him, and when dismissed no compensation was forthcoming. His complaints caused his arrest in 1798, and with a short interval he remained in gaol until 1800. Despard was arrested on a charge of plotting to assassinate George III, tried before a special commission, found guilty of high treason, and, with six of his fellow-conspirators, sentenced in 1803 to be hanged, drawn and quartered. These were the last men to be so sentenced in England. Despard was executed on Feb. 21, 1803.

His eldest brother, JOHN DESPARD (1745-1829), had a long and distinguished career in the British army, gazetted an ensign in 1760, he became general in 1814. In the American War of Independence he was twice made prisoner.

See Sir Charles Oman, *The Unfortunate Colonel Despard and other studies* (1922).

DESPATCH or **DISPATCH**, to send off immediately, or by express, particularly in the case of the sending of official messages, or of the immediate sending of troops to their destination, or the like. The word is used as a substantive of written official reports of events, battles and the like, sent by ambassadors, generals, etc., by means of a special messenger, or of express correspondence generally. From the primary meaning of the prompt sending of a message, the word is used of the quick disposal of business, or of the disposal of a person by violence. The French word *dépêche* came into England as *depeach*, which was in use from the 15th century until "despatch" was introduced. An early use of "despatch" occurs in a letter to Henry VIII from Bishop Tunstall, commissioner to Spain in 1516-17.

DESPENSER, HUGH LE (d. 1265), chief justiciar of England, first played an important part in 1258, being prominent on the baronial side in the Mad Parliament of Oxford. In 1260 the barons chose him to succeed Hugh Bigod as justiciar, and in 1263 the king was further compelled to put the Tower of London in his hands. On the outbreak of civil war he joined the party of Simon de Montfort, earl of Leicester, and led the Londoners when they sacked the manor-house of Isleworth, belonging to Richard, earl of Cornwall, king of the Romans. Having fought at Lewes (1264) he was made governor of six castles after the battle, and was then appointed one of the four arbitrators to mediate between Simon de Montfort and Gilbert de Clare, earl of Gloucester. He was summoned to Simon de Montfort's parliament in 1265, and acted as justiciar throughout the earl's dictatorship. Despensers were killed at Evesham in Aug. 1265.

See C. Bémont, *Simon de Montfort* (Paris, 1884), T. F. Tout in *Oxford Historical Essays*, pp. 76 ff. (Manchester, 1902).

DESPENSER, HUGH LE (1262-1326), English courtier, was a son of the justiciar, fought for Edward I. in Wales, France and Scotland, and in 1295 was summoned to parliament as a baron. Ten years later he was sent by the king to Pope Clement V. to secure Edward's release from the oaths he had taken to observe the charters in 1297. Almost alone Hugh spoke out for Edward II's favourite, Piers Gaveston, in 1308, but after Gaveston's death in 1312 he himself was the king's chief adviser until Edward's defeat at Bannockburn in 1314. Then, hated by the barons, and especially by Earl Thomas of Lancaster, as a deserter from their party, he was driven from the council, but was quickly restored to favour and loaded with lands and honours, being made earl of Winchester in 1322. Before this time Hugh's son, the younger Hugh le Despenser, had become associated with his father, and was enjoying a still larger share of royal favour. About 1306 this baron had married Eleanor (d. 1337), one of the sisters and heresses of Gilbert de Clare, earl of Gloucester, who was slain at Bannockburn, and after a division of the immense Clare lands had been made in 1317 violent quarrels broke out between the Despensers and the husbands of the other heiresses, Roger of Amery and Hugh of Audley. Intervened with this dispute was another between the younger Despenser and the Mowbrays, who

were supported by Humphrey Bohun, earl of Hereford, about some lands in Glamorganshire. Fighting having begun in Wales and on the Welsh borders, the English barons showed themselves decidedly hostile to the Despensers, and in 1321 Edward II was obliged to consent to their banishment. The elder Hugh left England for a time, but father and son were soon again at court. They fought against the rebellious barons at Boroughbridge, and after Lancaster's death in 1322 they practically ruled the country. But their next enemy, Queen Isabella, was more formidable, or more fortunate, than Lancaster. Returning from France in 1326 the queen directed her arms against her husband's favourites. The elder Despenser was seized at Bristol, where he was hanged on Oct. 27, 1326, and the younger was taken with the king at Llantrissant and hanged at Hereford on Nov. 24. The attainer against the Despensers was reversed in 1398. The intense hatred with which the barons regarded the Despensers was due to the enormous wealth which had passed into their hands, and to the arrogance and rapacity of the younger Hugh. The younger Despenser left two sons, Hugh (1308-49), and Edward, who was killed at Vannes in 1342.

The latter's son EDWARD LE DESPENSER (d. 1375) fought at the battle of Poitiers, he was a patron of Froissart, who called him *le grand sire Despensier*. His son, THOMAS LE DESPENSER (1373-1400), the husband of Constance (d. 1416), daughter of Edmund of Langley, duke of York, supported Richard II. against Thomas of Woodstock, duke of Gloucester, and the other lords appellant in 1397, when he himself was created earl of Gloucester, but he deserted the king in 1399. Then, degraded from his earldom for participating in Gloucester's death, Despensers joined the conspiracy against Henry IV, but he was seized and executed by a mob at Bristol in January 1400.

The elder Edward le Despenser left another son, HENRY (c. 1341-1406), who became bishop of Norwich in 1370. In early life Henry had been a soldier, and when the peasants revolted in 1381 he took readily to the field, defeated the insurgents at North Walsham, and suppressed the rising in Norfolk with some severity. Pope Urban VI in 1382 employed him to lead a crusade in Flanders against the supporters of the anti-pope Clement VII. After capturing several towns he was checked at Ypres, and defeated by the French. On his return the bishop was impeached and deprived of his lands, Richard II, however, stood by him. Almost alone among his peers Henry remained true to Richard in 1399, he was then imprisoned, but was quickly released. He died on Aug. 23, 1406. Despensers was an active enemy of the Lollards, whose leader, John Wycliffe, had fiercely denounced his crusade in Flanders.

The barony of Despenser, called out of abeyance in 1604, was held by the Fances, earls of Westmorland, from 1626 to 1762, by the notorious Sir Francis Dashwood from 1763 to 1781, and by the Stapletons from 1788 to 1891. In 1891 it was inherited, through his mother, by the 7th Viscount Falmouth.

DES PÉRIERS, BONAVENTURE (c. 1500-1544), French author, was born of a noble family at Armay-le-duc in Burgundy at the end of the 15th century. In 1533 or 1534 Des Périers visited Lyons, then the most enlightened town of France, and a refuge for many liberal scholars. He gave some assistance to Robert Olivetan and Lefèvre d'Étaples in the preparation of the vernacular version of the Old Testament, and to Étienne Dolet in the *Commentarii linguae latinae*. In 1536 he put himself under the protection of Marguerite d'Angoulême, queen of Navarre, who made him her *valet de chambre*. He acted as the queen's secretary, and transcribed the *Heptameron* for her. It is probable that his duties extended beyond those of a mere copyist, and some writers have gone so far as to say that the *Heptameron* was his work. The free discussions permitted at Marguerite's court encouraged a licence of thought as displeasing to the Calvinists as to the Catholics. This free enquiry became scepticism in Bonaventure's *Cymbalum Mundi* (1537), and the queen of Navarre disavowed the author, though she continued to help him privately until 1541. The book consisted of four dialogues in imitation of Lucian. Its allegorical form did not conceal its real meaning, and the Sorbonne secured the suppression of the edi-

tion (c 1538) before it was offered for sale. The book was reprinted in Paris in the same year. It made many bitter enemies for the author. Henri Estienne called it *détestable*, and Étienne Pasquier said it deserved to be thrown into the fire with its author if he were still living. Des Prés prudently left Paris, and settled at Lyons, where in 1544 he put an end to his existence by falling on his sword. In 1544 his collected works were printed at Lyons. The volume, *Recueil des oeuvres de Jean Bonaventure des Prés*, includes his poems, which are of small merit, the *Traté des quatrains verus cardinales après Sénèque*, and a translation of the *Lysis* of Plato. In 1558 appeared at Lyons the collection of stories and fables entitled the *Novelles récréations et joyeux devis*, the work on which his fame rests. Some of the tales are attributed to the editors, Nicholas Deniset and Jacques Pelletier, but their share is certainly limited to the later ones. The stories are models of simple, direct narration in the vigorous and picturesque French of the 16th century.

His *Oeuvres françaises* were published by Louis Lacour, 2 vol. (Paris, 1856). See also the preface to the *Cymbalum Mundi*, ed. by F. Franck (1874); A. Chenevère, *Bonaventure Després; sa vie, ses poésies* (1885); and P. Toldo, *Contributo allo studio della novella francese del XV. e XVI. secolo* (Rome, 1895).

DES PLAINES, a city of Cook county, Ill., U.S., on the Des Plaines river about 17 mi N.W. of Chicago. It is on federal highways 12, 14 and 45 and is served by the Chicago and North Western and Soo railways. The population was 14,975 in 1950 and 9,578 in 1940 by the federal census. Founded in the 1830s and originally called Rand after the first settler,ocrates Rand, it adopted its modern name in 1869 after the river flowing through the community. The municipal government is of the mayor council type, the waterworks are municipally owned and operated. There is some industry, including electrical appliance and tool manufacturing, and extensive greenhouses, although many of the employed are commuters to Chicago.

In 1860 the city became the site of a Methodist encampment which, occupying a wooded area along the river, has many summer homes, a large auditorium and a swimming pool.

DESPORTES, PHILIPPE (1546-1606), French poet, was born at Chartres in 1546. As secretary to the bishop of Le Puy he visited Italy, where he gained a knowledge of Italian poetry. He then attached himself to the duke of Anjou, and followed him to Warsaw on his election as king of Poland. Nine months in Poland satisfied the civilized Desportes, but in 1574 his patron became king of France as Henry III and gave the poet the abbey of Tiron and four other valuable benefices. A good example of the light and dainty verse in which Desportes excelled is furnished by the well-known villanelle with the refrain "Qui premier s'en repentira," which was on the lips of Henry, duke of Guise, just before his tragic death. Desportes imitated Petrarch, Lodovico Ariosto, Jacopo Sannazaro and still more closely the minor Italian poets, and in 1604 a number of his plagiarisms were exposed in the *Reconcontres des Muses de France et d'Italie*. As a sonneteer he showed much grace and sweetness, and English poets borrowed freely from him. In his old age Desportes prepared a translation of the Psalms remembered chiefly for the brutal motif of *Malherbe*. *Votre potage vaut mieux que vos passions*. Desportes died on Oct. 5, 1606, leaving the reputation of the courtier poet.

BIBLIOGRAPHY—Desportes had published in 1573 an edition of his works including *Diane*, *Les Amours d'Hippolyte*, *Élégies*, *Bergeries*, *Oeuvres chrétiennes*, etc. A splendid edition printed by Étienne appeared in 1579. An edition of his *Oeuvres*, by Alfred Michiels, was published in 1858.

DESPOT, in Greek usage the master of a household, hence the ruler of slaves (Gr *despotēs*, lord or master). It was also used by the Greeks of their gods, but was principally applied to the absolute monarchs of the eastern empires, and it is in this sense that the word, like its equivalent "tyrant," is in current usage for an absolute sovereign whose rule is not restricted by any constitution. In the Roman empire of the east "despot" was used as a title of honour or address of the emperor, and later of his sons, brothers and sons-in-law. Later still it was adopted by the vassal princes of the empire. This gave rise to the name "despotats" applied to the tributary states which survived the

breakup of the empire in Epirus, Cyprus, Trebizond, etc.

Under Ottoman rule the title was preserved by the despots of Serbia, etc.

DES PRES, JOSQUIN (c 1445-1521), also called **DEPREZ** or **DESPREZ**, and by a latinized form of his name, **JODOBUS PRATENSI** or **A PRATO**, French musical composer, was born, probably in Condé in the Hennegau, about 1445. He was a pupil of Joannes Okeghem, and himself one of the most learned musicians of his time. In spite of his great fame, the accounts of his life are vague and the dates contradictory. In his early youth Josquin seems to have been a member of the choir of the collegiate church at St. Quentin, when his voice changed he took lessons in counterpoint from Okeghem, afterward he again lived at his birthplace for several years and probably spent some time at various Italian courts until he joined the papal chapel in Rome in 1486. In Rome Des Prés lived till 1494, and it was there that many of his works were written. He was considered by his contemporaries to be the greatest master of his age. Martin Luther, who was a good judge, is credited with the saying that "other musicians do with notes what they can, Josquin what he likes." The composer's journey to Rome marks in a manner the transference of music's headquarters from the north to Italy, which for the next two centuries remained the centre of the musical world. To Des Prés and his pupils Jacob Arcadelt, Jean Mouton and others, much that is characteristic in modern music owes its rise, particularly in their influence upon Italian developments under Palestrina. After leaving Rome Josquin accepted an invitation of King Louis XII of France to become the chief singer of the royal chapel. He was also, for a time at least, in the service of the emperor Maximilian I, and at the time of his death, on Aug. 27, 1521, was a canon of the cathedral of Condé.

The most complete list of his compositions—consisting of masses, motets, psalms and other pieces of sacred music—will be found in F. Fétis. The largest collection of his ms. works, containing no fewer than 20 masses, is in the possession of the papal chapel in Rome. During the 17th and 18th centuries Josquin's value was ignored, nor does his work appear in the collections of G. Martini and G. Paolucci. C. Burney was the first to recover him from oblivion, and J. Forkel continued the task of rehabilitation. A. Ambros furnishes an exhaustive account of his achievements. An account of Josquin's art will be found in the article "Josquin," by the Rev. J. R. Malm in Grove's *Dictionary of Music and Musicians*, 3rd ed., vol. 1. An edition of the complete works of Josquin was undertaken by the *Vereeniging voor Noord-Nederlandse Musiekgeschiedenis* under the editorship of A. Smeyers. Seventeen of Josquin's masses were published during his lifetime by Perrucci (1502-16), and two others in 1539 by Johannes Ott at Nuremberg. Many of his motets were printed in various collections, notably in Commers's *Collectio operum musicorum Batavorum* (12 vol., 1840), and another selection of his works was edited by R. Elner.

DESPRES, SUZANNE (1875-), French actress, was born at Verdun, and trained at the Paris Conservatoire. She then became associated with, and subsequently married, Aurelien Lugné-Poe, the actor-manager, who had founded a new school of modern drama, L'Œuvre, and she had a brilliant success in several plays produced by him. In succeeding years she played at the Gymnase and at the Porte Saint Martin, and in 1902 made her début at the Comédie Française, appearing in *Phédre* and other important parts.

DESRUES, ANTOINE FRANÇOIS (1744-1777), French poisoner, was born at Chartres in 1744, of humble parents. He went to Paris to seek his fortune, and started in business as a grocer. He was known as a man of great piety and devotion, and his business was reputed to be a flourishing one, but when, in 1773, he gave up his shop, his finances, because of personal extravagance, were in a deplorable condition. Nevertheless he entered into negotiations with a Madame de la Mothe for the purchase from her of a country estate, and when the time came for the payment of the purchase money, invited her to stay with him in Paris pending the transfer. While she was still his guest, he poisoned

first her and then her son, a youth of 16. Then, having forged a receipt for the purchase money, he endeavoured to obtain possession of the property. But by this time the disappearance of Madame de la Mothe and her son had aroused suspicion. Desrues was arrested, the bodies of his victims were discovered, and the crime was brought home to him. He was tried, found guilty and condemned to be torn asunder alive and burned. The sentence was carried out (1777). Desrues repeating hypocritical protestations of his innocence to the last. The whole affair created a great sensation at the time, and as late as 1828 a dramatic version of it was performed in Paris.

DESSAUX, JOSEPH MARIE, COUNT (1764-1834), French general, was born at Thonon, Haute Savoie, on Sept. 24, 1764. He studied medicine, took his degree at Turin and then went to Paris, where in 1789 he joined the national guard. In 1791 he tried without success to raise an *émeute* in Savoy. In 1792 he organized the "legion of the Allobroges," and served at the siege of Toulon, in the army of the eastern Pyrenees and in the army of Italy. Dessaux was elected a member of the council of five hundred, and opposed the coup d'état of the 18th Brumaire (Nov. 9, 1799). Promoted general of brigade in 1803, he fought at Wagram (1809), was made general of division and in 1810 a count. He took part in the expedition to Russia, and was for some time commandant of Berlin. He joined Napoleon in the hundred days, and in 1816 was imprisoned for five months. He died on Oct. 26, 1834.

See *Le Général Dessaux, sa vie politique et militaire*, by his nephew Joseph Dessaux (Paris, 1879).

DESSAU, the capital city of the *Land* of Anhalt, Germany, on the left bank of the Mulde, 2 mi. from its confluence with the Elbe, 67 mi S.W. from Berlin and at the junction of lines to Cöthen and Zerbst. Pop. (1939), 120,744.

Dessau, probably founded by Albert the Bear, had attained civic rights as early as 1213. It grew into importance at the close of the 17th century, after the religious emancipation of the Jews in 1686, and of the Lutherans in 1697.

Apart from the old quarter on the Mulde, the town is well built with spacious squares such as the Grosse Markt and the public buildings of a capital. The Schlosskirche is adorned with paintings by Lucas Cranach, in one of which ("The Last Supper") are portraits of several reformers. The former ducal palace, standing in extensive grounds, contains a collection of historical curiosities and a gallery of pictures, which includes works by Cimabue, Fra Filippo Lippi, Peter Paul Rubens, Titian and Sir Anthony Van Dyck. The Amalienstift also has a picture gallery. Dessau manufactures sugar, chocolate, chemicals, small iron goods and machinery, various household objects and some textiles. There is also a considerable trade in corn and garden produce. Because of its arid soil, its importance as a railway centre and as the seat of the great Junkers plane factory, Dessau was frequently bombed by the British in World War II.

DESSEWFY, AUREL, COUNT (1808-1842), Hungarian journalist and politician, eldest son of Count József Dessewffy and Eleonora Szatmari, was born at Nagy-Mihály, County Zemplén, Hung. Carefully educated at his father's house, he was accustomed to the best society of his day. While still a child he could declaim most of the *Iliad* in Greek without a book, and read and quoted Tacitus with enthusiasm. He regularly accompanied his father to the diets of which he was a member, followed the course of the debates, of which he kept a journal, and made the acquaintance of Count Stephen Széchenyi, who encouraged his aspirations. On leaving college, he entered the royal aulic chancery, and in 1832 was appointed secretary of the royal stadtholder at Buda. The same year he turned his attentions to politics and was regarded as one of the most promising young orators of the day, especially during the sessions of the diet of 1832-36, when he had the courage to oppose Lajos Kossuth. At the Pressburg diet in 1840 Dessewffy was already the leading orator of the more enlightened and progressive Conservatives, but incurred great unpopularity for not going far enough, with the result that he was twice defeated at the polls. But his reputation in court circles was increasing, he was appointed a member

of the committee for the reform of the criminal law in 1840, and the same year, with a letter of recommendation from Metternich in his pocket, visited England and France, Holland and Belgium, made the acquaintance of Louis Thiers and Heinrich Heine in Paris, and returned home with an immense and precious store of practical information. He at once proceeded to put fresh life into the despondent and irresolute Conservative party and the Magyar aristocracy by gallantly combating in the *Világ* the opinions of Kossuth's paper, the *Pesti Hírlap*. But the multiplicity of his labours was too much for his feeble physique, and he died on Feb. 9, 1842.

DESSOIR, LUDWIG (1810-1874), German actor, whose name was originally Leopold Dessauer, was born on Dec. 15, 1810, at Posen, the son of a Jewish tradesman. He made his first appearance on the stage there in 1824 in a small part. After some experience at the theatre in Posen and on tour, he was engaged at Leipzig from 1834-36. In 1836 he was at the Breslau municipal theatre, and during 1837-39 at Budapest. From there he went to Karlsruhe and in 1847 to Berlin where his success in *Othello* and *Hamlet* won him a permanent engagement at the Hof theatre. In 1853 he appeared in London. He retired in 1872 and died on Dec. 30, 1874, in Berlin. Dessoir was twice married, by his first wife he had one son, the actor Ferdinand Dessoir (1836-92). In spite of certain physical disabilities Ludwig Dessoir's genius raised him to the first rank of actors, especially as an interpreter of Shakespeare's characters. G. H. Lewes placed Dessoir's *Othello* above that of Edmund Kean, and the *Athenaeum* preferred him in this part to Brooks or W. Macready.

DE STEFANI, ALBERTO (1879-), Italian economist and statesman, was born at Verona on Oct. 6, 1879. Educated at the University of Padua he became professor of political economy at the Superior Commercial Institute of Venice. In 1921 he was returned to the chamber as a Fascist and was Mussolini's first minister of finance. Later he was also entrusted with the treasury department and welded the two into a single ministry. He abolished useless expenditure and simplified the fiscal system, reducing innumerable taxes to three main sources of revenue, with the result that, in three years a deficit of 6,500,000,000 lire was converted into a surplus of 209,000,000. His measures for restraining speculation in the currency and stock markets during the financial slump in the spring of 1925 were less successful, he lost the confidence of the banking community, and in July was superseded by Count Giuseppe Volpi.

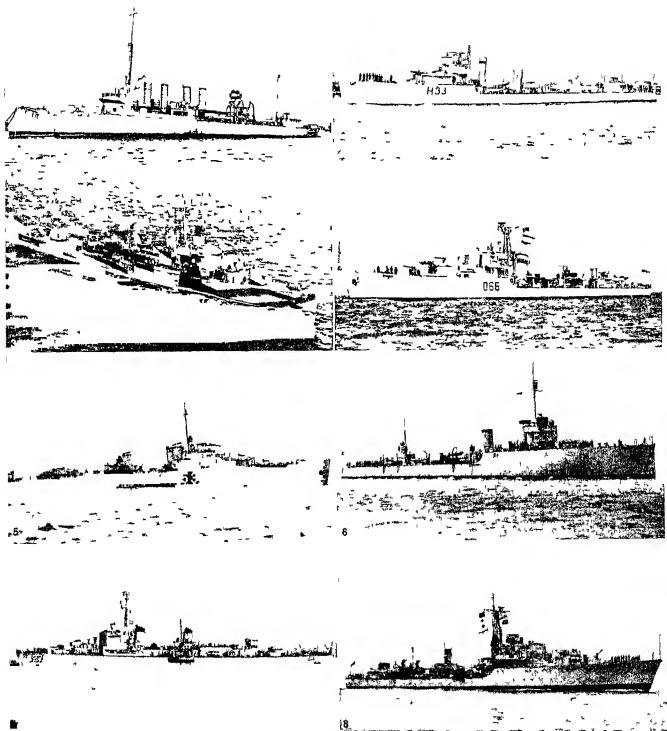
DESTOUCHES, PHILIPPE (1680-1754), French dramatist, whose real name was Néricault, was born at Tours. He was attached successively to the French embassies in Switzerland and in London, and married a Lancashire lady, Dorothea Johnston. On his return to France (1723) he was elected to the Academy. He died July 4, 1754. His early comedies were *Le Curieux im pertinent* (1710), *L'Ingrat* (1712), *L'Irrésolu* (1713) and *Le Médisant* (1715). The best of these is *L'Irrésolu*, in which Dorante, after hesitating throughout the play between Julie and Célimène, marries Julie, but concludes with the reflection — "J'aurais mieux fait, je crois, d'épouser Célimène."

After 11 years of diplomatic service Destouches returned to the stage with the *Philosophe marié* (1727), followed in 1732 by his masterpiece *Le Glorieux*, a picture of the struggle then beginning between the old nobility and the wealthy *parvenus* who found their opportunity in the poverty of France. Among his later comedies may be mentioned *Le Tambour nocturne* (1736), *La Force du naturel* (1750) and *Le Dissipateur* (1736).

His works were issued in collected form in 1755, 1757, 1811 and, in a limited edition (6 vol.), 1822. See J. Graziano, *Essai sur la vie et les œuvres de Destouches* (1889), A. Burner, *Destouches et ses comédies* (1906), J. Hankins, *Philippe Néricault Destouches, l'homme et l'écrivain* (1918).

DESTROYER. The modern destroyer, one of the most versatile of combat vessels, was the product of approximately 50 years of evolution in naval design. During that time, it grew from a small 200-ton ship built to repel torpedo boats to 2,000- or 3,000-ton craft capable of dealing destruction to anything afloat, under the sea or in the air.

It was not until the latter part of the 19th century brought



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DESTROYERS OF THE 20TH CENTURY

- 1 USS *Waters*, flush deck destroyer of World War I Displacement 1,090 tons
- 2 HMS *Vanecko*, a World War I destroyer of the Admiralty V class Displacement 1,090 tons
- 3 USS *Maddox*, destroyer of the Allen M. Sumner class representative of the World War II period Displacement 2,200 tons
- 4 HMS *Zambesi*, World War II destroyer Displacement 1,710 tons
- 5 The German destroyer *Hans Ludemann*, which was sunk by HMS *Warspite*, and British destroyers in the second battle of Narvik, 1940 Displacement 1,811 tons
- 6 The Italian destroyer *Leone*, sunk by British naval aircraft in the Red Sea 1941 Displacement 1,526 tons
- 7 USS *Robert A. Owens*, escort destroyer of the Carpenter class completed after World War II and fitted with electronic equipment and armament for anti-submarine activity Displacement 2,500 tons
- 8 HMS *Battleaxe*, post World War II anti-submarine destroyer

great improvements in the manufacture of high powered explosives that the destroyer had its beginning. With improved explosives, the underwater torpedo became a definite menace to even such large ships as battleships, and to carry the torpedoes to their targets, small, fast torpedo boats were built. It soon became apparent that the best defense against torpedo boats was more small, faster boats, and these craft were classified as torpedo-boat destroyers. Through a process of continued improvement in design, resulting in increased speed, power and armament, the torpedo boat destroyer eventually eliminated the torpedo boat (at least for many years) and took over its duties, becoming known as the destroyer.

First such vessels built for the U.S. navy were a group of sixteen 420-ton boats, authorized during the Spanish American War. All coal burners, they were stricken from the navy list in 1920, by which time the destroyer building program had progressed through eight classes and the navy was then sailing the famous World War I flush deck destroyers, or "four pipers" as they were called by destroyer sailors even during World War II. The World War I building program saw the completion of 111 "Wickes" class and 126 "Clemson" class destroyers, many of which were still in service in modified form at mid-20th century as mine sweepers or high speed transports. Although World War I operations against Germany in the Atlantic gave the destroyers very little actual combat, it was a testimonial to U.S. shipbuilding practice and naval training that these destroyers were still in fighting trim 25 years later, as was particularly evidenced by some of them in brilliant action against superior Japanese forces in the Java Sea campaign early in 1942. Fifty of these two types were transferred to Great Britain in 1940, in which service nine were lost in wartime action, and in 1944 ten of those remaining were again transferred, this time to the USSR.

With the addition to the fleet, commencing in 1934, of the "Farragut" class ships, the destroyer building program received continued attention and acceleration, until the end of World War II in 1945. During that time construction had progressed through 14 additional classes, and approximately 600 destroyers were in service when the war ended.

U.S. destroyers are named for deceased naval, marine and coast guard personnel who rendered distinguished service, secretaries and assistant secretaries of the navy, members of congress and inventors closely connected with naval affairs, while destroyer escorts commemorate personnel of the aforementioned services killed in enemy action in World War II. From such famous naval men as Stephen Decatur, Isaac Hull, James Lawrence and Thomas Truxtun, the roster of destroyer and escort names runs through history to Destroyer 537, the "Sullivans," named for five brothers lost on the cruiser "Juneau" in the Solomon campaign.

Originally planned as a single purpose craft and designed to operate in divisions and squadrons, usually in support of larger fleet units, the destroyer's evolution into a craft of unlimited abilities had commenced well before World War I. Convoy escort and submarine warfare had been added to their duties in World War I, the latter duty depending on underwater listening devices and depth charge attack. Development of carrier aviation made plane guard destroyers a necessary part of carrier operations, where they served as antisubmarine screen and performed rescue work in case of crashes. Protection of the slower-moving battle line was accomplished by destroyer-laid smoke screens and by torpedo attack against opposing light forces.

Because of rapid technical advances in many fields of naval warfare, the modern destroyer was a different and far more dangerous ship than the earlier types. Probably the least changed of its weapons were the depth charges, or "ash cans," the principal antisubmarine threat. Submarine warfare, however, was greatly intensified by the use of radar and sonar, which enabled destroyers to track submarines in any condition of weather or visibility, whether surfaced or submerged, while radiotelephone communications made it possible for several destroyers to corner a submarine and subject it to highly concentrated depth charge attack. The effectiveness of such tactics was reflected in a compilation

of Japanese war losses, which credited United States destroyers with sinking 47 out of 130 submarines lost as a result of all Allied action.

Destroyer fire power, greatly increased by rapid-firing 5-in. guns effective against either surface or aerial targets and controlled from a central location through "director fire," was made still more deadly by the use of radar and proximity-fused shells. The installation of many automatic firing 20 and 40 mm guns enabled destroyers to put up a fierce anti aircraft fire, which took no small toll of enemy aircraft.

Improved torpedoes, with greater range at higher speed, plus improved fire control systems and more effective detonators, gave destroyers a new "Sunday punch" effective against anything afloat, the best example of this occurred in the battle of Surigao Strait during the Philippine occupation, when the Japanese battleship "Yamato" went down under a destroyer torpedo attack.

In the most outstanding World War II innovation of naval warfare, the amphibious landings, destroyers again proved invaluable. Because of their shallow draught and high maneuverability, they were able to operate with comparative safety in waters dangerous for heavier vessels, where their high-powered and accurate fire was used in pin point shore bombardment. For the same reasons, destroyers were able to carry out rescue operations impossible for larger ships, notably evacuations of troops at Normandy and Crete by British destroyers, and the rescue of 1,000 survivors of the U.S. cruiser "Helena" from a Japanese-held island in the Pacific.

In postwar conversions of destroyer-type vessels, the U.S. navy developed another destroyer modification, called the destroyer-hunter killer. Twelve such vessels were completed during late 1949 and early 1950. In general appearance, the hunter-killers closely resembled other ships in their class, but were considerably altered to fit them for antisubmarine warfare. In addition to usual destroyer armament, they carried various fittings and devices still in the experimental stage. They were designed for use in hunter killer teams, consisting usually of several destroyers, an aircraft carrier with embarked planes and possibly a heavy patrol plane or lighter-than-air ship, all working together in a highly organized group.

Stripped of its outer covering, a destroyer proves to be a hull almost filled with machinery and little else. Four oil-fired high-pressure steam boilers produce steam at pressures up to 600 lb per square inch. Superheated to 850° F, the steam is fed to turbines developing up to 50,000 h.p., which drive twin screws through reduction gears. Evaporators and condensers transform sea water into fresh water for the boilers. Dynamos provide electrical current to train the guns, hoist ammunition and boats, diesel driven generators provide power if the dynamos fail. A myriad of pumps and thousands of feet of pipe carry oil and water to the boilers, salt water to ballast tanks and various fire-fighting stations, and fresh water throughout the ship for various uses. Powerful electrical blowers keep up air pressure in the firerooms and other blowers ventilate the ship. Complicated and intricate electrical and electronic devices steer the ship, aim and fire guns and torpedoes, maintain radar watch for planes and other ships, make sonar search for submarines, and navigate the ship by use of loran and dead reckoning tracers. A telephone system provides communication throughout the ship, while radio phones keep it in communication with other ships and planes.

Although much was added to the destroyer during the course of its development, little was left off, the hull is so packed with machinery that provision for the crew appears to have been made only as an afterthought. While admittedly crowded, destroyer quarters are, in themselves, no less comfortable than those of other ships.

Destroyer types, in various modifications, are included in all navies, but their characteristics vary with the strategic situations which they may be expected to encounter. France and Italy, for instance, with a limited sphere of naval influence, favoured high speed ships, while Great Britain and the United States, with protection of ocean commerce and long sea lanes in mind, tended to sacrifice some speed for greater cruising radius. Destroyer

Comparison of U S Destroyer Types with Types Constructed by Other Nations

| Type | United States | | Great Britain | | France | Italy |
|----------------|---------------|--------------|-------------------|--------------|--------------|--------------|
| | Fletcher | Gearing | Battle | Daring | Le Fantasque | Granatiero |
| Number built | 173 | 105 | 24 | 8 | 4 | 2 |
| Building years | 1940-42 | 1942-43 | 1944-46 | 1946-47 | 1911-14 | 1918 |
| Overall length | 175 ft 4 in | 300 ft 5 in | 370 ft | 300 ft | 435 ft | 330 ft |
| Beam | 40 ft 10 in | 40 ft 10 in | 40 ft 3 in | 41 ft | 30 ft 6 in | 31 ft 5 in |
| Displacement | 60 000 | 60 000 | 50 000 | (6) | 74 000 | 16 000 |
| Speed in knots | 35 plus | 35 plus | 34 | 34 | 37½ | 30 |
| Displacement | 2 000 tons | 2 000 tons | 2 315 tons | 2 630 tons | 2 550 tons | 1 650 tons |
| Armament | five 5 in | five 5 in | four or five 5 in | size 4.5 in | five 5 in | five 4.7 in |
| | ten 21 in TT | ten 21 in TT | ten 21 in TT | ten 21 in TT | eight 40 mm | six 37 mm |
| | | | | | two 13 mm | six 21 in TT |

* Installations of 50- and 40-mm batteries vary.

† For Fletcher class ships originally had one torpedo tube mount removed replaced by catapult for seaplane. Aircraft were later removed and ships altered to conform to term of class.

†† The "Le Terrible" of this class averaged 43 knots for eight hours.

††† Not announced.

building in the United States and Great Britain and, for a while, Japan, was limited by terms of the London Naval treaty, while Italy and France, not so limited, tended to build larger ships. Destroyers ranging from 2,500 to 3,500 tons were serving with Italian, French, Japanese, Netherlands and Russian fleets during World War II. Japan lost 134 destroyers during the war, and Italy lost 131. The United States lost 84 of all classes.

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DESTRUCTORS This term is applied, particularly in England, by municipal engineers, to a battery of high-temperature furnaces constructed for disposing, by burning, of household and town refuse. Messrs Manlove, Alliott and Co, of Nottingham, first registered the word destructor as its special trade name for such a furnace. (For developments in the United States, see REFUSE DISPOSAL.) The first destructor built by this firm under Fryer's patent was erected in Manchester in 1874. Disposal of refuse is not, however, the only consideration. Utilization of refuse as fuel for steam production is also important. Many towns systematically utilize the calorific value of refuse.

A proper degree of caution, however, should be exercised when contemplating the use of refuse as a low grade fuel. When its value for this purpose was first recognized it was believed that the refuse of a given population was of itself sufficient to develop the necessary steam-power for supplying that population with their electric lighting requirements. The supposed economic importance of a combined destructor and electric undertaking of this character possibly had much to do, in some districts, with the development both of the adoption of the principle of dealing with refuse by fire and of lighting by electricity. Engineering experience, however, very often has shown this to be impractical. But, under favourable circumstances, determining the merits in each case, useful service to other power-using undertakings, such as sewage pumping, clinker crushing plants, etc., may be obtained.

Composition of Refuse.—The composition of house refuse, which obviously affects its calorific value, varies widely in different districts. The following is an analysis of refuse as dealt with in destructors, based on the average of 12 towns in Great Britain. The percentages of the various constituents are as follows—fine dust 45.45, 4 in to 2 in and large cinders 36.16, bricks, pots, shale, etc., 6.5, tins 1.3, rags 54, glass 83, bones 0.9, vegetable refuse 4.05, scrap iron 42, paper 2.26, fish offal, greens, small paper bags, carpet, oil cloth, boots, etc., 2.4 per cent.

In London, the quantity of house-refuse amounts approximately to from 4 cwt. to 5 cwt. per head per annum, or to from 200 to 250 tons per 1,000 of the population per annum. Statistics, however, vary widely in different districts. At Ipswich 7 cwt. per 1,000 of the population per working day are collected, whereas, at Merthyr Tydfil 40 cwt. per 1,000 people per day are produced. Recent data show the normal quantity collected to lie between 15 and 20 cwt. per 1,000 people per day. When estimating the required capacity of a destructor plant, the quantity of refuse produced

by the particular town in question must first be independently investigated, and all calculations based accordingly.

A cubic yard of ordinary house-refuse weighs from 12 to 15 cwt. but varies according to its condition whether wet or dry, etc. Shop refuse often consists largely of paper, packings, straw and cardboard. Its weight may be as little as 7 cwt. per cubic yard.

Methods of Disposal.—Various methods of disposal of refuse are adopted by different towns according to local facilities and

conditions. Owing to the high costs involved after World War I in the working of refuse destructors, a system of controlled tipping upon suitable land has been largely resorted to, notably at Bradford, where some 45 tips within the city boundaries are in use. The refuse is spread in layers of about 8 ft in depth and regularly covered with soil. By this means waste land, old quarries, etc., are reclaimed for future use as parks and open spaces. Pulverization of refuse has been adopted in some towns. The refuse is crushed to a small gauge, and where possible disposed of as manure, but the difficulty of securing a reliable market is usually considerable. When obtained such markets are not to be relied upon with any certainty of continuity. Another means of disposal is by the separation or salvage system. In this case the dust, cinders, paper, rags, glass, metals, tins, etc., are all separately sorted out and sold where markets can be found. The vegetable and other putrescible constituents are burned. The handling and redistribution of refuse material in this way amongst the population cannot be regarded with favour in the interests of public health. Disposal at sea and sinking in deep water are also practised, but is often rather costly and sometimes unsatisfactory.

The Destructor System.—The destructor system in which the refuse is burned to an innocuous cinder in specially constructed high-temperature furnaces is that which is most generally resorted to when other methods have proved unsatisfactory, especially in districts which have become well built up and thickly populated. Conditions regarding this method of disposal have, however,

neating stoves, the high price of coal and the more economical habits of householders, have all contributed to the production of house refuse with a smaller proportion of cinders and scraps of coal, thereby resulting in a low calorific value, and also a poorer quality of clinker from the destructor furnace. At Farnborough it was found that the calorific value of refuse was about 50% less than in pre-World War I days, and there was similar experience at Southampton, Hull and elsewhere.

Many of the earlier destructor and electricity station combinations have not proved satisfactory for various reasons, and have been abandoned. One difficulty often experienced has been that of maintaining a steady and reliable steam pressure with so variable and uncertain a fuel.

A number of destructor-electric combinations are, however, working satisfactorily in districts where the local conditions are favourable, as at Rhondda, Wolverhampton and Pontypool. At Rhondda and Pontypool the refuse is of a high calorific value, and contains a relatively large percentage of small coal and unburnt cinders. During an official test, the Rhondda destructor (Heenan and Froude) evaporated 4.15 lb of water per 1 lb of refuse burned from and at 212°. This destructor was erected

In 1915, and the South Wales Power Co purchased the electric current produced at this installation. The electrical energy generated is equal to 264 units per ton of refuse burnt.

The electrical output at the Rhondda destructor plant has not been equalled by any combined destructor and electric station. Other power-using services to which the surplus heat from a destructor is applied include the pumping of low level sewage, as carried out at Salisbury, Lincoln, Cambridge, Watford, Eastbourne, Luton, Felixstowe, Aldershot and Twickenham.

During recent years, the question of high running costs at destructor installations has been under careful review by many British public authorities, and many destructors have either been discontinued or rendered of limited service.

Conditions for Destructor System—As regards the general question of the advisability or otherwise of erecting a destructor, each town should decide for itself, according to the local conditions and requirements. It is a question upon which it is unwise to generalize, but when considering the matter, some leading points to be kept in view are: (a) Is the district so closely built up and congested as to render all other less costly means of disposal impracticable, thus rendering the expense of a destructor necessary as a last resort? (b) Has the refuse sufficient calorific value to justify its use for steam raising purposes, and are there any necessary local services, such as sewage pumping, upon which the heat from the destructor can be profitably utilized, and thus save the cost of coal as a set off against the heavy working expenses? (c) Are any local markets available for the sale of surplus clinker, tins, etc.? (d) Can a suitable central site for a destructor be found in a populated area without involving additional expense in haulage to some outlying site, or causing nuisance from smells, dust, and the concentrated cartage of refuse, to the neighbouring inhabitants? (e) Can the existing system of disposal be carried on without risk of real danger (as distinguished from sentiment) to the public health? If not, the installation of a destructor must then be seriously considered.

Although the conditions arising out of the World War placed a check in Great Britain, in the United States and on the Continent upon the laying down of new destructor installations, and the maintenance of existing plants, the past few years have shown a renewal of activity in this direction.

Notwithstanding high capital costs and working expenses, necessity arising out of local conditions has led to the erection of new plants at Birmingham, Hornsey, Devonport, Rochdale, Wimbledon, Portsmouth, Brighton, Llandudno, East Ham, Hastings, Leicester, Leeds, Hereford, Accrington, Coventry, Edinburgh, Perth, Stoke, New York, Gibraltar and elsewhere.

Modern Equipment—A modern installation usually includes, in addition to the leading feature of the destructor cells or furnaces, a mechanical power driven plant used in connection with the preliminary screening of the refuse and comprising screens, elevators, etc., for the removal of dust up to about $\frac{1}{2}$ in gauge, an overhead runway for conveyance of hot clinkers from the furnace mouths, and storage accommodation for raw refuse for use when the collectors are not at work.

For the removal of tins and iron from the raw refuse electromagnetic separators are frequently installed where these materials have a marketable value. The tins are reduced in bulk to convenient blocks by means of a hydraulic baling-press. Clinker from the furnaces is reduced to saleable form by suitable clinker-crushing and screening plants. Other accessory machinery includes a strongly built mortar mill and a hydraulic press for the manufacture of slab-paving in order to utilize the surplus clinker, a power driven fan with air-ducts for the supply of forced draught to the cells. Machinery for the manufacture of asphalt from clinker for the surfacing of roadways is in some cases also installed, as, e.g., at Brighton and Aberthaw. The motive-power for actuating all this accessory plant at the destructor station, including an electric lighting equipment, is usually economically obtainable from the surplus heat from the cells when applied to the generation of steam in a suitable boiler.

Forced Draught—The forced draught to destructor cells may be given by an air fan or by steam blast. The air fan will

require to work at about 6 in total water-gauge pressure, and to give from 2 in to 3 in of pressure in the ashpit itself. The actual pressure will vary according to the thickness of the fires being burnt at any given time. The power required to drive the air fan suitable for six furnaces of the Sterling type (New Destructor Co., Ltd.) will not exceed 25 brake horse power.

In the case of steam blast with 2 in to 2½ in water gauge pressure in the ashpit, the quantity of steam used per hour would be approximately 1,000 lb in four Heenan cells, or 250 lb of steam per hour per grate of 305 sq ft area. The temperature required to be developed in the combustion chamber is approximately 2,000°. The advantages of forced draught are that a much higher temperature is attained, little more air than the quantity theoretically necessary is needed, and the minimum amount of cold air is admitted to the furnaces. The air supply to modern furnaces is usually delivered hot—the inlet air being first passed through an air-heater the temperature of which is maintained by the waste heat in the main flue.

Types of Cells—The evolution of a good type of destructor cell or furnace, has occupied many years of experience, and has been the subject of much experiment and many failures. The principal towns in England which took the lead in the adoption of the destructor were Manchester, Birmingham, Leeds, Warrington, Blackburn, Bradford, Bury, Hull, Nottingham, Ealing and London. Ordinary furnaces, built mostly by dust contractors, began to come into use in London and in the north of England in the second half of the 19th century, but they were not scientifically adapted to the purpose, and necessitated the admixture of coal with the refuse to ensure its proper cremation.

The Manchester Corporation erected a furnace of this kind about the year 1873-74, and Messrs Mead and Co made an unsatisfactory attempt in 1870 to burn house-refuse in closed furnaces at Paddington. Shortly after Alfred Fryer erected his destructor at Manchester, several other towns also adopted this furnace. Other types were from time to time brought before the public, among which may be mentioned those of Pearce and Lupton, Pickard, Hesley, Whitley, Thwaite, Young, Wilkinson, Burton, Hardie, Jacobs and Ogden. In addition to these the Beehive and the Nelson destructors became well known. The former was introduced by Stafford and Pearson of Burnley, and one was built in 1884 in the parish yard at Richmond, Surrey, but the results being unsatisfactory, it was closed during the following year. The Nelson furnace, patented in 1885 by Messrs Richmond and Birtwistle, was erected at Nelson in-Marsden, Lancashire, but, being costly in working, was abandoned.

Types of Destructors—The principal types of destructors now in use are those of Fryer, Warner, Manlove-Allott, Meldrum, Beaman and Deas, Heenan and Froude, and the Horsfall and Sterling destructor. The Fryer destructor was patented by Alfred Fryer in 1876. The cells are usually arranged in pairs back to back, and enclosed in a rectangular block of brickwork having a flat top on which the house refuse is tipped from the carts. The furnace burns from four to six tons of refuse per cell per 24 hours. The outlets for the products of combustion are placed at the back near the refuse feed openings. This arrangement is imperfect in design as it permits offensive vapours from unburnt refuse to escape into the main flue with the products of combustion. Nuisances from smell arising from this cause led, in some instances, to the introduction of a secondary furnace, known as a cremator, which was patented by C. Jones of Ealing in 1885. This furnace was placed in the main flue leading to the chimney shaft for the purpose of cremating the organic matters in the vapours from the unburnt refuse, but it added considerably to the cost of running the destructor and was abandoned. The Fryer destructor, with a cremator, was largely used during the early history of destructors, but it has given place to more modern and improved designs of high temperature furnaces.

The Horsfall destructor is a high-temperature furnace of later design than the foregoing. Important improvements are to be found in the arrangement of the flues and flue outlets for the products of combustion, and in the provision of a forced draught duct through which air is supplied under pressure into a closed

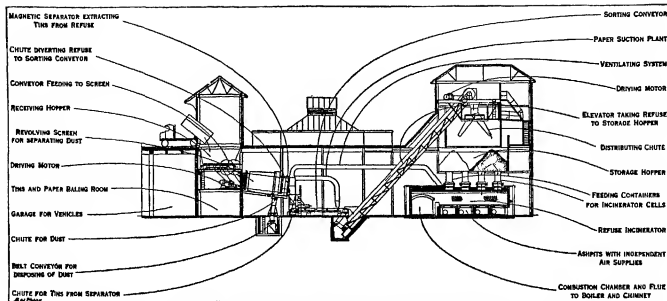


FIG 1—CROSS SECTION THROUGH HEENAN DESTRUCTOR SYSTEM
Showing dust screening plant and entire course of the refuse from arrival in the refuse-collecting vehicle to its destruction in the furnaces

ashpit The flue opening for the removal of gaseous products of combustion is placed at the front of the furnace over the dead plate whilst the feeding hole for the raw refuse is situated at the back of and above the furnace. By these means the gases from the raw refuse must pass, on their way to the main flue, over the hottest part of the furnace and through the flue opening in the red-hot reverberatory arch. By means of the forced draught, a temperature of from 1,500° to 2,000°, as tested by a thermo-electric pyrometer, is attained in the main flue. Cast-iron boxes are provided at the sides of the furnaces, and through these the forced draught is conveyed on its way to the fire grate. The boxes are also designed to prevent the adhesion of clinker to the side walls of the cells and so to preserve the brickwork.

The standard arrangement for a modern Manlove-Alliott top-feed destructor is designed on the "continuous hearth" principle whereby the furnace gases pass from cell to cell on their way to the combustion chamber, thus ensuring a uniform temperature and minimising the cooling down effect when fresh refuse is charged into the furnaces. A joint destructor and sewage pumping scheme has been installed by the Borough of Guildford and the Rural District Council of Hambledon, in which sewage is raised by pneumatic ejectors worked by steam from the refuse. There are four cells of the top-feed type arranged with two water-tube boilers on the Wood and Brodie "Unit" system. Each boiler is sandwiched between a pair of cells, and the high-temperature gases pass immediately into contact with the boiler heating surface. There are eight ejector stations, in each of which two ejectors work as a pair, arranged so that both ejectors cannot be filling or discharging at the same time. The ejectors are of the Alliott and Phelps' automatic improved type.

Warner's destructor (the "Perfectus") was similar to Fryer's in general arrangement, but was provided with special charging hoppers, dampers in flues, dust-catching arrangements, rocking grate bars, and other improvements. The refuse was tipped into feeding-hoppers, consisting of rectangular cast-iron boxes over which plates were placed to prevent the escape of smoke and fumes. When refuse was fed into the furnace a flap door controlled by a lever was thrown over, the contents of the hopper dropped on to the sloping fire brick hearth beneath, and the door at once closed again to prevent the admission of cold air into the furnace as far as possible. The cells were each 5 ft wide by 11 ft deep. The rear portion consisted of a fire brick drying hearth, and the front of rocking grate bars upon which the combustion took place. The amount of refuse consumed varied from five to eight tons per cell per 24 hours.

The Meldrum "Simplex" destructor produced good steam rais-

ing results and was first installed at Rochdale, Hereford, Darwen, Nelson, Plumstead and Woolwich. Cells have also been erected at Burton, Hunstanton, Blackburn, Burnley, Cleckheaton, Lancaster, Sheerness and Weymouth. This destructor differs from those previously described in general arrangement. The fire-grates are placed side by side without separation except by dead plates, but, in order to localize the forced draught, the ashpit is divided into parts corresponding with the different grate areas. Each ashpit is closed airtight by a cast iron plate, and is provided with an airtight door for removing the fine ash. Two Meldrum steam-jet blowers are provided for each furnace, supplying any required pressure of blast up to 6 in. water column. The pressure usually used is about 1½ to 2 inches. The furnaces are designed for hand-feeding from the front, but hopper-feeding can be applied if preferred. The products of combustion are led from the back of each fire grate into a common flue leading to the boilers and to the chimney shaft, or are conveyed sideways over the various grates and a common fire bridge to the boilers or chimney. The heat in the gases, after passing the boilers, is still further used to heat the air supplied to the furnaces—the gases being passed through an air-heater or continuous regenerator consisting of a number of cast-iron pipes from which the air is delivered through the Meldrum blowers at a temperature of about 300°. At Rochdale, the Meldrum furnaces consumed from 53 lb to 66 lb of refuse per square foot of grate area per hour, as compared with 22.4 lb per square foot in a low temperature destructor burning six tons per cell per 24 hours with a grate-area of 25 square feet. The evaporative efficiency varied from 1.39 lb to 1.87 lb of water (actual) per 1 lb of refuse burned, and the average steam pressure was about 114 lb per square inch.

The Beaman and Deas destructor was installed at Warrington, Dewsbury, Leyton, Canterbury, Llandudno, Colne, Streatham, Rotherhithe, Wimbledon, Bolton and elsewhere. At Leyton, which, at the date when this destructor was installed, had a population of over 100,000, an eight cell plant dealt with house refuse and filter press cakes of sewage sludge from the sewage disposal works adjoining. Each cell burnt about 16 tons of the mixture in 24 hours and developed about 35 h.p. continuously, at an average steam pressure in the boilers of 105 lb. The essential features of this destructor include a level fire-grate with ordinary type bars spaced only ¾ in. apart, a high temperature combustion chamber of about 2,000° at the back of the cells, a closed ashpit with forced draught, provision for the admission of a secondary air supply at the fire-bridge, and a fire-brick hearth sloping at an angle of about 52°. The forced draught is supplied from fans at a pressure of from 1½ to 2 in. of water gauge, and is

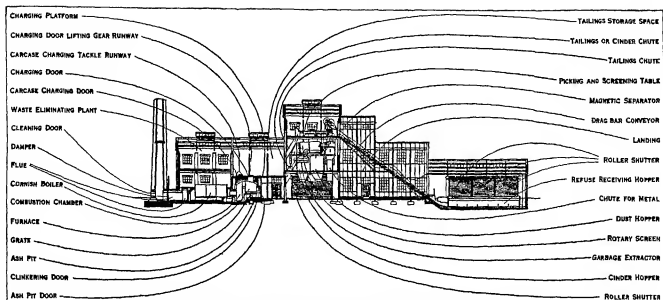


FIG 2—LONGITUDINAL SECTION OF REFUSE DISPOSAL PLANT OF THE NEW DESTRUCTOR COMPANY WITH REFUSE SCREENING PLANT
The refuse is delivered to 'refuse receiving hopper' then raised by dragbar conveyor to the 'picking and screening table.' After sorting and screening the 'tailings' from the refuse are passed on to the 'charging platform' over the destructor cells where the material is burnt to an innocuous clinker.

controlled by means of baffle valves worked by handles on either side of the furnace. The heat from the cells is used in conjunction with a water-tube boiler such as the Babcock and Wilcox, and the gases on their way from the combustion chamber to the main flue pass three times between the boiler tubes. The grate area of each cell is 25sq ft and the consumption varies from 16 to 20 tons of refuse per cell per 24 hours.

The Heenan destructor has been in use for over 25 years and a large number of installations have been erected in many of the largest cities throughout the world, including Birmingham, Glasgow, London, Leeds, Brussels, Paris, Rotterdam, Leningrad, New York, San Francisco, Montreal, Melbourne, Singapore, Edinburgh, Coventry, and many other places. The essential features of the Heenan System (fig 1) include a continuous furnace chamber with divided ashpits, air heater or regenerator, combustion and gas mixing chamber, steam generator, forced draught supply with efficient air regulation and a ventilation system.

The cells may be designed for hand feed under the direct control of the eye and hand of the stoker, either on the front-feed or back-feed system, or, where preferred, a system of mechanical charging and clinkering is installed. Mechanical clinkering has involved a change in grate design, and what is known as the trough-gate has been largely employed in the Heenan system. The advantages claimed are perfect combustion and the maintenance of a regular temperature and boiler pressure during the process of feeding and clinkering, freedom from dust and a minimum of labour in the clinkering operations, the production of a hard clinker practically free from carbon, and a general cleanliness and expedition in the clinkering operations.

By means of the air-heater or regenerator system (placed in the path of the gases after these have passed through the boiler) employed with these furnaces, the thermal efficiency of the furnace is improved, excess of air in the cells is avoided, and more steady and better steaming results are obtained. Those destructors fitted with top-feed are either charged by container feed, skip feed, or feed by conveyor. The mechanical control of the doors permitting the fall of the refuse into the furnace chamber may be by hand operation from the clinkering floor, hydraulic operation with ram cylinders on platforms at the level of the top charging doors, or electric motors may be used for the opening and closing of the doors controlled from the clinkering floor.

Furnace doors are air-cooled. When clinkering, provision is made by means of an asbestos preparation to seal the doors to prevent the escape of fumes into the building. During the three years the Coventry Heenan plant was under observation, over 2 lb

of steam at 160 lb pressure was produced for every 1 lb of refuse burnt, and in colliery districts as much as 4 lb of steam per 1 lb of refuse have been developed from the refuse.

In the London metropolitan area an important installation of the Heenan system was installed at Ilford in 1916, embodying mechanical charging and clinkering accessories. The plant consists of two three-gate (trough-type) units, each unit comprising three mechanically charged and clinkered grates, one Babcock and Wilcox water tube boiler of 200 lb per square inch working pressure, one Foster superheater, three electrically operated top-charging doors with frames, shafting, drums, pulleys and wire ropes complete, one Heenan fan and engine for forced draught, and two electric cranes for lifting the refuse skips. The steam produced is used to drive generators in an adjoining station. The average rate of evaporation per hour, from and at 212° per square foot heating surface of boiler, under test, was 3.9 lb. The average rate of evaporation per 1 lb of refuse burnt (from and at 212°) was 1.82 lb, and the steam pressure 155 lb per square inch. The temperature of the combustion chamber was—maximum 2,462°, minimum 1,886°.

At a modern installation at Birmingham (Brookvale road depot) a specially designed suction plant was installed to collect waste paper from the end of the conveying belts, and to deliver it free of dust, to baling presses. To facilitate clinker handling, a mono-rail or overhead railway, with skips equipped with raising and lowering gear, provides convenient means of transporting the clinker to the cooling area or to the clinker plant.

The Heenan system had been largely used on the Continent, where some of the largest and best equipped installations are to be found. The plant erected at Rotterdam (Holland) in 1912 is a good example.

The refuse disposal plants of the New Destructor Co include designs on the improved Horsfall and Sterling types. A typical plant is illustrated in fig 2 showing the handling and path of the refuse from the time it is delivered to the destructor works until its reception into the furnaces. The cells are of modern continuous grate high-temperature type, and equipped for good steam-raising results. The Horsfall Poplar plant yields 700 h.p. from the combustion of the refuse, the power being used for generating electric current. The evaporation per 1 lb of refuse burnt (from and at 212°) is about 1.5 lb of water. The Mersey Dock and Harbour Board, Liverpool, use a Horsfall plant yielding 360 h.p. for lighting, clinker treatment, etc., the capacity of five cells being 130 tons of refuse per 24 hour day. Sterling plants are used at Sydney (N.S.W.), Zurich, Colombo, Pittsburgh

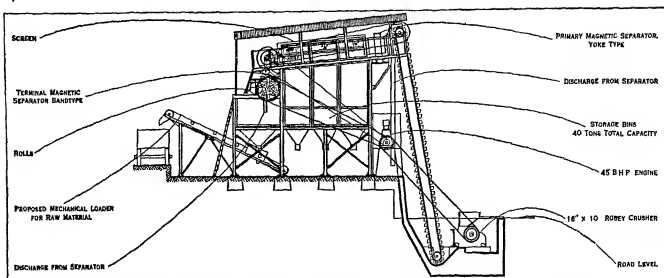


FIG 3—SIDE ELEVATION OF MILLAR'S CLINKER CRUSHING, SCREENING AND GRADING PLANT FOR THE ECONOMICAL PREPARATION OF DESTRUCTOR CLINKER BEFORE ITS USE IN THE MANUFACTURE OF ASPHALT

(USA), Berkeley (USA), and Toronto (Canada). The Colombo plant is a six-cell Horsfall back-feed type with continuous grate, each cell has a grate area of 30sq ft and is capable of burning ten tons per 24 hours. Forced draught is supplied by two positive blowers of the Roots pattern, exhausted through a galvanized iron overhead man with its intake in the hoppers. The foul gases from the refuse are thus drawn over with the cold air and forced through the regenerative air heater and through underground ducts to the front of the furnace blocks. A 6in. cast-iron pipe is built into these ducts and connected to the side boxes for delivering the heated air to the underside of the grate bars.

Clinker asphalt machinery for the manufacture of road surfacing material is also provided, when required, in connection with Horsfall and Sterling furnaces. At an installation at Aberlury the cost per square yard of finished road including 2½in. base or binder course with a 1in. surfacing carpet costs about 7s. 3d. per square yard. Clinker asphalt plants are also in use at Woolwich and Hendon, and a complete plant is being erected at Walthamstow.

Beast-cremating Chamber.—This installation includes two beast-cremating chambers to enable cattle, horses, dogs, etc., to be disposed of in the event of cattle murrain breaking out in the city. At the top of the chambers are large cast-iron doors lined with fire bricks. The doors are fitted with a water seal to prevent hot gases blowing out. Carcasses are hoisted by pulley blocks mounted on a trolley fixed to steel joists so placed as to enable the beast to be lifted from the clinkering floor, traversed over the top of the furnaces to the centre of the cremating chamber, and dropped in by cutting a rope to avoid handling.

Destructor Records and Tests.—To judge correctly of the true performance of a destructor installation it is necessary to take careful observations and tests over long periods. Reliable records of every-day working throughout the whole year are necessary to gain a true knowledge of the performance of the plant. For such tests the destructor station should be provided with a road platform weigh-bridge, water meter, a pyrometer and, if possible, a carbon-dioxide recorder. The principal data to be noted include the weight and description of refuse burned, the quantity of water evaporated in destructor fired boilers, the average steam pressure, the weight of clinker and dust produced, the temperature in the combustion chamber and settings, and the percentage of carbon-dioxide in the flue gases. In order to determine the all-round efficiency of an installation, the leading facts to be ascertained from these data are the weight of refuse burnt per square foot of grate area, the water evaporation per 1 lb. of refuse consumed from and at 212°, the average temperature of the combustion chamber, the average carbon-dioxide gas analysis, the percentage of steam required to operate the de-

structor and its accessory plant, and the percentage and quality of clinker compared with the weight of refuse consumed.

Temperatures in the combustion chamber may be obtained by the use of the Féry radiation pyrometer, after the boiler by a mercury pressure pyrometer, and other temperatures by the mercury expansion thermometer. Other instruments used in connection with destructor tests are the Meyland-D'Arsonval galvanometer, and the Chatellier resistance pyrometer and galvanometer, as made by the Cambridge Scientific Instrument Co., Ltd. The continuous record of the chemical composition of the gases in the combustion chamber may be taken by means of the Simmance and Abady CO₂ recorder.

The higher the percentage of carbon-dioxide passing away in the gases the more efficient the furnace, provided there is no formation of carbon-monoxide. The presence of which would indicate incomplete combustion. The theoretical maximum of carbon-dioxide for refuse burning is about 20%, and, by maintaining an even clean fire, by admitting secondary air over the fire, and by regulating the dampers or the air-pressure in the asphalt, an amount approximating to this percentage may be attained in a well designed furnace if properly worked. If the proportion of free oxygen (i.e., excess of air) is large, more air is passed through the furnace than is required for complete combustion, and the heating of this excess is clearly a waste of heat.

Capital Costs and Working Expenses.—The capital cost of a destructor installation will depend very largely upon the local conditions, situation and nature of the site. In addition to the customary destructor buildings, cells, charging and clinkering machinery, brick settings, chimney shaft, inclined approach roadway, water supply, drainage, light, etc., a modern installation also usually comprises screening machinery for the removal of dust up to about 4in. to ½in. gauge, power-driven elevators, sorting conveyor, electro-magnetic separators, clinker crusher and grading machinery, mortar mills, tin baling press, mess room and spray room, foreman's cottage, office, workshop, weigh-bridge, necessary road and yard formation, electric lighting and other accessories. The writer has had recent occasion closely to investigate the capital cost of such an installation for erection in Kent, capable of dealing with about 72 tons of refuse per 24 hours, and the inclusive cost based on quotations received, was estimated at £19,700 including a 15chp Lancashire boiler, a 40bhp horizontal engine, and a five-kilowatt electric lighting set, all comprised within destructor buildings built with steel stanchions, 14in. pipes and 9in. plain brick panels.

As regards the working expenses of dealing with the refuse by destructor, the average cost per ton of refuse, based on data from 20 towns in the south of England, was found to be 7s. 4½d. exclusive of loan charges. On a large portion of this class of

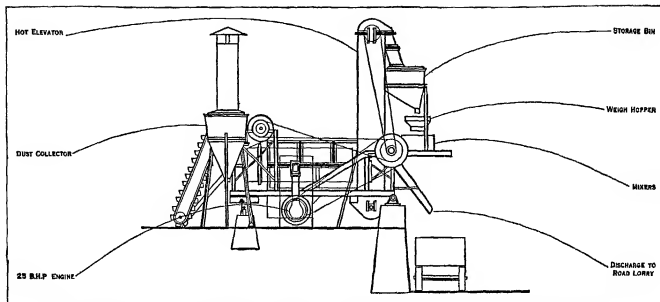


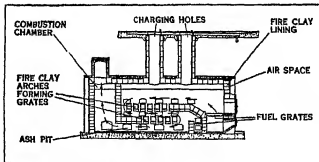
FIG. 4.—SIDE ELEVATION OF MILLAR'S CLINKER ASPHALT PLANT FOR THE CONVERSION OF DESTRUCTOR CLINKER INTO ASPHALT FOR ROADWAYS

plant the depreciation and wear and tear are considerable. The loan period would therefore be relatively short, say from ten to 15 years only. Loan charges may amount to about 4s per ton, under present conditions of high costs of building and machinery, on a complete scheme as outlined above. In view of the high temperature at which the cells work they would probably require relining within a period of ten years.

As regards labour required, stokers, with hand fed plants, may deal with from five to six tons of refuse per man per eight-hour shift. For burning 50 tons of refuse per day of 16 hours four men per eight-hour shift would be required for stoking and firing. Extra labour would be needed for outside work such as clinker crushing, mortar making and other such work.

General Arrangement of Station.—In the general arrangement of a destructor station the cells are placed either side by side, with a common main flue in the rear, or back to back with the main flue arranged in the centre and leading to a tall chimney-shaft. The heated gases on leaving the cells pass through the combustion chamber into the main flue, and thence go forward to the boilers, where their heat is absorbed and utilized. Forced draught, or in many cases, hot blast, is supplied from fans through a conduit commanding the whole of the cells. An inclined road way, of as easy gradient as circumstances will admit, is provided for the conveyance of the refuse to the tipping platform, from which it is fed, either by hand or mechanically, through feed-holes into the furnaces. In the installation of a destructor, the choice of suitable plant and the general design of the works must be largely dependent upon local requirements, and should be entrusted to an engineer experienced in these matters. The following primary considerations, however, may be enumerated as materially affecting the design of such works: (a) The plant must be simple, easily worked without stoppages, and without mechanical complications upon which stokers may lay the blame for bad results, (b) it must be strong, must withstand variations of temperature, must not be liable to get out of order, and should admit of being readily repaired, (c) it must be such as can be easily understood by stokers or firemen of average intelligence, so that the continuous working of the plant may not be disorganized by change of workmen, (d) a sufficiently high temperature must be attained in the cells to reduce the refuse to an entirely innocuous clinker, and all fumes or gases should pass either through an adjoining red-hot cell or through a chamber whose temperature is maintained by the ordinary working of the destructor itself at a degree sufficient to exclude the possibility of the escape of any unconsumed gases, vapours or particles. The temperature may vary between 1,800° and 2,000°.

Modern practice favours the continuous hearth principle whereby the furnace gases pass from one cell to another on their way to a common combustion chamber, (e) the plant must be so worked that while some of the cells are being recharged, others are at a glowing red heat, in order that a high temperature may be uniformly maintained, (f) the design of the furnaces must admit of clinkering and recharging being easily and quickly performed, the furnace doors being open for a minimum of time so as to obviate the rush of cold air to lower the temperature in the main flues, etc., (g) the chimney draught must be assisted with forced draught from fans or steam jet to a pressure of 1½ in. to 2 in. under grates by water-gauge, (h) where a destructor is required to work without risk of nuisance to the neighbouring inhabitants, its efficiency as a refuse destructor plant must be primarily kept in view in designing the works, steam-raising being regarded as a secondary consideration, (i) where steam power and a high fuel efficiency are desired a large percentage of carbon-dioxide should be sought in the furnaces with as little excess of air as possible,



BY COURTESY OF HOBBS ROBEES DESTRUCTOR CO.

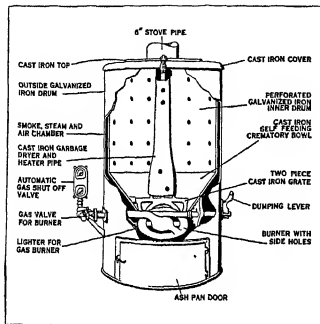
FIG. 5.—DIAGRAM OF THE INSIDE OF A DESTRUCTOR DESIGNED TO DISPOSE OF REFUSE BY BURNING AND AT THE SAME TIME UTILIZE THE REFUSE AS FUEL TO DEVELOP STEAM POWER AND OTHER USEFUL SERVICES

and the flue gases should be utilized in heating the air-supply to the grates, and the feed water to the boilers, (j) ample boiler capacity and hot-water storage feed-tanks should be included in the design where steam-power is required.

Clinker Asphalt Plants.—The cells at the Brighton destructor works have been reconstructed by Messrs Heenan and Froude, Ltd., of Worcester, and a modern clinker asphalt plant installed. By means of this the destructor clinker is crushed, graded and mixed for use as an asphalt carpet or surfacing for roadways. This plant is illustrated in figs 3 and 4. Where there is a suitable outlet

for the manufactured product, such a plant is found to be a serviceable addition to a destructor installation, and affords a satisfactory means of using large quantities of clinker. The equipment consists of two sections—a crushing, separating, screening, grading and storage section, and a drying, heating and mixing section for the manufacture of asphalt from the prepared clinker.

The amount of clinker produced in Great Britain ranges from 20% to about 35% and it is important, financially, that suitable outlets should be made available for its use. In addition to asphalt making, it may be used in making clinker bituminous grout for carriageways, for tarmacadam work, for making concrete building blocks by hand-operated machines or by hydraulic plants. Paving slabs, kerbs and channels may also be made from the crushed and graded clinker. Other uses include the bedding of street paving with the crushed material, the making of mortar



BY COURTESY OF HUME INCINERATOR CO.

FIG. 6.—DIAGRAM OF THE INCINERATOR. A TYPE OF DESTRUCTOR.

for building, and the bottoming of roads and footways.

The carbon content of the clinker is an indication of the efficiency of the combustion in the cell, and should always be low. The usual accessories for dealing with clinker include crushing, elevating and grading machinery, paving slab presses and machinery, clinker concrete block and brick making machines, mortar mills and asphalt plant. At the Coventry destructor the clinker represents about 25% of the refuse, and some 5,000 tons of clinker per annum are utilized for slab making, mortar making, tarmacadam work, for road foundations and similar requirements.

Use of Surplus Heat.—In order to render the refuse and gases therefrom perfectly innocuous and harmless, the modern high-temperature destructor must be worked at a temperature of not less than from 1,800° to 2,000°. The great heat thus developed has naturally suggested its utilization for steam production, and, where suitable outlets exist for its use, a reasonable additional expenditure on plant and labour is justified. The actual calorific value of refuse varies widely in different places and also during different seasons of the year, but as a general average, with a suitably designed and well managed plant, an evaporation of 1 lb of water per 1 lb of refuse burned is a result readily attainable, and one which affords a basis of calculation which engineers may adopt in practice. The evaporative results obtained depend also upon the industry and skill of the stokers as well as on the quality of the refuse. Many destructor steam-raising plants give considerably higher results than those named above, and evaporations approaching 2 lb of water per 1 lb of refuse are met with under favourable conditions. In the coal-mining districts of Rhondda and Pontypridd evaporations from and at 212° of 4.15 lb and

3.47 lb of water per 1 lb of refuse are recorded. From long experience it may be accepted, therefore, that the calorific value of unscreened house refuse varies from 1 to 2 lb of water evaporated per 1 lb of refuse burned, and, taking the evaporative power of coal at 10 lb of water per 1 lb of coal, this gives for domestic house refuse a value of from one-tenth to one-fifth that of coal under normal conditions.

Destructor Electric Combinations.—In practice, however, when the electric energy is for the purpose of lighting only, difficulty has been experienced in fully using the thermal energy from a destructor plant owing to the want of adequate means of storage either of the thermal or of the electric energy. A destructor usually produces a fairly uniform amount of heat throughout the period of its work, while the consumption of electric lighting current is irregular and the maximum demand may be several times the mean demand. This difficulty may be greatly reduced by the provision of ample boiler capacity, or by the introduction of feed thermal storage vessels in which hot feed-water may be stored during the hours of light load. At the time of maximum load the steam boiler may be filled directly from these vessels which work at the same pressure and temperature as the boiler.

In cases where there is a day load, as for electric motive power purposes, equalizing the demand on both the destructor and the electric plant, the situation becomes much more favourable to the full utilization of the available surplus heat.

As regards sewage pumping, destructor installations of the New Destructor Co. are supplying power for this purpose at Gosport, Hampton, Leamington, Teddington, Worthing and other places, and a similar service is rendered by plants of Messrs. Manlove, Albion and Co. at Guildford, Stroud and Cambridge, whilst the Heenan destructor affords power for sewage pumping at Portsmouth, Nuneaton, Hanwell, Lincoln and elsewhere. (See *REFUSE DISPOSAL* for American practice.)

Bibliography.—W. H. Maxwell, *Removal and Disposal of Town Refuse*, with an exhaustive treatment of Refuse Destructor Plants, a special supplement embodies later results, H. F. Goodrich, *Refuse Disposal and Power*. See also the *Proceedings of the Incorporated Association of Municipal and County Engineers*, vols. xii p. 216, xiii p. 211, xiv p. 214 and xv p. 138, the *Proceedings of the Institution of Civil Engineers*, vols. cxxii p. 443, cxxiv p. 469, cxxvi p. 413, cxxviii p. 598, cxxx p. 434, cxxxii p. 213 and 347, cxxxiii pp. 369 and 498, cxxxvii p. 293, cxxxix p. 300, and cxxxix.

(W. H. M.)

DESTUTT DE TRACY, ANTOINE LOUIS, COUNT:

see TRACY, ANTOINE LOUIS DESTUTT, COMTE DE

DE SYLVA, GEORGE GARD ("BUDDY") (1896-1950),

U.S. theatrical producer and song writer, was born in New York city, Jan. 27, 1896. De Sylva was the author of many popular song hits as well as producer of stage shows and motion pictures.

He teamed with George Gershwin to write the musical comedy *La, La, Lucille*, which was produced in 1919. Together they also wrote the songs "Somebody Loves Me" and "Do It Again." He collaborated with Victor Herbert on the musical *Orange Blossoms*, which contained the well-known song "A Kiss in the Dark."

He also wrote the books for such hit reviews as *Sally*, *Ziegfeld Follies of 1921*, six editions of *George White's Scandals*, *Follow Through*, *Three Cheers*, *Good News* and others.

Many of the 500 popular songs with which De Sylva was identified were composed in collaboration with Ray Henderson and Lew Brown. One of these was "Sonny Boy," written for Al Jolson, of which more than 1,500,000 copies were sold.

De Sylva produced five of Shirley Temple's pictures, *The Little Colonel*, *The Littlest Rebel*, *Captain January*, *Poor Little Rich Girl* and *Siowaway*. He also produced *Bachelor Mother*, starring Ginger Rogers.

He returned to New York as a stage producer in 1939, producing *Du Barry Was a Lady*, *Panama Hathe* and *Louisiana Purchase*. He was executive producer of the film *For Whom the Bell Tolls*.

De Sylva died in Hollywood, Calif., July 17, 1950.

DE TABLEY, JOHN BYRNE LEICESTER WARREN, 3rd Baron (1835-1895), English poet, eldest son of George Fleming Leicester (afterward Warren), and Baron de Tabley, was born on April 26, 1835, and died at Ryde on Nov. 22, 1895. He was educated at Eton and Christ Church, Oxford, where he

took his degree in 1856 with second classes in classics and in law and modern history

In the autumn of 1858 he went to Turkey as unpaid attaché to Lord Stratford de Redcliffe and two years later was called to the bar. In 1871 he removed to London, where he was a close friend of Tennyson for several years. From 1877 till his succession to the title in 1887 he lived in complete seclusion, but in 1884 he returned to London and enjoyed a sort of renaissance of reputation and friendship

De Tabley was at one time an authority on numismatics, he wrote, and also published *A Guide to the Study of Book Plates* (1830). The fruit of his careful researches in the science of botany was printed posthumously in his elaborate *Flora of Cheshire* (1890)

From time to time he published volumes of verse under various pseudonyms. On the publication of *Philoctetes* in 1866 De Tabley met with wide recognition. *Philoctetes* bore the initials "M.A.," which were interpreted as meaning Matthew Arnold. He at once disclosed his identity

In 1867 he published *Orestes*, in 1870 *Rehearsals* and in 1873 *Searching the Net*. These last two bore his own name, John Leicester Warren. *The Soldier of Fortune* (1876), a drama on which he had bestowed much careful labour, proved a complete failure. The success of his *Poems*, *Dramatic and Lyrical* (1893) encouraged him to publish a second series in 1895, the year of his death

His posthumous poems were collected in 1902. The characteristics of De Tabley's poetry are pre-eminently magnificence of style, derived from close study of Milton, sonority, dignity, weight and colour. He was always a student of the classic poets and drew much of his inspiration directly from them

See a sketch by Sir Edmund Gosse in his *Critical Kit Kats* (1896)
DETAILLE, (JEAN BAPTISTE) EDOUARD (1848-1912), French painter, was born in Paris on Oct. 5, 1848, and died there on Dec. 23, 1912. Using a technique of literal exactitude based on that of J. L. E. Meissonnier, whose studio he at first frequented, he painted anecdotal military subjects such as "Le Régiment qui passe" (1873). His most characteristic works, burdened with legend and sentiment, deal with Napoleon I and his armies. Among these are "Le Réve" (1888, City of Paris collection) and "L'Oeil du maître" (1897), but he later painted military scenes of his own times especially of the 1870-71 war. He visited Algeria, England and Russia, working for the prince of Wales and Tsar Alexander III. After 1891 he produced lifesize works such as "Les Victimes du devoir", a rare departure from military subjects, it depicts firemen at work. Detaille was also a gifted actor

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DETAINDER see DETINUE

DETECTIVE STORIES see MYSTERY STORIES

DETECTOR, that part of a radio circuit whose function is to pick up or detect the electric oscillations which are set up in the antenna ($q \nu$) by the electromagnetic vibrations. (See WIRELESS TELEGRAPHY)

As used in a radio receiving apparatus it is connected to a circuit-carrying current of radio frequency and translates the radio-frequency power into a form suitable for the operation of an indicator. This translation may be effected either by the conversion of the radio frequency power into some other form or by the control of local power

The indicator may be a telephone receiver, loud speaker, relaying device, tape recorder, etc. The most common type of detector is a vacuum tube operated on a nonlinear portion of its characteristic curve, thereby converting a modulated radio-frequency current into a modulated direct current

DETERDING, SIR HENRI WILHELM AUGUST (1866-1939), Dutch oil executive and director general from 1902 to 1936 of the Royal Dutch Oil company. He was born in Amsterdam on April 19, 1866

He left school at the age of 16 to join the staff of the Twentsche bank in Amsterdam, but after six years of drudgery as a clerk he

decided to seek his fortune in the East Indies

In 1888 he was a bookkeeper at Belwau, in North Sumatra, for the Nederlandsche Handels Mij, the next year he was in agent for the trading company at Medan, and the year following at Penang

In May 1896 he joined the Royal Dutch Oil company, then a comparatively small organization which had been founded six years before. Deterding advanced rapidly and expanded the company until it had storage outlets in many important Asian ports. A year after he became director general he formed the Asiatic Petroleum company, which immediately challenged the Standard Oil company for control of the rich oil markets in the far east. Deterding then extended his operations to Rumania, Russia, Egypt, South America and, in 1908, to the United States

The company he originally founded in Oklahoma became the Rovina company and later the Shell Oil company

He retired in 1936 from active direction of his far flung oil empire. Two years before he had published his autobiography *An International Oilman*, a work which served to dispel the public notion of him as a legendary giant of international finance

Deterding, who was a knight of the British empire, died on Feb. 4, 1939, at St. Moritz, Switzerland

DETERGENTS AND WETTING AGENTS Ordinary soaps are sodium and sometimes potassium salts of the fatty acids with from 12 to 18 carbon atoms per molecule. They are the most universal and simplest of detergents and wetting agents, and are used for cleaning all sorts of surfaces and for enabling a cleaning liquid, such as water, to wet a surface or to penetrate a porous body such as a piece of cloth. The necessity of using a detergent or wetting agent is seen immediately if one attempts to wash a greasy dish with water

Ordinary soaps leave a sticky residue of lime soap on bathtubs and towels when used with hard water because the calcium and magnesium soaps formed are insoluble. Likewise, if the attempt is made to use soaps in acid solution, the soap is decomposed with the formation of insoluble acid soaps and fatty acids

Cleaning materials have long been sought that do not possess the limitations of ordinary soaps or that surpass them in one or more respects. The need for these is greatest throughout the textile industry, whether one is dealing with cotton, silk, wool or some synthetic fabric such as rayon. It was first felt in connection with dyeing, in which the dye solution must wet and evenly penetrate the fabric

In the middle of the 19th century Turkey red oil came into use to carry the dye (Turkey red) by means of modified soaps made from an oil such as castor oil that had first been treated with concentrated sulphuric acid

It was not until after 1932 that the chemical industry began to supply a series of detergents that could be used, without decomposition, with hard water or even in the presence of an acid. The first of these synthetic detergents or wetting agents were closely modelled upon soaps. A soap consists of an oily part resembling a hydrocarbon in composition and structure together with a polar or soluble part that brings it into solution in water, in the simplest synthetics only the nature of the polar part was altered. The first examples were the familiar sodium alkyl sulphates. Subsequently, thousands of patents described large classes of synthetic detergents, some of very complicated structure and possessing special uses

All detergents which, like soaps, are sodium or potassium salts are anion active, that is to say, they owe their detergent action to the distinctive properties of their negative ions (*viz.*, anions). Conversely, all detergents which are chloride, bromide, iodide or acetate salts, and which owe their detergent action to large positive organic ions, are cationic active. Examples are the chlorides of amines containing from 12 to 18 carbon atoms per molecule. A third important class of detergents consists of non ionic compounds, which are not salts. Many of them are derived by condensing ethylene oxide with organic substances such as phenols or fatty acids. They are unaffected by hard water, salts, acids and mild alkalis

Detergency involves the replacing of dirt with an infinitesimal

film of detergent and the carrying away of the dirt in solubilized, emulsified or suspended form.

Detergents derived by combining kerosene with sodium benzene sulphate were largely used throughout World War II for washing in sea water. Detergents are invaluable as germicides, insecticides, emulsifiers, spreaders, foaming and antifoaming agents, additives in foods and in drilling muds, as aids in the conversion of the proteins of milk, chicken feathers and soybeans into fibres which may be spun into textiles, as carriers for insoluble dyes, and as additives to control the adhesion of paints, lacquers or bituminous coatings on roads. They are produced in amounts almost comparable with that of soap although many commercial soaps, to meet this rivalry, were improved by incorporating phosphates in them. (See Soap.)

BIOCETANES—W. W. Niven, *The Fundamentals of Detergency* (New York, London, 1950); E. G. Thomssen and J. W. McCutcheon, *Soaps and Detergents* (New York, 1949); J. L. Mollet and B. Collin, *Surface Activity* (New York, London, 1951); A. M. Schwartz and J. W. Perry, *Surface Active Agents* (New York, 1949); the *Journal of the American Oil Chemists' Society* in annual "Review of Soap and Detergent Literature"; E. K. Goette, "Theoretical Consideration of Detergency," *Journal of Colloid Science*, 4, 459 (1949) (J. W. McB.).

DETERMINANT, an algebraic expression associated with a square array whose elements are numbers or other numberlike mathematical quantities. A determinant of n rows and n columns is called an n -rowed determinant, or a determinant of order n . Let the element in its i th row and j th column be designated by the symbol a_{ij} . Then the accepted notation for the array or matrix of elements is

$$A = (a_{ij}) \quad (i, j = 1, \dots, n),$$

and for the determinant of this square matrix A is

$$|A| = |a_{ij}|$$

Determinants of orders one and two, respectively, are defined as follows

$$|a| = a, \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

Thus a number a defines a one by one matrix (a) whose determinant is the number a .

Determinants of order n are defined as follows. Let $A = (a_{ij})$ be an n -rowed square matrix. The diagonal term of $|A|$ is the product $d = a_{11}a_{22}\dots a_{nn}$. If P is the permutation which carries the integers $1, 2, \dots, n$ into the rearrangement i_1, i_2, \dots, i_n , there is a corresponding product $d_P = a_{1i_1}a_{2i_2}\dots a_{ni_n}$. There are $n! = n(n-1)\dots 3 \cdot 2 \cdot 1$ permutations P on the first n integers and so there are $n!$ products d_P . These are all the possible products obtainable by selecting one and only one element from each row and column of A . Apply P to the so-called alternating function $f = f(x_1, x_2, \dots, x_n) = (x_n - x_{n-1})(x_{n-1} - x_{n-2})\dots(x_2 - x_1)$ and obtain the function $f_P = f(x_{i_1}, x_{i_2}, \dots, x_{i_n})$. It can be shown that $f_P = \epsilon_P f$ where $\epsilon_P = +1$ or -1 . Add the $n!$ terms $\epsilon_P d_P$ and define the n -rowed determinant $|A|$ to be the sum of these $n!$ signed products.

This definition appears to have been formulated first by Gottfried W. Leibnitz in a letter which he wrote to Guillaume F. L'Hôpital in 1693. The discovery does not seem to have had any influence, and determinants did not come into general use until they were rediscovered by G. Cramer, who published this same definition in 1750. The vertical bar notation was first introduced by Arthur Cayley in 1841.

Determinants arise in the study of the solution of a simultaneous system of n linear equations in n unknowns. For example, consider the system

$$\begin{aligned} ax + by &= c, \\ cx + dy &= f, \end{aligned}$$

in which the letters a, b, c, d stand for known quantities and x and y are to be determined. We may eliminate y by subtracting b times the second equation from d times the first equation and obtain $(ad - bc)x = ed - bf$. Hence if $D = ad - bc$ is not zero, we can express x as the quotient of two determinants. Indeed,

$$x = \frac{\begin{vmatrix} c & b \\ f & d \end{vmatrix}}{D}, \quad y = \frac{\begin{vmatrix} a & c \\ c & f \end{vmatrix}}{D}$$

Similarly, consider a system of n linear equations of the form

$$\begin{aligned} a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n &= k_1, \\ a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n &= k_2, \\ &\vdots \\ a_{n1}x_1 + a_{n2}x_2 + \dots + a_{nn}x_n &= k_n, \end{aligned}$$

with $D = |a_{ij}|$ as the determinant of its coefficients. Define K_j to be the determinant obtained by replacing the j th column of D by the column of constants k_1, k_2, \dots, k_n . Then $Dx_j = K_j$. This is called Cramer's rule for the solution of linear equations. It implies that if $D \neq 0$ the system has the unique solution $x_j = K_j/D$.

Determinants are useful as an instrument by means of which systems of linear equations may be classified. Thus, in dealing with linear equations with $D = 0$, one possibility is that in which one k_j is not zero. Then there will be no values whatever satisfying all the equations. Criteria for deciding when systems of linear equations have solutions and how many of these solutions are independent can be obtained from the theory of determinants.

EXPANSIONS OF DETERMINANTS—The array formed by the elements in r rows and r columns of a matrix A is an r -rowed square matrix whose determinant is called a minor of A . The minors of a determinant $|A|$ are merely the minors of the square matrix A . If r rows and r columns of an n -rowed square matrix A are selected the remaining $n-r$ rows and columns are thereby also selected. Thus every r -rowed minor of an n -rowed determinant $|A|$ determines an $(n-r)$ -rowed minor of $|A|$, and these two minors are said to be complementary minors of $|A|$.

Every element of a determinant $|A|$ may be regarded as a one-rowed minor of $|A|$ and the elements of $|A|$ then have complementary minors which are $(n-1)$ -rowed. If d_{ij} is the complementary minor of the element a_{ij} , we shall call the signed determinant, $k_{ij} = (-1)^{i+j}d_{ij}$, the cofactor of a_{ij} . If we multiply the elements of any row (or column) of $|A|$ by their cofactors, and add, the resulting sum is the determinant of A . For example,

$$\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} = a_{11} \begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12} \begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13} \begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$$

The sum of the products of the elements of the i th row (column) by their cofactors is called the expansion of $|A|$ according to its i th row (column). The expansion of a determinant according to the elements of its first row may be used as an inductive definition of a determinant and provides an alternative basis of the theory of determinants. Note, finally, that the sums obtained by multiplying the elements of any row (column) by the cofactors of the elements of any other row (column) are all zero.

A generalization of the expansions given above is due to Pierre Simon Laplace and may be described as follows. Select any r rows of $|A|$. Compute all r -rowed minors with elements in these r rows. There are $C_{n-r} = n(n-1)\dots(r+1)r(r-1)\dots 3 \cdot 2 \cdot 1$ such minors, where C_{n-r} is then the number of ways of selecting r columns from n columns. Multiply each of these r -rowed minors M_r by its complementary minor M_{n-r} and prefix the sign $+1$ or -1 according as the sum of all of the r row subscripts and all of the column subscripts of M_r are even or odd. The sum of these C_{n-r} signed products will be the determinant of A . The sum of the signed minors in r rows by the complementary minors of a different selection of r rows is zero. There are corresponding results on column expansions.

The Laplace expansions imply the following important consequence. Suppose that the matrix of a determinant has the form

$$A = \begin{pmatrix} B & O \\ C & D \end{pmatrix},$$

where B is an r -rowed square matrix, C has $n-r$ rows and r columns, D is an $(m-r)$ -rowed square matrix, and the symbol O represents an array with r rows and $n-r$ columns of elements all zero. Then $|A| = |B| |D|$. Matrices of this kind occur frequently in algebraic research. The main use of the result is that we can state that if $|A| \neq 0$ then $|B| \neq 0$ and $|D| \neq 0$ and conversely if $|D| \neq 0$ and $|B| \neq 0$ then $|A| \neq 0$.

Elementary Properties of Determinants—The computation of a determinant whose elements are numbers may be simplified

to a considerable extent by the use of certain properties of determinants. Suppose first that the rows of the matrix of a determinant are interchanged with the columns. Then the value of the determinant is unchanged. This law permits the restatement of any property given in terms of the rows of a determinant as a corresponding property in terms of columns. The row properties are the following:

If two rows of a determinant are interchanged, the determinant is changed in sign only.

If a row of a determinant is multiplied by a number k the determinant is multiplied by k .

A determinant is not changed in value if a multiple of any one of its rows is added to another row.

If two rows of a determinant are proportional or one row consists of elements all zero, the value of the determinant is zero.

Let $|A|$, $|B|$ and $|C|$ differ only in the i th row and suppose that every element of the i th row of C is the sum of the corresponding elements in the i th row of A and B . Then $|A| + |B| = |C|$.

The properties above are not only useful for the computation of determinants but are also of fundamental importance in the theory of matrices.

Special Properties — Determinants may be used to determine whether or not two polynomial equations in one variable have a solution in common. Let the equations be

$$\begin{aligned} f(x) &= a_1x^m + a_2x^{m-1} + \dots + a_{m+1} = 0 \\ g(x) &= b_1x^n + b_2x^{n-1} + \dots + b_{n+1} = 0 \end{aligned}$$

Form the determinant of order $m+n+2$ given by

$$D = \begin{vmatrix} A \\ B \end{vmatrix}$$

where A has $m+1$ rows, B has $n+1$ rows and we have the formulas

$$A = \begin{pmatrix} a_1 & a_2 & \dots & a_{m+1} & 0 & \dots & 0 \\ 0 & a_1 & a_2 & \dots & a_{m+1} & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & 0 & a_{m+1} & 0 & \dots & 0 \end{pmatrix}, \quad B = \begin{pmatrix} 0 & b_1 & b_2 & \dots & b_{n+1} & 0 & \dots & 0 \\ 0 & 0 & b_1 & b_2 & \dots & b_{n+1} & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & 0 & 0 & b_{n+1} & 0 & \dots & 0 \end{pmatrix}$$

The two equations will have a solution in common if and only if $D=0$. For example let $f(x)=x+x-2$ and $g(x)=x-1$. Then the expansions we have given may be used to show that

$$D = \begin{vmatrix} 1 & 1 & -2 & 0 & 0 \\ 0 & 1 & 1 & -2 & 0 \\ 0 & 0 & 1 & 1 & -2 \\ 1 & -1 & 0 & 0 & 0 \\ 0 & 1 & -1 & 0 & 0 \end{vmatrix} = -4 \begin{vmatrix} 1 & -2 \\ 1 & -1 \end{vmatrix} = 0$$

and the equations have a solution in common. The result was due to James J. Sylvester and is called Sylvester's dialytic method of elimination.

Another topic connected with the theory of equations is the subject of alternants. An alternant is an n -rowed determinant which is a function $d = d(x_1, \dots, x_n)$ such that the interchange of any two of the variables changes the sign of d . The alternating function $f(x_1, \dots, x_n) = (x_n - x_{n-1})(x_{n-1} - x_{n-2}) \dots (x_2 - x_1)$ which was used in the definition of determinants is expressible as an alternant, namely,

$$f(x_1, \dots, x_n) = \begin{vmatrix} 1 & x_1 & x_1^2 & \dots & x_1^{n-1} \\ 1 & x_2 & x_2^2 & \dots & x_2^{n-1} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 1 & x_n & x_n^2 & \dots & x_n^{n-1} \end{vmatrix}$$

and this determinant is called the Vandermonde determinant of order n . Every alternant with polynomial elements has the alternating function as a factor. The discriminant δ of the equation $F(x) = (x-x_1)(x-x_2) \dots (x-x_n) = 0$, whose roots are x_1, \dots, x_n , is the square of the alternating function. The coefficients of δ are polynomials in the coefficients of $F(x)$ with integer coefficients. The importance of δ lies in the fact that formulas for computing it in terms of the coefficients of $F(x)$ are known and $F(x)=0$ has a multiple root if and only if $\delta=0$.

Symmetric and skew determinants are especially interesting. Since there may be symmetry with respect to a line or a point there are two kinds of determinants which possess symmetry. Those which are symmetric with respect to the centre are called centrosymmetric. The term "symmetric" is usually reserved for those determinants which are symmetric with respect to the main diagonal.

In a centrosymmetric determinant the $(n-i)$ th row coincides with the i th row read in reverse order. Every centrosymmetric determinant of even order $2m$ is expressible as a product of two determinants each of order m . A determinant is said to be skew centrosymmetric when every element is the negative of the element symmetrically placed with respect to the centre. Every skew centrosymmetric determinant of even order is expressible as the difference of two squares.

A symmetric determinant $|A| = |a_{ij}|$ is defined by the property that $a_{ij} = a_{ji}$ for $i, j = 1, \dots, n$. Determinants may be multiplied by the law for the product of matrices (see MATRICES) and so $|A| = |A| |A'| = |AA'|$, where A' is the result of interchanging rows and columns in A . The product AA' is symmetric and it follows that the square of every determinant is expressible as a symmetric determinant. The product $|A| |B'| = |AB'|$ of any symmetric n -rowed determinant $|A|$ by the square of any n -rowed determinant $|B|$ is expressible as the n -rowed symmetric determinant of the matrix product AB' . It is also true that any power of a symmetric n -rowed determinant is expressible as a symmetric n -rowed determinant.

A determinant $|a_{ij}|$ is called a skew determinant if $a_{ij} = -a_{ji}$. The diagonal elements are then all zero. Every skew determinant of odd order is zero. A skew determinant of even order is the square of a polynomial in its elements.

The adjoint of a determinant $A = |a_{ij}|$ is the determinant $|a_{ji}|$ where a_{ji} is the cofactor of a_{ij} . Then $|a_{ji}| = |a_{ij}|^{n-1}$. The adjoint of a skew determinant of even order is again skew.

See Thomas Muir, *The Theory of Determinants in the Historical Order of Development*, vol. 1-IV (London, 1906-20), A. A. Albert, *College Algebra* (New York, 1946). (A. A. AT)

DETERMINISM, in ethics, the name given to the theory that all moral choice, so called, is the determined or necessary result of previously existing mental, physical or environmental causes (Lat. *determinare*, to prescribe or limit). The doctrine of determinism is opposed to the various doctrines of free will, known as voluntarism, libertarianism, indeterminism, and is commonly regarded as more or less akin to necessitarianism and fatalism.

There are various degrees of determinism. It may be held that every action is causally connected not only externally with the agent's environment but also internally with his motives and impulses. In other words, if we could know exactly all these conditions, we should be able to forecast with mathematical certainty the course which the agent would pursue.

On this theory the agent cannot be held responsible for his action in any sense. It is the extreme antithesis of indeterminism or in determinism, the doctrine that a man is absolutely free to choose between alternative courses (the *liberum arbitrium indifference*). Since, however, the evidence of ordinary consciousness almost always goes to prove that the individual, especially in relation to future acts, regards himself as being free within certain limitations to make his own choice of alternatives, many determinists go so far as to admit that there may be in any action which is neither reflex nor determined by external causes solely an element of freedom.

This view is corroborated by the phenomenon of remorse, in which the agent feels that he ought to, and could, have chosen a different course of action. These two kinds of determinism are sometimes distinguished by the terms "hard" and "soft" determinism.

The controversy between determinism and libertarianism hinges largely on the significance of the word "motive." Indeed in no other philosophical controversy has so much difficulty been caused by purely verbal disputation and ambiguity of expression. How far, and in what sense, can action which is determined by motives be said to be free?

The scientific doctrine of evolution has gone far toward obliterating the distinction between external and internal compulsion, *e. g.*, motives, character and the like. Insofar as man can be shown to be the product of, and a link in, a long chain of causal development, so far does it become impossible to regard him as entirely self-determined.

Even in his motives and his impulses, in his mental attitude toward outward surroundings, in his appetites and aversions, inherited tendency and environment have been found to play a very large part, indeed many thinkers hold that the whole of a man's development, mental as well as physical, is determined by external conditions.

In the Bible the philosophical-religious problem is nowhere discussed, but the Bible usually assumes the freedom of the human will. It has been argued by theologians that the doctrine of divine foreknowledge, coupled with that of the divine origin of all things, necessarily implies that all human action was foreordained from the beginning of the world.

Such an inference as this is, however, clearly at variance with the whole doctrine of sin, repentance and the atonement, as also with the doctrine of eternal reward and punishment, which postulates a real measure of human responsibility, impossible without free will.

For the history of the free will controversy, see the articles, FREE WILL, PREDESTINATION (for the theological problems), ETHICS, HISTORY OF.

DETINUE, in law, an action whereby one who has an absolute or a special property in goods seeks to recover from another who is in actual possession and refuses to redeliver them. (See CONTRACT, TORT.)

DETMOLD, the capital city of the former *Land* of Lippe, Ger., is on the east slope of the Teutoburger Wald, 25 mi. S of Minden, on the Herford Altenbeken line of the Prussian State railways. Pop. (1939) 35,314.

The Renaissance chateau of the princes of Lippe-Detmold (1550) is an imposing building nearly in the centre of the town, while at the entrance to the large park on the south is the New Palace (1708-18), enlarged in 1850. Detmold possesses a natural history museum, theatre, etc. Furniture, gloves, agricultural implements, etc., are made.

At a distance of about 3 mi. to the southwest of the town of Detmold is the Grotenburg, with Ernst von Bandel's colossal statue of Hermann, or Arminius, the leader of the Cherusci. Detmold (Thattmelli) was in 783 the scene of a conflict between the Saxons and the troops of Charlemagne.

DETONATOR, device employing certain sensitive explosives, called initiating or primary, to cause explosion of other less sensitive materials, called high explosives. Mercuric fulminate (*qv*), lead azide (*qv*) and some organic diazo derivatives are used in the initiating charge of the detonators.

This charge is usually followed by a larger charge of a sensitive high explosive, such as tetryl or PETN, to enhance the initiating action of a detonator without employing a large quantity of a hazardous primary explosive. The charge of a detonator is usually contained in a thin walled copper or aluminum capsule sealed against moisture.

Detonators are manufactured in various sizes, numbered 1 to 8, to indicate the strength of the charge they contain. They may be exploded by heating electrically a thin bridge wire (of electric detonators) or by igniting the initiating charge (of blasting caps) by a fuse (*qv*). In some military fuses the detonator is exploded by the action of a primer.

Each high explosive requires a certain minimum size of detonator for a reliable initiation. In general, the less sensitive to percussion an explosive is (*i. e.*, the safer it is to handle), the stronger is the detonator required to explode it. (See EXPLOSIVES.) (G B K.)

DETROIT, a city of Michigan, U.S., fronting 12 mi. along the Detroit river and covering an area of 140 sq. mi., was founded and named by the French under the command of Antoine de la Mothe Cadillac July 24, 1701. Detroit ("City of the Straits") is strategically located on the Great Lakes. Across the river is

Windsor, Ont., a gateway to Canada. Because of the course of the Detroit river, Windsor lies south of Detroit. Detroit has a moderate climate with a mean average temperature of 48.6° F. and an average rainfall of approximately 31.53 in., equally distributed throughout the year. Average humidity is 71%, altitude is 581 ft. above sea level.

Population—In 1820 the population of Detroit was 1,422. By 1830 the population rose to 2,222 and to 9,102 by 1840. Better railroad service led to continued growth, and by 1850 the population was 21,019; it was 45,619 in 1860, 79,577 in 1870 and 285,704 in 1900.

The coming of the automobile and related industries gave the city its greatest increase in population. In 1900-30 more than 1,250,000 additional persons established residence in the city. In 1910 the population was 465,766, succeeding censuses were as follows: (1920) 993,678, (1930) 1,568,662, (1940) 1,623,452, (1950) 1,849,568.

The Detroit metropolitan district (Wayne, Oakland and Macomb counties) had 2,973,019 in 1950—an addition of more than 500,000 since 1940. There are two independent cities (Hamtramck and Highland Park) within the boundaries of Detroit. Each has a population of nearly 50,000.

Detroit is one of the most healthful cities in the United States, with a death rate in 1949 of only 8.2 per 1,000 inhabitants.

Industry, Commerce, Communications—Fur was the only commodity early Detroiters sold outside their own community. A few grist mills, soap factories and distilleries made products for local use. In 1810, the total volume was approximately \$25,000 annually.

Around 1830 shipbuilding was a vital industry. By 1860 steam engines and other machinery manufactured in the Detroit area had increased the total volume of business to more than \$600,000 annually. By 1900 Detroit had a diversity of industries—foundry and machine shops, druggist preparations, stoves and furnaces, carriages, woodcrafts, meat packing and cigar making. About this time several men in these industries became interested in the French inventions of the internal combustion gas engine. In 1894 Charles King caused much excitement when he drove his first car down a Detroit street.

Others fostered this new development and the automobile industry was born and nurtured in Detroit. Pioneers in the field were Ransom Olds, Henry Leland, the Dodge brothers, W. C. Durant and Henry Ford. Ford's name and automobiles came to be almost synonymous. His first automobile was a two cylinder machine mounted on a light chassis geared to rubber-tired bicycle wheels.

Ford's outstanding contribution to the industry was the development of the assembly line in mass production. With 0.4% of the United States population in 1904, Detroit was making one-fifth of the nation's automotive products.

By mid-century Detroit was making one-half of the products of the country's largest industry. It also ranked at or near the top in U.S. production of pharmaceuticals, adding machines, foundry products, machine tool accessories, ranges and heating devices, paints and heavy chemicals. Other important industries include machinery, stampings, hardware, wirework, machine shop products, rubber products and electrical household appliances. About 1920 Detroit became a steel centre because of the availability of raw materials and the demands of its local industries for steel. The chemical industry in Detroit also prospered after discovery of a layer of rock salt 34 ft. thick, 1,000 ft. below the surface. The mine has about 60 mi. of tunnels, and the supply is believed to be unlimited.

World War II brought more prime contracts for war materials to Detroit than to any other area in the United States. Reconversion to peacetime production was accomplished speedily.

The Michigan customs district ranked third in foreign trade in the United States at mid 20th century, with exports totalling \$653,300,000 during 1949. The Great Lakes waterway is the principal means for carrying on this trade, which accounts for \$1 out of every \$7 spent in the Detroit area. About 300 items are imported for use in the production of automobiles. Facilities es-

sential to international commerce are available in Detroit, which is a port of call for cargo boats including ocean going freighters operating on the Great Lakes. Passenger, cruise and excursion lines provide regular service.

There are nine major railroad systems operating out of the city. Seven commercial air lines use the facilities of Willow Run airport, City airport and Wayne County airport provide additional terminals for private passenger and freight carrying air lines. Four major bus lines serve the entire industrial area and connect with a nation wide system.

Within Detroit, the public transportation system operates over 1,200 route miles. Deliveries are made by more than 200 motor truck carriers throughout the U.S. and Canada. Trade with Canada is facilitated by two tunnels, a bridge and three railroad car ferries. There were 650,000 passenger cars and 70,000 privately owned trucks in use in the city in 1950.

Eleven AM and FM radio and three television stations were broadcasting from Detroit at mid 20th century. Three daily newspapers, the *Free Press*, *News and Times*, had a combined daily circulation of 1,302,000.

Detroit's rapid industrial growth has presented many problems, complicated by business booms, depressions and war. To meet them, better planning of production, low cost housing, slum clearance and labour management received the constant attention of civic leaders.

Industrial and civic groups co-operated on two major projects—a United Fund drive, whereby all agencies soliciting contributions concentrate their efforts into one sustained drive for funds, and a commission to study plans and obtain funds to expand the hospital facilities in the city. There were 60 hospitals in Wayne County at mid century.

Government—Detroit has a mayor-council, nonpartisan type of government. A new charter was adopted in 1918 whereby the mayor, city clerk, city treasurer and board of education are elected at large. The mayor has broad powers to appoint most of the administrative officials and commissions—board of assessors, board of health, city planning, public lighting, water, street railway, fire, public welfare, police and other commissions. The common council consists of nine members, elected at large. The councilman receiving the most votes at the election automatically becomes president of the council and acting mayor in the absence of that official.

After the federal government began its housing program in 1934, Detroit promoted and sponsored slum clearance and low-cost housing. Wide streets and expressways were built to accommodate the many private automobiles and buses that pour into the city from the outlying industrial and residential communities of River Rouge, Dearborn, Ecorse, Wyandotte, the Grosse Pointes, Lincoln Park, Melvindale, Allen Park, Inkster, Ferndale, Pleasant Ridge, Royal Oak, Bloomfield, Hazel Park, Berkley, Roseville, East Detroit, St. Clair, Centerline and Birmingham.

Within the downtown loop are most of the city's largest office buildings, its great hotels, department stores and banks. The Penobscot building, 47 stories, is the tallest skyscraper. Largest office building outside the loop is the General Motors building in the new centre area. The financial and banking firms are centred around Griswold street. Many exclusive shops are to be found on Washington boulevard.

In 1950 municipal planning included a new civic centre, a river front drive and extended parking facilities in the downtown area. The civic centre is located on a 58.3 ac site along the Detroit river at the hub of the radial pattern of the city. The plan called for seven main buildings: Veterans' Memorial building (completed in 1950), city county building, civic auditorium, a convention hall, an exhibition area, a state building and a federal building. Many unsightly and antiquated structures were removed to provide space for this project.

Education—There were 251,897 regularly enrolled students in 1950, including 20,257 at Wayne university, which is part of the public school system. The physical plant totalled 270 school buildings, including 22 high schools and 10 trade schools. Parochial and private schools numbered 146, with 79,171 students enrolled.

Higher education is provided by Wayne university, University of Detroit, Marygrove college, Detroit Institute of Technology, University of Michigan extension service and Highland Park Junior college. Several private schools add fame to the community. Cranbrook Academy of Art, Edison Institute at Greenfield Village, and Merrill Palmer, a pioneer in the field of home economics.

Early in the history of Detroit such men as Father Gabriel Richard, John Monteith and Augustus Woodward recognized the vital need of free educational opportunities and directed their efforts toward promoting these advantages for Detroiters. In 1842 a bill was passed to establish free public schools for all children between the ages of 4 and 17. The board of education had 23 inspectors from each ward, or 12 men, and the mayor and a recorder as ex officio members, and the city was incorporated into one school district. This act was modified later, but the pattern remained much the same.

In 1918 an act provided for a board of education with seven members elected at large, a few at a time with no party designation. The board has entire charge of the public schools, with certain veto rights given to the mayor and appropriations subject to revision by the mayor and the common council.

A census taken every year of children of school age is the basis for appropriations from the primary school interest fund. When the foreign born were coming to Detroit in large numbers to work in the factories, the public schools set up night schools for instruction leading to citizenship, and from this a well rounded program of adult education developed. During World War II using these facilities, skilled workers were trained for war production in a short time.

Culture and Recreation—There are 22 branches to the Detroit Public Library. About 350,000 registered borrowers were drawing about 4,000,000 books annually at mid-20th century. The main library is located in the cultural centre, with the Detroit Institute of Arts, the Rackham Educational memorial, the Children's museum, the Detroit Historical museum and Wayne university near by. The Institute of Arts, a municipally owned museum, houses paintings, sculptures and decorative arts from prehistoric to the modern. The Children's museum contains mobile exhibits to assist in supplementing the current curriculum of the public schools.

Henry Ford's Greenfield Village and Edison museum are devoted exclusively to U.S. historical buildings, machines and products. There Thomas A. Edison is immortalized in the restoration of his Menlo Park laboratory. The village embodies 200 ac of historical buildings moved from their original sites and restored for posterity. There are approximately 1,100 churches of all denominations in Detroit.

Recreational facilities of the metropolitan area have been supplemented by Wayne county and the state of Michigan with parks, camping and picnicking sites, fishing and hunting sites, bathing beaches and amusement parks. Within the city of Detroit itself there were 46 parks at mid-century, covering 3,400 ac maintained by the city.

Belle Isle, a 1,000 ac island in the Detroit river, is notable for its beautiful drives, virgin forests, formal rose gardens, carousel tower, monuments and fountains, picnic and playground areas, bridle paths, golf course, artificial lakes, city zoo, casino, aquarium, bathing beach, botanical conservatory, outdoor theatre, yacht basin and private yacht clubs. Another large park is River Rouge park, comprised of 1,204 ac with many recreational provisions: a large municipal nursery, golf course, winter sports facilities and swimming pools. There are numerous neighbourhood block parks.

Convention hall is the scene of many annual events: a flower show, builder's show, automobile show, sports show and many trade shows. In 1948 an annual air show was organized by the various air minded groups of the city. Automobile and other industrial plants maintain visiting hours for tourists.

History—Fort Pontchartrain du Detroit was settled under the leadership of Antoine de la Mothe Cadillac. Cadillac was transferred to the governorship of Louisiana in 1710 and shortly after, hostilities broke out between the settlers and the Fox Indians of Wisconsin. From 1717 until the French and Indian War and the

end of French rule in North America, the residents of the fort devoted themselves to trade and agriculture. On Nov. 29, 1760, the fort surrendered, without resistance, to Maj. Robert Rogers of the British army. Under British control there was a decline in population and trade.

John Jay negotiated a treaty with England after the American Revolution, and the U.S. flag was raised over the fort. The national government recognized Detroit as a port of entry and representative government was established. The first post road was opened to Monroe, Mich., in 1801.

In Jan. 1802 the town of Detroit was incorporated. A land office was opened by the federal government in 1804. Congress created the Michigan territory, which included what are now Michigan, Wisconsin and a part of Minnesota, and in 1805 Detroit was made the capital of the territory.

The same year fire destroyed all but one building in the town, which was rebuilt on a plan submitted by Pierre Charles l'Enfant, the French engineer who designed Washington, D.C., the plan was of the same general radial pattern as the U.S. capital. Each citizen who had his home destroyed was awarded a larger lot, resulting in a city of openness. During the War of 1812 Gov. William Hull surrendered the town to English forces under suspicious circumstances. The attackers had met with no resistance. The British maintained their control of Detroit until the battle of Lake Erie on Sept. 10, 1813, when Lieut. (later Comm.) Oliver Perry defeated the British.

Detroit was incorporated as a city in 1815, but it was not until 1824 that the first mayor was elected—Gen. John R. Williams. The opening of the Erie canal in 1825 provided better communications with the east, and many pioneers sought land in Detroit and vicinity.

When Michigan was admitted to the union in 1837, Detroit became the capital and remained so until 1847, when the capital was moved to Lansing. Detroit was an important terminal for the Underground Railroad for runaway slaves transported to Canada before the Civil War.

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DETROIT LAKES, a city of Minnesota, U.S., and seat of Becker county, in the western part of the state. The population was 5,787 in 1950 and 5,015 in 1940 by the federal census. It is served by the Northern Pacific and the Minneapolis, St. Paul and Soo Stearns railways, and is the junction of federal highways 10 and 59. It has a mayor-council form of government. The electric, water and sewerage utilities are municipally owned. The surrounding area is good agricultural country, studded with many lakes, one of the largest being Detroit lake. These attract a large summer tourist and winter-sports trade.

A short distance to the north is the White Earth Indian reservation.

DETTINGEN, a village of Germany (Bavaria), 10 mi. NW of Aschaffenburg, scene of the battle of Dettingen (1743) (see *ASTUTIAN SUCCESSION WAR* or *rim*).

DE TUCIC, SERGE (1873-1940), Croatian playwright, was born in Poasari, Croatia, later Yugoslavia.

After working as a sculptor for a short time he began to write for the theatre. His play *Truly Dum* (1896) was translated into several languages and was widely produced in southern Europe.

In 1904 King Ferdinand of Bulgaria made him the first director of the National theatre in Sofia. During World War I he went to London, where in 1914 he published a book on the Slav nations and later wrote a play, *The Liberator*, produced under the sponsorship of George Bernard Shaw and H. Wickham Stead.

He was for two years professor of Slavonic languages in King's college, London.

In 1918 he went to the United States. He died in New York city, Sept. 25, 1940.

DEUCALION, in Greek legend, son of Prometheus, king of Phthia in Thessaly, husband of Pyrrha and father of Hellen,

the mythical ancestor of the Hellenic race. When Zeus had resolved to destroy all mankind by a flood, Deucalion constructed a boat in which he landed on Mt. Parnassus with his wife.

Having offered sacrifice and inquired how to renew the human race they were ordered to cast behind them the "bones of the great mother", that is, the stones from the hillsides. Those thrown by Deucalion became men, those thrown by Pyrrha, women.

DEUCE, a term applied to the "two" of any suit of cards, or of dice. It is also a term in tennis when both sides have each scored three points in a game, or five games in a set, to win the game or set two points or games must then be won consecutively, and the players return to a position of equality as often as they cannot score two such points or games consecutively. The earliest instances in English of the use of the slang expression "the deuce" in exclamations date from the 17th century.

DEUS, JOÃO DE (1830-1896), the greatest Portuguese poet of his generation, was born at Messines in Algarve on March 8, 1830. Matriculating in the faculty of law at the University of Coimbra, he settled in the city, dedicating himself wholly to the composition of verses, which circulated among professors and undergraduates in manuscript copies.

In the volume of his art, as in the conduct of his life, he practised a rigorous self control. He printed nothing previous to 1855, and the first of his poems to appear in a separate form was *La Lata* in 1860.

In 1862 he left Coimbra for Beja, where he was appointed editor of *O Bejense*, and four years later he edited the *Folha do Sul*. As the pungent satirical verses entitled *Elasques* prove, he was not an ardent politician and, although he was returned as Liberal deputy for the constituency of Silves in 1868, he acted independently and promptly resigned his mandate. The renunciation implied in the act, which cut him off from all advancement, is in accord with nearly all that is known of his lofty character.

In 1868 his friend Jose Antonio Garcia Blanco collected from local journals the series of poems *Flores do campo*, which is supplemented by the *Ramo de flores* (1875). This is João de Deus's masterpiece.

The *Folhas soltas* (1876) is a collection of verse in the manner of *Flores do campo*, brilliantly effective and exquisitely refined. Within the next few years the writer turned his attention to educational problems. This was a misfortune for Portuguese literature, his educational mission absorbed João de Deus completely and is responsible for many publications which were of no literary value. A copy of verses in Antonio Vieira's *Graúda de Maria* (1877), the *Loas á Virgem* (1878) and the *Proverbios de Salomão* are evidence of a complete return to orthodoxy during the poet's last years.

He died at Lisbon, Port., on Jan. 11, 1896, and was accorded a public funeral in the National Pantheon at Belem.

Next to Luis de Camoens and perhaps João Garrett, no Portuguese poet was more widely read, more profoundly admired than João de Deus, yet no poet in any country was more indifferent to public opinion and more deliberately careless of personal fame. He is not responsible for any single edition of his poems, which were put together by ill-informed enthusiasts who ascribed to him verses that he had not written; he kept no copies of his compositions, seldom troubled to write them himself and was content for the most part to dictate them to others. And yet, though he never appeared to the patriotic spirit, though he wrote nothing at all comparable in force or majesty to the restrained splendour of *Os Lusadas*, the popular instinct which linked his name with that of his great predecessor, Camoens, was just. For Camoens was his model, not Camoens of the epic, but the Camoens of the lyrics and the sonnets, where the passion of tenderness finds its supreme utterance. Theophilo Braga, who published Deus's scattered minor prose writings and correspondence, noted five stages of development in his artistic life—the imitative, the idyllic, the lyric, the pessimistic and the devout phases.

But it is as the singer of love that João de Deus delights posterity as he delighted his own generation. The elegiac music of *Rachel* and of *Maria*, the melancholy of *Adeus* and of *Remorso*,



VIEWS OF DETROIT

- 1 Air view showing the Detroit river and Belle Isle in the distance, Canada is at the right
- 2 Campus Martius (right foreground) and Woodward avenue Detroit's principal street
- 3 Sky line of the city as seen across the Detroit river from Belle Isle park
- 4 The Detroit Boat club on Belle Isle The island, located near the centre of the city, also has a zoo a golf course, swimming beach and play grounds
- 5 Washington boulevard a main thoroughfare of downtown Detroit

the tenderness and sincerity of *Meu casto luto*, of *Lágrima celeste*, of *Descalça* and a score more songs are distinguished by the large, vital simplicity which withstands time. It is precisely in the quality of unstudied simplicity that João de Deus is incomparably strong. The temptations to a display of virtuosity are almost irresistible for a Portuguese poet, he has the tradition of virtuosity in his blood, he has before him the example of all contemporaries, and he has at hand an instrument of wonderful sonority and compass. Yet not once is João de Deus clamorous or rhetorical, not once does he indulge in idle ornament. His prevailing note is that of exquisite sweetness and of reverent purity, yet with all his caressing softness he is never sentimental, and, though he has not the strength for a long fight, emotion has seldom been set to more delicate music.

Had he included among his other gifts the gift of selection, had he continued the poetic discipline of his youth instead of dedicating his powers to a task, which well as he performed it, might have been done no less well by a much lesser man, there is scarcely any height to which he might not have risen.

DEUSEDIT, or **ABDONATO**, pope and saint (7-618), became pope on Oct. 19, 615, and died on Nov. 3, 618. The few decretals ascribed to him are unauthenticated and nothing is really known about him.

He is said to have been the first pope to use leaden seals for pontifical documents. From these seals came the word bull (*bulle*, a "leaden seal").

DEUSSEN, PAUL (1845-1919), German philosopher and Sanskrit scholar, was born at Oberdisen on Jan. 7, 1845. He taught at Berlin (1881-89), and then became professor of philosophy in Kiel where he died on July 7, 1919. As a philosopher, Deussen regarded the spatial world and objects as forms of the all important empirical consciousness. The reality for him lay in a nonspatial, nontemporal and noncausal sphere to which we attain by moral activity rather than by intellect.

DEUTERIUM AND TRITIUM Deuterium and tritium are the isotopes of hydrogen of atomic weights 2 and 3 respectively. The former is a stable atomic species found in natural hydrogen compounds (water being the most abundant) to the extent of 0.014% to 0.015%. The latter is a radioactive species emitting negative beta particles of 19,000 electron volts energy and having a half life of 12.5 years; it occurs in natural water (Norwegian snow) with an abundance of 10^{-18} of that of natural hydrogen. The names, symbols and some atomic constants of the three hydrogen and the neutron are given in Table I.

TABLE I—Atomic Constants of Neutron and Hydrogens

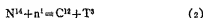
| Name | Symbol | Atomic weight (physical scale) | Nuclear spin | Nuclear magnetic moment* |
|-----------|-------------------|--------------------------------|---------------|--------------------------|
| Neutron | n | 1.008698 | $\frac{1}{2}$ | -1.9135 |
| Protium | H or ^1H | 1.008125 | $\frac{1}{2}$ | 2.7080 |
| Deuterium | D or ^2H | 2.014710 | 1 | 0.8576 |
| Tritium | T or ^3H | 3.017703 | $\frac{3}{2}$ | 2.9795 |

*In units of nuclear Bohr magnetons ($= \frac{eh}{4\pi m_p c}$)

Deuterium was discovered (1931) by H. C. Urey with the help of F. G. Brickwedde and G. M. Murphy. Urey, using the third law of thermodynamics and the Debye theory of the solid state, predicted a difference in vapour pressures of H_2 and HD and thus the possibility of separating these substances by distillation of liquid hydrogen. The deuterium was detected in the residue of a distillation of liquid hydrogen by its atomic spectrum. L. W. Alvarez and R. Cornog (1939) discovered tritium by bombarding deuterium with high energy deuterons,



W. F. Libby and A. V. Grosse showed that it is present in natural water. Neutrons produced by the action of cosmic rays probably produce this tritium by reacting with nitrogen in the high atmosphere,



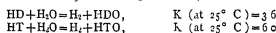
Deuterium was first prepared in pure form by G. N. Lewis using

the electrolytic method of concentration discovered by E. W. Washburn. When a water solution of an electrolyte (NaOH usually) is electrolyzed, the hydrogen produced contains a smaller fraction of deuterium than the water and hence deuterium is concentrated in the residue. Very nearly pure deuterium oxide (heavy water) is secured when the residue is reduced to $\frac{1}{1000}$ of the original water. This method of preparation was used before World War II for the commercial preparation of D_2O and later in Norway for the large scale preparation. During the war other methods for the preparation of D_2O were devised and subsequently used to produce large quantities of this substance. These methods depend upon the substantial differences in chemical and physical properties of the compound of protium and deuterium. F. G. Brickwedde used the distillation of liquid hydrogen to produce hydrogen deuteride (HD) and studied its properties (see below).

Tritium is produced most directly by the nuclear reaction between Li^7 and neutrons from nuclear fission reactors, i.e.,



The compounds of the three hydrogen isotopes differ quantitatively in their physical properties though they are very similar to each other qualitatively. This is shown by the physical properties of the waters (see Table II) and of the elementary substances (see Table III). The same is true of their chemical properties as is illustrated by the exchange reactions,



If the protium and deuterium or tritium compounds had exactly the same chemical properties, the equilibrium constant for each reaction would be unity. Since both constants are greater than unity the ratios of the isotopes D/H and T/H are less in the hydrogen gases than in the corresponding waters when equilibrium is established. Similar differences are characteristic of other exchange reactions of this type. Such differences in properties are potentially useful for devising separation processes for protium and deuterium.

The velocities of reactions of the compounds containing deuterium or tritium are usually less than those in which protium is present and these differences are often large. Protium reacts 13.4 times as rapidly with chlorine at 0°C than does deuterium.

The nucleus of the deuterium atom, the deuteron, proved to be especially useful in understanding the structure of atomic nuclei. It consists of one proton and one neutron and hence is the nuclear two body problem just as the hydrogen atom consisting of one nucleus and one electron is the two body problem of atomic structure.

TABLE II—Physical Properties of the Waters

| | D_2O | H_2O |
|--|----------------------|----------------------|
| Specific gravity d_{20}^{20} | 1.10775 | 1.00000 |
| Melting point ($^\circ \text{C}$) | 1.1 | 0 |
| Boiling point ($^\circ \text{C}$) | 101.41 | 100 |
| Temperature of maximum density ($^\circ \text{C}$) | 11.9 | 3.98 |
| Critical temperature ($^\circ \text{C}$) | 372.5 | 374.2 |
| Critical pressure (atm.) | 218.6 | 218.2 |
| Critical density (g/ml) | 0.363 | 0.325 |

TABLE III—Physical Properties of the Elementary Substances

| | H_2 | D_2 | D_2 | T_2 |
|---|------------------|------------------|------------------|------------------|
| Gram molecular volume of the solid (cc) at the triple point ($^\circ \text{K}$) | 21.5 | 21.81 | 20.45 | — |
| Triple point ($^\circ \text{K}$) | 13.81 | 18.60 | 18.71 | 20.6 |
| Vapour pressure at triple point (mm) | 54.0 | 92.8 | 128.4 | 162.0 |
| Boiling point ($^\circ \text{K}$) | 20.39 | 23.13 | 21.67 | 25.04 |
| Heat of fusion at triple point | 25.0 | 35.1 | 17.0 | — |
| Heat of vapourisation (cal/mol at temperature shown) | 216 (20.19°K) | 257 (23.15°K) | 203 (21.67°K) | 333 (25.04°K) |

ture and theory. Because of the comparative simplicity of the theoretical problem it has been possible to compare theoretical calculations effectively with observational data. The theory shows that the attractive forces between the neutron and proton are very short range in character and cannot follow any inverse square law. They appear to be the meson forces introduced by H. Yu-

1.1.1.1 The normal state of the deuteron is $^2\text{S}_1$, with a binding energy of 1.186 000 electron volts. This is the only stable state. The triton consists of two neutrons and one proton and already presents a three-body problem of much greater complexity, but still of great usefulness in these problems.

The biological effects of deuterium oxide are of considerable interest. It has been established that neither plants nor animals continue to live and thrive in water containing deuterium oxide of high concentrations. At mid 20th century, no case of acclimatization to the deuterium oxide was known.

Both deuterium and tritium are very useful as isotopic tracers in the investigation of chemical and biochemical reactions. The rather marked differences in chemical properties are sometimes troublesome (more so in the case of tritium than in that of deuterium). Deuterium particularly has been used in this way since it is readily available and easy to analyze. These tracers make possible a much greater understanding of biochemical processes. In general the heavier isotopes of hydrogen have proved to be of interest in so many aspects of the chemistry of hydrogen that no general review is possible since an adequate review would cover the entire chemistry of the element.

Deuterium oxide is useful in atomic energy engineering problems as a moderator in reactors. It has the advantage of being a liquid which absorbs neutrons only slightly, with an absorption cross section of only $0.0002 \times 10^{-24} \text{ cm}^2$ for D_2O as compared with $0.6 \times 10^{-24} \text{ cm}^2$ for H_2O . At mid-century it was expected to be of great industrial use.

Because of their low atomic numbers, i.e., charges on their nuclei, deuterium and tritium are of interest in connection with thermonuclear reactions. The mass change in reaction (1) is 0.00338 g , and using the relativity relation between mass and energy, namely, $E=mc^2$, this gives 4.5×10^{10} calories per gram atom of deuterium. Thus about 0.1% of the mass is converted to heat energy. Tritium is likewise capable of liberating large quantities of energy but must be produced by costly processes, while deuterium is relatively inexpensive. At mid century, controlled thermonuclear reactions suitable for sources of power seemed unlikely to be devised in the near future.

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(H. C. U.)

DEUTERONOMY, the fifth book of the Law in the Old Testament. The name is a Greek mistranslation of the term *Mishneh ha'Torah*, "copy of the Law," found in Deut. xvi, 18, and Josh. viii, 32. It is ostensibly an account of the Law as given by Moses just before his death in the plains of Moab, the theory of the book being, apparently, that the Law given 38 years earlier at Horeb was confined to the "Ten Words" (see DECALOGUE), and that the present precepts are offered as a rule for life in the country which Israel will soon enter.

Contents and Structure—The book falls into the following well-marked divisions: (1) i, 1-iv, 43. Introductory discourse by Moses, mainly a historical retrospect. (2) iv, 44-xi, 32. A second introduction, consisting of a repetition of the Decalogue and an exhortation to observe the Law. (3) xii-xxviii. A code containing both religious and civil laws and including in ch. xxvii instructions for the solemn ratification of the Law after the conquest of Canaan. (4) xxix-xxxii. Concluding exhortation, with Moses' farewell to Israel. (5) xxxiii and xxxiv. Two poems ascribed to Moses, the latter being a collection of tribal songs similar in form to Gen. xli. (6) xxxv. The death of Moses.

The original extent of the book is not fully determined. It may well have begun with iv, 44, or even with xii, 1 (though this is

less probable). Ch. xxxiii, xxxiv-xxxv may have been later appendices and it is extremely unlikely that the two poems formed a part of the original book. There are signs of a double tradition e.g., xii, 2-7 and 8-14, cover the same ground ostensibly. The curious variation between the use of the second plural and the second singular in addressing Israel has led some scholars to believe that we have here the interweaving of two different documents, though it must be admitted that the two forms interchange so frequently and irregularly that analysis on this basis is most precarious. The tone and style of the book are very clearly marked. The whole has a humanitarian outlook, which is manifested both in modifications of existing laws and in the promulgation of new regulations. It thus contains repeated exhortations to love Yahweh and to recognize His love to Israel. The ritual and ceremonial elements are comparatively slight.

Date—1. *Comparative*. There are three other codes with which Deuteronomy may be compared and the relation of the book to the work of some of the prophets, especially Hosea and Ezekiel, is of importance. In its present form it seems to be later than the Book of the Covenant (Exod. xx-xxiii) and Hosea and earlier than the Priestly Code and, probably, Ezekiel. It may also be a little earlier than the Law of Holiness, though the affinities between these two documents suggest some connection. The order JE, D, Ezekiel, P, is, however, generally accepted.

2. *Absolute*. Part of the importance of Deuteronomy for the history of Hebrew literature and thought lies in the fact that it seems possible to assign an actual date to its promulgation. Its main ritual provision, the concentration of sacrifice, finds practical expression in the religious measures of Josiah, 621 B.C. (II Kings xxii, xxiii) and Deuteronomy, or a nucleus of the book has therefore been identified with the Book of the Law found by Hilkiah in the temple. If that view be correct, then Deuteronomy is a "program" based on the teaching of the 8th century prophets and compiled during the 7th century.

While this is the "regnant hypothesis," it has not passed unchallenged. It involves two difficulties. One is that the provisions—or some of them—intended to meet the new order are unworkable in practice. Even in II Kings xxii, 9, it is stated that the priests of the local sanctuaries, brought to Jerusalem as prescribed in Deut. xiii, 6-8, were not permitted to share in the offices performed by the Jerusalem priesthood in the temple. The other difficulty is that while the reform of Josiah tended to exalt Jerusalem, the Book of the Covenant (on which the Deuteronomistic code is clearly based) and the historical traditions followed in Deuteronomy are of northern provenance, belonging to E rather than to J. Attempts have been made to solve these problems by throwing the date of the book either forward or backward. Here it can only be remarked that these solutions raise other difficulties which would also have to be solved.

Whatever the exact date of the book may have been, its influence on Hebrew literature and thought is undeniable. In its spirit and from its point of view the Book of Kings was written, and some of the material now found in our prophetic books (especially Jeremiah) bears the same stamp, alike in matter and in style. It sprang out of and represents one of the most important schools of thought in the history of Israel.

BIBLIOGRAPHY—In addition to commentaries and works on biblical criticism (on which see *BIBLE, Old Testament*) see especially R. H. Kennet, *Deuteronomy and the Decalogue*, and A. C. Welch, *The Code of Deuteronomy*. See also JUDAEISM. (T. H. R.)

DEUTSCH, IMMANUEL OSCAR MENAHEM (1829-1873), German orientalist, was born of Jewish extraction at Neisse on Oct. 28, 1829. His studies at the University of Berlin made him an excellent Hebrew and classical scholar, and in 1855 he became assistant in the British Museum library.

Deutsch worked intensely on the Talmud and contributed more than 190 papers to *Chambers's Encyclopaedia*. His famous article on the Talmud in the *Quarterly Review* for Oct. 1867 was translated into many European languages. He died at Alexandria on May 12, 1873. His *Literary Remains* were edited by Lady Strangford in 1874.

DEUTSCHE BANK, established in 1870, became Germany's

largest commercial bank as a result of numerous mergers. The absorption of banks in western Germany strengthened its position in the highly industrialized Ruhr area. The merger with the Disconto Gesellschaft in 1929 united Germany's two largest banks. The combined institution was called the Deutsche Bank. The assets of the bank increased from 3,700,000,000 RM in 1938 to 8,700,000,000 RM in 1943. About 85% of this increase consisted of government securities, which accounted for 59% of total assets in 1943. The capital of the bank was raised from 130,000,000 RM to 160,000,000 RM in 1930 because of the rising volume of deposits and the increase in participations in foreign banks.

The head office of the bank was in Berlin. In 1941 the bank had 489 branches and agencies. Particularly before and during World War II it developed an extensive foreign system, with branches in many countries including Turkey, Czechoslovakia and Poland; in addition it obtained controlling interests in foreign banks. Its subsidiary, the Deutsche Überseebank, was the largest and most influential German bank for South America; in 1938 it had 21 branches, mainly in Argentina, Brazil, Chile, Peru, Uruguay and Spain.

The bank had close relations with numerous industrial enterprises. Important firms, such as Siemens and Halske A. G., I. G. Farbenindustrie A. G. and Mannesmannröhren Werke A. G. were represented on its board of directors. The head office of the bank in Berlin was closed in 1945, and its branches in eastern Germany were liquidated. (H A Ar)

DEUTSCHER LANDER, BANK, is the central note issuing bank of western Germany. It was established in 1948 in Frankfurt as part of the Allied decentralization of the German banking system, replacing the Reichsbank. (q v)

The bank is the "bank of the Land central banks." Its board of directors consists of a chairman, the president of the board of managers and the presidents of the Land central banks. The bank is not allowed to maintain branches or subsidiaries, but the Land central banks, with their numerous branches, perform the functions of subsidiaries. The bank is not subject to instructions of any political body or public nonjudicial agency.

The bank's transactions with central banks include purchase and sale of foreign exchange and valuable metals, acceptance of deposits, rediscount bills of exchange, and advances against bills of exchange, treasury bills or other securities of the federal government or the *Land*. It may grant the federal government short-term advances in anticipation of specific revenues, generally not to exceed 1,500,000,000 DM. It may act as fiscal agent for the federal government and buy and sell its treasury bills and fixed interest-bearing securities in the open market.

The bank controls credit through its power to issue directives to the Land central banks, reject bills bought for rediscount, change requirements for both minimum reserves the Land central banks must keep with it and those which commercial banks must keep with Land central banks, and alter the discount rate.

The bank had assets of 13,600,000,000 DM in 1950. Its capital of 100,000,000 DM was subscribed by the Land central banks in proportion to their deposits, annual profits, after establishment of reserves, are distributed to these banks in proportion to their capital participation. (H A Ar)

DEUTSCHKRONE, a town formerly in the east of the *Land* of Prussia, Ger., between the two lakes of Arens and Radau, 15 mi N W of Schneidemühl, a railway junction 60 mi N of Poznan. Pop. (1946) 7,816.

DLUTZ
RI
It
was in 1230 granted to the citizens by the archbishop of Cologne
The fortifications were finally razed in 1838

DEUX-SEVRES, an inland department of western France, formed in 1790 mainly of the three districts of Poitou: Thouars, Gâtine and Niortais, added to a small portion of Sautonge and a still smaller portion of Anjou. Area, 2,358 sq mi. Pop. (1946) 312,756. It is bounded N by Maine et Loire, E by Vienne, S E by Charente, S by Charente Maritime and W by Vendée. The Sevre of Niort traverses the southern portion, and the Sevre of Nantes (an affluent of the Loire) drains the northwest. There are three regions—the Gâtine, in the north and centre, the Plaine in the south and the Marais—distinguished by their geological and physical character. The Gâtine, formed of primitive rocks (granite and schists) is the continuation of the "Boisge" of Vendée and Maine et Loire. Its surface is irregular and covered with hedges and clumps of wood or forests. Application of lime has improved the soil, which is naturally poor. The Plaine, resting on oolite limestone, is treeless but fertile. The Marais, a low lying alluvial district in the extreme southwest, is extremely productive, when properly drained. The highest points, several above 700 ft, are found in a line of hills which begins in the centre of the department, to the south of Parthenay and stretches north-west into the neighbouring department of Vendée. It divides the region drained by the Sevre Niortaise and the Thouet (both affluents of the Loire) in the north from the basins of the Sevre Niortaise and the Charente in the south.

The climate is mild; the annual temperature at Niort being 52°, the rainfall nearly 25 in. Winters are colder in the Gâtine, summers warmer in the Plaine.

Three quarters of the entire area of Deux-Sevres, which is primarily an agricultural department, consists of arable land. Wheat and oats are the main cereals. Potatoes and mangel wurzels are the chief root crops. Niort is a centre for the growing of vegetables (onions, asparagus, artichokes, etc.) and of angelica. Much beetroot is raised to supply the distilleries of Melle. Colza, hemp, rape and flax are also grown. Vineyards are numerous in the neighbourhood of Bressuire in the north, and of Niort and Melle in the south. The department is well known for the Parthenay breed of cattle and the Poitou breed of horses, and good mules are reared in the south. The system of co-operative dairy ing is practised in some localities.

The apple trees of the Gâtine and the walnut trees of the Plaine bring a good return.

Some coal is mined, and the department produces building stone and lime.

There is manufacture of textiles (serges, druggets, linen, handkerchiefs, flannels, and knitted goods). Tanning and leather dressing are carried on at Niort and other places, and gloves are made at Niort.

Wool and cotton spinning, hat and shoe making, distilling, flour milling and oil refining are also main industries. The department exports cattle and sheep to Paris and Poitiers, also cereals, oils, wines, vegetables and its industrial products.

The Sevre Niortaise and its tributary the Mignon furnish 19 mi of navigable waterway. The department is served by the Ouest-Etat railway. It contains a large proportion of Protestants, especially in the southeast. The three *arrondissements* are Bressuire, Niort and Parthenay, the cantons number 31, and the communes 357.

Deux-Sevres is part of the region of the IX Army Corps (Tours) and of the diocese and the *académie* (educational or conscription) of Poitiers, where also is its court of appeal.

Niort (the capital), Bressuire, Melle, Parthenay, St. Maixent-Thouars and Oiron are the principal places in the department. Several other towns contain features of interest. Among these are Airvault, where there is a church of the 12th and 14th centuries which once belonged to the abbey of St. Pierre, and an ancient bridge built by the monks, Celles-sur-Belle, where there is an old church rebuilt by Louis XI, and again in the 17th century, and St. Jean de-Marnes, with a fine Romanesque abbey church with Gothic restoration.

DEVA, a Roman legionary fortress in Britain on the Dee at the site of the modern Chester. (q v)

DEVA, DEWA, in the Zoroastrian mythology the Dev

as a fuel for gas turbines in the generation of electricity and for a lobster storage and marketing scheme.

Fisheries have been aided by grants for research with the assistance of a scientific advisory committee, to the fisheries departments and independent institutions with the object of studying the resources of seas, rivers and lakes. Fishery harbours have been improved, particularly in Scotland.

DEVENS, CHARLES (1820–1891), U.S. lawyer and jurist, was born in Charlestown, Mass., April 4, 1820. He graduated at Harvard college in 1838, and at the Harvard law school in 1840, and was admitted to the bar. Throughout the Civil War he served in the Federal army, becoming colonel of volunteers in July 1861 and brigadier general of volunteers in April 1862. After the war he was a judge of the Massachusetts superior court from 1867 to 1873, and was an associate justice of the supreme court of the state from 1873 to 1877, and again from 1881 to 1891. From 1877 to 1881 he was attorney general of the United States in the cabinet of Pres. Rutherford B. Hayes. He died at Boston, Mass., on Jan. 7, 1891.

See his *Orations and Addresses*, with a memoir by John Codman Ropes (Boston, 1891).

DEVENTER, SIR JACOB LOUIS VAN (1874–1922), South African soldier was born in the Orange Free State. He fought in the South African War of 1899–1902, becoming second in command to Gen. Jan Christiaan Smuts during the latter's invasion of Cape colony. A colonel on the permanent staff of the South African defense force, Van Deventer served with distinction in German South West Africa, 1914–15. His gifts were shown later in the operations in East Africa, where in May 1917 he was appointed commander in chief in succession to Smuts. He was then a major general, and was given the temporary rank of lieutenant general on becoming commander in chief. Shortly after war, he was appointed K.C.B. As commander in chief he brought the campaign to a successful end. He died on Aug. 27, 1922. (See EAST AFRICA OPERATIONS in.)

DEVENTER, a town in the province of Overysel, the Netherlands, on the right bank of the Ysel, at the union of the Schipbeek, and a junction station 10 mi. N. of Zutphen. Pop. (1947) 44,089. In the 14th century Deventer was the centre of the famous religious educational movement associated with the name of Gerhard Groot (qv), who was a native of the town (see BROTHERS or COMMON LIFE). The Groote Kerk (St. Lebuinus) dates from 1334 and occupies the site of an older structure of which the 11th-century crypt remains.

The Roman Catholic Broederkerk, or Brothers' church, contains among its relics three ancient gospels attributed to St. Lebuinus (Lebwin), the apostle of the Frisians and Westphalians (d. c. 773). The Bergkerk, dedicated in 1206, has two late Romanesque towers. The town hall was built in 1693. In the fine square called the Brink is the old weigh house, now a school (*Gymnasium*), built in 1528, with a large external staircase (1644). The town library, also called the library of the Athenaeum, includes many manuscripts and incunabula, and a 13th-century copy of *Reynard the Fox*. The archives of the town are of considerable value. Besides a considerable agricultural trade, Deventer has important carpet and textile factories (the Smyrna carpets being especially famous).

In the church of Bathmen, a village 5 mi. E. of Deventer, some 14th-century frescoes were discovered. German troops occupied Deventer in 1940.

DE VERE, AUBREY THOMAS (1814–1902) Irish poet and critic, was born at Curragh Chase, County Limerick, being the third son of Sir Aubrey de Vere Hunt (1788–1846), also a poet, whose verses and a drama, *Mary Tudor*, were published by his son in 1875 and 1884. Aubrey de Vere was educated at Trinity college, Dublin, and in his 28th year published *The Waldenses*, the first of his many volumes of verse and prose. In many of his poems, notably in the volume of sonnets called *St. Peter's Chams* (1888), he made rich additions to devotional verse. After Matthew Arnold's fine lecture on "Celtic Literature," nothing perhaps did more to help the Celtic revival than Aubrey de Vere's insight into the Irish character and his reproductions of the early Irish

epic poetry.

See *Selections* ed. by G. E. Woodberry (New York, London, 1891), Geoffrey Taylor (ed.), *Irish Poets of the Nineteenth Century* (London, 1951).

DEVIATION, in magnetism (qv), the horizontal angle through which a magnetic needle is deflected away from the magnetic meridian by the iron in a ship (see COMPASS).

DEVICE, a scheme or simple mechanical contrivance, also a design, particularly a heraldic design or emblem, often combined with a motto or legend. (See HERALDRY.)

DEVIDASI (DEVADASI) see CASTE (INDIAN).

DEVIL is the generic name for a spirit of evil especially the supreme spirit of evil, the foe of God and man, but also for minor evil spirits or demons. It is given as a name to many destructive and repulsive animals, to apparatus for tearing cloth, etc. to highly seasoned dishes to boy assistants in printing houses (probably because of their inky appearance) and to juniors and hacks who prepare work (or "devil") for barnstormers, authors, etc. Here, however, we are concerned with the word only as used in mythology and religion.

The primitive philosophy of animism involves the ascription of all phenomena to personal agencies, the agents of good being gods, those of evil, demons. When the divine is most completely conceived as unity, the demonic is also so conceived, and over against God stands Satan or the devil.

Though it is in connection with Hebrew and Christian monotheism that belief in the devil has been most fully developed, there are approaches to the doctrine in other religions, e.g., "the lady Nina" and the dragon Tiamat in Babylonian, the serpent Apap in Egyptian, the Titans and Prometheus in Greek, Hel and Loki among the Teutons and Ahu and Siva among Hindus. The opposition of good and evil is most fully carried out in Zoroastrianism. Opposed to Ormuzd, the author of all good is Ahriman, the source of all evil, and the opposition runs through the whole universe (D'Alviella's *Hubert Lectures*, pp. 158–164).

The conception of Satan belongs to the postexilic period of Hebrew development, and probably shows traces of the influence of Persian on Jewish thought, it also has its roots in much older beliefs (cf. 1 Sam. xvi, 14, Judges i, 23, 1 Kings xii, 22, Gen. vi, 1–4), and evil, whether as misfortune or as sin, is generally assigned to divine causality (1 Sam. xviii, 10, 2 Sam. xxiv, 1, 1 Kings xii, 20, Isa. vi, 10, lxx, 17). After the exile there is a tendency to protect the divine transcendence by the introduction of mediating angelic agency, and to separate all evil from God by ascribing its origin to Satan, the enemy of God and man. In the prophecy of Zechariah (iii, 1, 2) he stands as the adversary of Joshua, the high priest, in the book of Job he presents himself before the Lord among the sons of God (ii, 1), yet is represented both as accuser and tempter, and while, according to 2 Sam. xxiv, 1, God himself tests David in regard to the numbering of the people, according to 1 Chron. xxi, 1, it is Satan who tempts him.

The development of the conception continued in later Judaism, which was probably more strongly influenced by Persian dualism, as in Tobit ii, 8, vi, 14, Ecclesiasticus xvi, 27, Wisdom ii, 24, Psalms of Solomon xvi, 49, and the book of Enoch. In the Jewish *Targum* Sammael "the highest angel that stands before God's throne, caused the serpent to seduce the woman", he coalesces with Satan, and has inferior Satans as his servants. The birth of Cain is ascribed to a union of Satan with Eve. As accuser affecting man's standing before God he is greatly feared.

This doctrine, stripped of much of its grossness, is reproduced in the New Testament. Satan is the *diabolos*, from *διαβάλλειν*, to slander (Matt. xii, 30, John xii, 2, Eph. iv, 27, Heb. ii, 14, Rev. ii, 10), slanderer or accuser, the *πειράζων* (Matt. iv, 3, 1 Thess. ii, 5), the tempter, the *πρωτότος* (Matt. v, 37, John xvii, 15, Eph. vi, 16), the evil one, and the *ἐχθρός* (Matt. xii, 30), the enemy. He is apparently identified with Beelzebub (or Beelzebul) in Matt. xii, 26, 27. Jesus appears to recognize the existence of demons belonging to a kingdom of evil under the leadership of Satan "the prince of demons" (Matt. xii, 24, 26, 27), whose works in demonic possessions it is his function to destroy (Matt.

1 34 III 11 VI 7 Luke x 17-20) but he himself conquers Satan in resisting his temptations (Matt. iv 1-11). Simon is warned against him, and Judas yields to him as tempter (Luke xxi 34, John xii 7). Jesus' Jewish doctrine is found in Paul's letters also. Satan rules over a world of evil. Paul's own "strike in the flesh" is Satan's messenger (2 Cor. xii 7). According to Hebrews Satan's power over death Jesus destroys by dying (ii 14). Revelation describes the war in heaven between God with his angels and Satan or the dragon, the "old serpent," the discover of the whole world (xii 9), with his hosts of darkness after the overthrow of the Beast and the Kings of the earth, Satan is imprisoned in the bottomless pit a thousand years (xix 2). As an angel to deceive the nations, he is finally cast into the lake of fire and brimstone (xx. 10). cf. Enoch iv 5, 6, 2 Peter ii 4). In John's Gospel and Epistles Satan is opposed to Christ. Sinners and murderers from the beginning (i John ii 8) and live by nature (John viii 44) he enslaves men to sin (viii 34), causes death (verse 44), rules the present world (xiv 30), but has no power over Christ or those who are His (xiv 30, xvi 11, i John v 18). He will be destroyed by Christ with all his works (John xvi 33, i John ii 8).

In the common faith of the Gentile Churches after the Apostolic age the influence of polytheism survived in the belief in the dominion of demons from which Christ is the Redeemer. While Christ's First Advent delivered believers from Satan's bondage, his overthrow would be completed only by the Second Advent. The belief in Satan appears in fantastic forms in Gnosticism. The Gnostics traced false doctrine as well as evil practice to him. In Irenaeus emerges the strange doctrine that the death of Christ was a ransom paid to the devil. God was represented by Origen as dupe of the devil, and His right to do so was justified. While this view was maintained by several Christian thinkers, others felt scruples about ascribing a "pious fraud" to God, and it at last fell into the background. The possibility of the redemption of Satan, advanced by Origen, however, was in the 5th century branded as a heresy. Persian dualism was brought into contact with Christian thought in the doctrine of Mani, and it is permissible to believe that the gloomy views of Augustine regarding man's condition are due in some measure to this influence. Man taught that Satan attacked the earth, and defeated man sent against him by the God of light, but was overthrown by the God of light, who then delivered the primal man. "During the middle ages," says Tulloch, "the belief in the devil was absorbing—suns conceived themselves and others to be in constant conflict with him." This superstition perhaps at its strongest in the 13th to the 15th century, passed into Protestantism. Luther was always conscious of the presence and opposition of Satan. He held that this world will pass away with its pleasures, as there can be no real improvement in it for the devil continues in it to ply his daring and seductive devices. This belief in the devil was especially strong in Scotland among both clergy and laity in the 17th century.

In more recent times a great variety of opinions has been expressed on this subject. The reality of demonic possession has been denied and Satan variously represented as a personification of the principle of evil. But some Christian theologians, such as Daulton, Dornier, Martensen have tried to form a speculative defence of the common belief. A. Ritschl gives no place in his constructive doctrine to the belief in the devil, but recognizes that the mutual action of individual sinners on one another constitutes a kingdom of sin opposed to the kingdom of God (A. E. Garvie, *The Ritschlian Theology*, p. 304). In the book entitled *Evil and Exaltation* there is 'an attempt to turn the light of modern science on to the ancient mystery of evil.' The author contends that the existence of evil is best explained by assuming that God is confronted with Satan, who in the process of evolution interferes with the divine designs, an interference which the instability of such an evolving process makes not incredible. Satan is however held to be a creature who has by abuse of his freedom been estranged from, and opposed to his Creator, and who at last will be conquered by moral means. W. M. Alexander in his book on demonic possession maintains that "the confession

of Jesus as the Messiah or Son of God is the classical criterion of genuine demonic possession" (p. 150) and argues that as "the Incarnation indicated the establishment of the kingdom of heaven upon earth," there took place "a counter movement among the powers of darkness" of which "genuine demonic possession was one of the manifestations" (p. 249).

Interesting as these speculations are, it may be confidently affirmed that belief in Satan is not now generally regarded as an essential article of the Christian faith, nor is it found to be an indispensable element of Christian experience. On the one hand science has so explained many of the processes of outer nature and of the inner life of man as to leave no room for Satanic agency. On the other hand the modern view of the inspiration of the Scriptures does not necessitate the acceptance of the doctrine of the Scriptures on this subject as finally and absolutely authoritative. The preaching of Jesus even in this matter may be accounted for as either an accommodation to the views of those with whom He was dealing, or more probably as a proof of the limitation of knowledge which was a necessary condition of the Incarnation, for it cannot be contended that as revealer of God and redeemer of men it was imperative that He should either correct or confirm men's beliefs in this respect. The possibility of the existence of evil spirits, organized under one leader Satan to tempt man and oppose God, cannot be denied, the sufficiency of the evidence for such evil agency may be doubted, the necessity of any such belief for Christian thought and life cannot, therefore, be affirmed. (See also DEMONOLOGY, POSSESSION.)

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DE VILLIERS, JOHN HENRY, BARON (1842-1914), first Chief Justice of the Union of South Africa, was born at Pieter, Cape Colony, in June 1842. He was educated at the South African college, Cape Town, and Utrecht and Berlin universities. In 1865 he was called to the bar by the Inner Temple and began practice in Cape Colony. Entering Cape politics in 1866, he was elected a member of the House of Assembly, became attorney general of the Colony in 1872 and two years later was appointed Chief Justice of the Cape. In this capacity he succeeded, by his decisions, in adapting the Roman-Dutch law of the colony to modern requirements. He was appointed President of the National Convention in 1908 and in 1910 was raised to the peerage on becoming Chief Justice of the Union of South Africa. He died Sept. 2, 1914.

DEVIL POSTPILE, a national monument (reservation) in the southeast corner of Madera county, California, U.S.A., and only a few miles southeast of Yosemite national park. The reservation (798.46 ac. in area) was created on July 6, 1911, to preserve an unusual mass of basaltic columns, 10 to 30 in in diameter, and rising like an immense pile of posts, as high as 60 ft. It is said to rank with the Giant's Causeway in Ireland.

DEVIL'S ADVOCATE see ADVOCATUS DIABOLI.

DEVIL'S ISLAND, a small island in the Atlantic Ocean off the coast of French Guiana, South America, formerly used by the French as a penal settlement because of the difficulty of escape. It was here that Capt. Alfred Dreyfus (q.v.) was confined.

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DEVILS LAKE, a city of North Dakota, U.S.A., on Devils lake, 85 mi. W by N of Grand Forks, the county seat of Ramsey county. It is on federal highway 2, and is served by the Great Northern and the Soo Line railways.

Population in the 1950 census was 6,419, in 1940 it was 6,204. The city has creameries, flour mills and railroad shops. It is the seat of the state school for the deaf. The state university has a biological station on the lake, and just south of the lake is Sully's Hill National park, an important wild animal preserve, with historic associations. Devils Lake was settled in 1880 and incorporated in 1887.

DEVILS TOWER, first of the U.S. national monuments, on the Belle Fourche river about 25 mi. northwest of Sundance in Crook county, Wyoming, U.S.A. The area (1,193.97 ac.) was

established Sept. 24, 1906, to preserve a remarkable natural rock tower, of volcanic origin, 600 ft from base to summit and 1,300 ft above the Belle Fourche river.

DE VINNE, THEODORE LOW (1828-1914), the most eminent American printer during the latter 19th century and the first decade of the 20th. He was known as an authority on the history of typography and was the author of many scholarly books on this subject. Born at Stamford, Conn., on Dec. 25, 1828, he took the first steps toward learning his trade in 1843 in a printing office at Fishkill, N.Y., but entered on his regular apprenticeship soon after in the office of the *Gazette* at Newburgh, N.Y. In 1847 he went to New York city and after working in several offices, in 1849 entered the employ of Francis Hart, one of the leading printers in that city, a relation destined to prove both happy and permanent. From work as a job compositor, he graduated in 1850 into the position of foreman. Nine years later, when De Vinne was offered a partnership elsewhere, Hart decided to hold him by making him a member of the firm. At this period the business of Francis Hart and Co. was tending more and more to book printing, a field to which De Vinne devoted most of his efforts from that time onward. About 1864 De Vinne began to write on printing, his earliest contributions dealing with the economic aspects of the business, but his attention soon turned to the aspects of typographic style and the history of the craft.

In 1873 the firm began to print *St. Nicholas* and soon after took on the *Century Magazine*, in printing the illustrations for which some new standards were established. The *Century Dictionary* was another job of importance produced under De Vinne's direction.

Francis Hart died in 1877 and in 1883 the name of the firm was changed to Theodore L. De Vinne and Company, the plant coming to be known as the De Vinne press, which earned a reputation as the outstanding printing office of the country. De Vinne was one of the founders of the Grolier Club and one of its most active members, printing most of the early books issued by that organization, and writing or editing a number of them. He died on Feb. 16, 1914.

As a printer De Vinne was a craftsman of high standards and stood head and shoulders above his contemporaries, but he could not be regarded as a great creative artist. His simplest books were his best. De Vinne's most important contributions to typographic literature were *The Practice of Typography* (1900-04), a series of four manuals, *The Invention of Printing* (1876), *Christopher Plantin and the Plantin Moretus Museum at Antwerp* (1888), and *Notable Printers of Italy during the Fifteenth Century* (1910). (D. C. McM.)

DEVISE or DEVICE, the conveyance of real property by will. See **LEGACY**.

DEVIZES, a market town and municipal borough in the eastern parliamentary division of Wiltshire, England, 86 mi. S.W. of London by the G.W. Ry. Pop. (1938) 7,000. Area 2.2 sq. mi. Its castle was built on a tongue of land flanked by two deep ravines, behind which the town grew up on a stretch of exposed tableland. Its main streets, in which a few ancient timbered houses are left, radiate from the market place, where stands a market cross with a remarkable inscription referring to a certain dishonest market transaction in 1753. The Kennet and Avon canal, now practically disused, is raised to two levels of ten towers through a chain of locks. St. John's church (12th century), one of the most interesting in Wiltshire, is cruciform, with a massive central tower and fine Norman chancel, and contains several ancient monuments, besides some beautiful carved stonework and oak ceilings. St. Mary's, a smaller church, is partly Norman, but was rebuilt in the 15th and restored in the 19th century. Roundway Down, on the edge of which the town stands, stretches eastward and is the site of an ancient British earthwork, besides having yielded other remains. The county general and mental hospitals are situated in Devizes, which also has a museum, and is the depot of the Wiltshire regiment. It is an important corn, cattle and pig market, and has bacon and cheese factories, tleworks, engineering works and manufactures of snuff and tobacco. Assize courts are held at Devizes, which has its own commission of the

peace and court of quarter sessions.

The construction at Devizes in the reign of Henry I. of a castle of exceptional magnificence by Roger, bishop of Salisbury, at once constituted the town an important political centre, and the name itself is possibly a corruption of the mediæval Latin referring to the "castle at the boundaries" (*ad drivas*). After the disgrace of Roger in 1139 the castle was seized by King Stephen. In the 14th century it formed part of the dowry of the queens of England. Devizes' first charter, from Matilda, confirmed by successive later sovereigns, merely grants exemption from certain tolls and the enjoyment of undisturbed peace. Edward III. added a clause conferring on the town the liberties of Marlborough, and Richard II. instituted a coroner. A gild merchant was granted by Edward I., Edward II. and Edward III., and in 1614 was divided into the three companies of drapers, mercers and leather-sellers. The present governing charters were issued by James I. and Charles I., the latter being little more than a confirmation of the former, which instituted the common council. Devizes returned two members to parliament from 1295 until deprived of one member in 1867, its representation was merged in that of the county in 1885.

See *Viet, County Hist., Wiltshire, History of Devizes* (Devizes, 1859). **DEVOLUTION, WAR OF** (1667-68), the name applied to the war which arose out of Louis XIV's claims to certain Spanish territories in right of his wife Maria Theresa, upon whom the ownership was alleged to have "devolved" (See, for the military operations, **DUTCH WARS**). The war was ended by the Treaty of Artois-Chapelle in 1668.

DEVON, EARLS OF. From the family of De Redvers (De Ruparis, Rivers), who had been earls of Devon from about 1100, this title passed to Hugh de Courtenay (c. 1275-1346), but was subsequently forfeited by Thomas Courtenay (1432-1462), a Lancastrian who was beheaded after the battle of Towton. It was revived in 1485 in favour of Edward Courtenay (d. 1509), whose son Sir William (d. 1511) married Catherine, daughter of Edward IV. Too great proximity to the throne led to his attainder, but his son Henry (c. 1498-1539) was restored in 1517 as earl of Devon, and in 1525 was created marquis of Exeter, his second wife was a daughter of William Blount, 4th Lord Mountjoy. The title again suffered forfeiture on Henry's execution, but in 1553 it was recreated for his son Edward (1526-1556). At the latter's death it became dormant in the Courtenay family, till in 1831 a claim by a collateral branch was allowed by the House of Lords, and the earldom of Devon was restored to the peerage, still being held by the head of the Courtenays. The earlier earls of Devon were referred to occasionally as earls of Devonshire, but the former variant has prevailed, and the latter is now solely used for the earldom and dukedom held by the Cavendishes (see **DEVONSHIRE, EARLS AND DUKES OF**, and also the article **COURTENAY**).

DEVON, a south-western county of England, bounded north-west and north by the Bristol channel, north-east by Somerset and Dorset, south-east and south by the English channel, and west by Cornwall. The area, 2,612 sq. mi., is exceeded only by those of Yorkshire and Lincolnshire among the English counties. East to west structural lines, dating from Armanian times, are dominant features. The high ground to the north of Barnstaple may be considered as an extension of the Quantock hills—Brenon hills—Exmoor forest line, and terminates in Morte point and Buggy point, which face Lundy. Here are exposed a series of slates, grits and limestones considered so characteristic of the county that it was called the Devonian system (q.v.). It represents here the northern rim of a trough in the hollow of which lie the Culm measures of central Devon. The same series appears in the southern rim of the trough in the latitude of Tavistock, but this line is much affected by the granitic mass of Dartmoor, intruded into the Culm and Devonian strata in post-Carboniferous times and subsequently exposed by denudation. The hard core stands out in High Willhays (2,039 ft.), Yes Tor (2,028 ft.) and other peaks. Evidences of Devonian volcanic activity are abundant in the masses of diabase, dolerite, etc., at Bradford and Trusham, south of Exeter, around Plymouth and at Ashprington. Perhaps the most interesting is the Carboniferous volcano of

Brent Tor, near Tavistock. An Eocene deposit, the product of the denudation of the Dartmoor hills, lies in a small basin at Bovey Tracy, it yields beds of lignite and valuable clays.

The eastern side of the county is built of younger rocks, unconformable above the old ones and dipping gently eastwards. The lower and most westerly situated member of the younger rocks is a series of breccias, conglomerates, sandstones and marls which are exposed on the coast by Dawlish and Teignmouth, and extend inland, producing a red soil, past Exeter and Tiverton. A long narrow strip of the same formation reaches out westward on the top of the Culm as far as Jacobstow. Further east, the Bunter pebble beds are represented by the well-known pebble deposit of Budleigh Salterton, whence they are traceable inwards towards Rockbeare. These are succeeded by Keuper marls and sandstones, well exposed at Sidmouth, where the Upper Greensand plateau is clearly seen to overlie them. Greensand covers all the high ground northward from Sidmouth as far as the Blackdown hills. At Beer Head and Axmouth the chalk is seen, and at the latter place is a land-rip caused by the springs which issue from the Greensand below the chalk. The lower chalk at Beer has been mined for building stone, and was formerly in considerable demand. At the extreme east of the county, Rhaetic and Liassic beds make their appearance, the former with a "bone" bed bearing the remains of saurians and fish.

Local Tertiary movements may account for relics of penepains, one of which has been located at a height of about 1,000 ft. on the south eastern edge of Dartmoor, and for the north west and north north west systems of faults, which can be traced in several valleys on the eastern edge of Dartmoor. The raised beaches of Hops's Nose, the Thatcher Stone and other parts of the coast, together with traces of submerged forests, and most of all the long, steep-sided, drowned valleys forming the numerous inlets of the south Devon coast are evidences of recent coastal movements.

The Tamur, which constitutes the boundary between Devon and Cornwall, flows into the English channel. Its estuary has been utilized for the harbours of Plymouth and Devonport. The other principal rivers rise on Dartmoor. These include the Teign, Dart, Plym and Tavy, falling into the English channel, and the Taw flowing north towards Bideford bay. The river Torridge, also discharging northward, receives part of its waters from Dartmoor through the Okement, but itself rises in the angle of high land near Hartland point on the north coast. The lesser Dartmoor streams are the Avon, the Erme and the Yealm, all running south. The Exe rises on Exmoor in Somerset, but the main part of its course is through Devon, and it is joined on its way to the English channel by the lesser streams of the Culm, the Credy and the Clyst. The Otter, rising on the Blackdown hills, also runs south, and the Axe, for part of its course, divides the counties of Devon and Dorset. The finds made at Oreston, near Plymouth, at Kent's Cavern, near Torquay, at Windmill Hill Cavern, Brixham, and at Cattedown, Plymouth, suggest that these limestone areas with southerly aspects were much favoured by Palaeolithic man. Later settlement seems to have been chiefly on the higher land of the interior. Tumuli, stone circles and alignments are numerous on Dartmoor, and are fairly well distributed over the high land of the county. Hill forts and camps occupy strategic positions, and their distribution suggests that Dartmoor had already lost much of its former significance when they were built. Many are found around the coast guarding routes into the interior.

Roman relics have been found from time to time at Exeter (Isca Dumnoniorum), the only large Roman station in the county.

HISTORY

The Saxon conquest of Devon must have begun some time before the 8th century, for in 700 there existed at Exeter a famous Saxon school. By this time, however, the Saxons had become Christians, and established their supremacy not by destructive irruptions, but by a gradual process of colonization settling among the native Welsh and allowing them to hold land under equal laws. The final incorporation of the district which is now Devon with the kingdom of Wessex must have taken place about 766. At the beginning of the 9th century Wessex was divided into definite

pages, probably corresponding to the later shires, and the Saxon Chronicle mentions the district by name in 823, when a battle was fought between the Welsh in Cornwall and the people of Devon at Camelford. During the Danish invasions of the 9th century aldermen of Devon are frequently mentioned. In 851 the invaders were defeated by the fyrd and aldermen of Devon, and in 878 they were again defeated with great slaughter. In 1003, in the reign of Ethelred the Unready, the Danes sacked Exeter.

Devon, in the 7th century, formed part of the west bishopric of Dorchester on Thames. In 705 it was attached to the newly created diocese of Sherborne, and in 910 Archbishop Plegmund constituted Devon a separate diocese, and placed the see at Crediton. About 1030 the dioceses of Devon and Cornwall were united, and in 1049 the see was fixed at Exeter.

William the Conqueror immediately recognized the importance of securing the loyalty of the West by the capture of Exeter. The city withstood an 18 days' siege, and William was only admitted at length upon honourable terms. The many vast fiefs held by Norman barons in Devon were known as honours, chief among them being Plympton, Okehampton, Barnstaple, Harberton and Totnes. The honour of Plympton was bestowed in the 12th century on the Redvers family, together with the earldom of Devon, in the 13th century it passed to the Courtenay family (q.v.), who had already become possessed of the honour of Okehampton, and who in 1335 obtained the earldom. The dukedom of Exeter was bestowed, in the 14th century, on the Holand family, which became extinct in the reign of Edward IV. The ancestors of Sir Walter Raleigh, who was born at Budleigh, had long held considerable estates in the county. In 1204 the inhabitants paid 5,000 marks to have the county disafforested, with the exception of Dartmoor and Exmoor.

Devon had an independent sheriff, the appointment being at first hereditary, but afterwards held for one year only. In 1320 complaint was made that all the hundreds of Devon were in the hands of the great lords who did not appoint a sufficiency of bailiffs for their proper government. The miners of Devon had independent courts, known as stannary courts, for the regulation of mining affairs, the four stannary towns being Tavistock, Ashburton, Chagford, and Plympton. The ancient miners' parliament was held in the open air on Crocker Tor. For mining purposes West Devon is in the Duchy of Cornwall and under the jurisdiction of the Stannary court.

In 1140 the castles of Exeter and Plympton were held against Stephen by Baldwin de Redvers. In the 14th and 15th centuries the French made frequent attacks on the coast. During the Wars of the Roses frequent skirmishes took place between the earl of Devon and Lord Bonville, the respective champions of the Lancastrian and Yorkist parties. In 1470 Warwick and Clarence were pursued as far as Exeter by Edward IV after the battle of "Lose-Cot Field." Warwick subsequently escaped to the Continent from Dartmouth. Richard III came to Exeter to punish personally those who had inflamed the West against him. Hundreds were outlawed, including the bishop and the dean. Perkin Warbeck besieged Exeter in 1497, and Henry VII came down to thank the citizens for their resistance and to judge the prisoners. Great disturbances in the county followed the inaugural service of Edward VI's prayer book on Whit Sunday, 1549. A priest at Sampford Courtenay was persuaded to read the old Mass on the following day. Swiftly the insubordination spread into a serious revolt, in which the men of Cornwall joined, and Exeter suffered a distressing siege before it was relieved by Lord Russell. On the outbreak of the Civil War the county as a whole favoured the parliament, but the prevailing desire was for peace, and in 1643 a treaty for the cessation of hostilities in Devon and Cornwall was agreed upon. Skirmishes, however, continued until 1646. After the Monmouth rebellion, Judge Jeffreys held a "bloody assize" at Exeter. In 1688 the prince of Orange landed at Torbay and stayed for several days at Forde and at Exeter.

The tin mines of Devon have been worked from time immemorial, and in the 14th century mines of tin, copper, lead, gold and silver are mentioned. At the time of the Domesday Survey the salt industry was important, and there were 99 mills in the

county and 13 fisheries. From an early period the chief manufacture was that of woollen cloth, and a statute 4 Ed IV permitted the manufacture of cloths of a distinct make in certain parts of Devon. About 1505 Anthony Bonvis, an Italian, introduced an improved method of spinning into the county, and cidei making is mentioned in the 16th century. In 1680 the lace industry was already flourishing at Colyton and Ottery St Mary, and flax, hemp and mill were largely produced in the 17th and 18th centuries.

Devon returned two members to parliament in 1290, and in 1295 Barnstaple, Exeter, Plympton, Tavistock, Torrington and Totnes were also represented. In 1831 the county, with its boroughs returned 26 members, but under the Reform Act of 1832 they were reduced to 18. Subsequent bills brought further reductions. The redistribution bill of 1918 left the county with a total of 11 members.

The churches are for the most part of the Perpendicular period, dating from the middle of the 14th to the end of the 15th century. Exeter Cathedral is an exception the whole (except the Norman towers) being very beautiful Decorated work. The special features of Devonshire churches are the richly carved pulpits and chancel screens of wood. The largest and the most beautiful screen is that at Hartland (c. 1450). Granite crosses are frequent, the finest being that of Coplestone near Crediton. A number of ancient rude stone crosses stand among the prehistoric ruins remains on the wastes of Dartmoor. Monastic remains in the county, the principal are those at Tor, Buckfast, Tavistock and Buckland abbeys. Buckfast abbey was reconstructed (see Buckfastleton). Among domestic buildings may be mentioned the 14th century parsonage at Little Hempston, the house of Weir Gifford, Bradley and Dartington of the 15th century, Bradnald and Holcombe Rogus (Elizabethan) and Ford (Jacobean). The ruined castles of Okehampton (Edward I), Exeter, with its vast British earthworks, Burrington (Henry III, with ruins of a large Tudor mansion) Tonnes (Henry III) and Compton (early 15th century), are all interesting.

Climate and Agriculture.—The climate is more humid than that of the eastern or southeastern parts of England. The mean annual temperature somewhat exceeds that of the midlands, but the average summer heat is rather less than that of the southern counties to the east. The air of the Dartmoor highlands is sharp and bracing. Mists are frequent, and snow often lies long. On the south coast frost is little known, and hydrangeas, myrtles, geraniums and heliotrope live through the winter without protection. The climate of the watering places on this coast is very equable, the mean temperature in January being 43.9° at Plymouth. The north coast, exposed to the storms of the Atlantic, is more bracing, although there also, in the more sheltered nooks (as at Combe Martin), myrtles of great size and age flower freely.

The cultivated area falls a little below the average of the English counties. In 1939 there were, however, about 364,381 ac. of rough grazing and 708,272 ac. of permanent grass. The arable land was estimated at 415,438 ac. Oats, wheat, barley and root-crops are chiefly grown. The acreage under oats—83,600 ac.—was about four times that under barley. Wheat occupied 22,901 ac. The Devon breed of cattle is well adapted both for fattening and for dairy purposes, while sheep are kept in great numbers on the hill pastures (973,209 in 1939). Devon is specially famous for clotted cream and junket. The bulk of the acreage under green crops is occupied by turnips and swedes and mangolds at 22,335 ac. and 14,984 ac. respectively. Orchards occupy a large acreage, 21,400 ac. in 1939, and consist chiefly of apple trees, mainly for the manufacture of cider. The National Trust owned about 2,250 ac. in the county in 1942 and had a 500-year lease of 10,000 acres in Exmoor at a nominal rent.

Fisheries.—Large quantities of the pilchard and herrings caught in Cornish waters are landed at Plymouth. Much of the fishing is carried on within the three-mile limit, and it may be asserted that trawling is the main feature of the Devonshire industry, whereas seining and driving characterize that of Cornwall. Pilchard, cod, sprats, brill, plaice, sole, turbot, shrimps, lobsters, oysters and mussels are met with, besides herring and mackerel,

which are fairly plentiful. After Plymouth the principal fishing station is at Brixham, but there are many lesser stations.

Other Industries.—The principal industrial works are the various government establishments at Plymouth and Devonport. Among other industries may be noted the lace works at Tiverton, the manufacture of pillow lace for which Honiton and its neighbourhood has long been famous, and the potteries and terra cotta works of Bovey Tracey and Watcombe. Woollen goods and seiges are made at Buckfastleigh, while Plymouth produces chemical manure, soap, starch, black and black lead.

Minerals.—Silver lead was formerly worked at Combe Martin, near the north coast, and elsewhere. Tin has been worked on Dartmoor (in stream works) from an unknown period. Copper was not much worked before the end of the 18th century. Tin occurs in the granite of Dartmoor, and along its borders, and especially, with zinc and iron, around Tavistock, which has the Devon Great Consols mine within 4 mi., which from 1843-71 were the richest of copper mines. But Devonshire mining is affected by the same causes as that of Cornwall. The quantity of ore has greatly diminished and the cost of raising it from the deep mines prevents competition with foreign markets. In many mines tin underlies the general depth of the copper, and is worked when the latter has been exhausted. Great quantities of refined arsenic have been produced at the Devon Great Consols mine, by elution from the iron pyrites contained in the various lodes. Manganese occurs in the neighbourhood of Exeter, in the valley of the Teign and in north Devon, but the most profitable mines are in the Tavistock district. There are two mines for tungsten ores, at Gunnislake, near Tavistock, and Maryvett.

The other mineral productions of the county consist of marbles, building stones, slates and potters' clay. The granite of Dartmoor is much quarried near Princetown, near Moreton Hampstead on the northeast of Dartmoor, and elsewhere. Hard traps, which occur in many places, are also much used for building, as are the limestones of Buckfastleigh and of Plymouth. The Roborough stone, used from an early period in Devonshire churches, is found near Tavistock, and is a hard porphyritic elvan, taking a fine polish. Excellent roofing slates occur in the Devonian series round the southern part of Dartmoor. The chief quarries are near Ashburton and Plymouth (Cann quarry). Potters' clay is worked at King's Teignton, whence it is largely exported, at Bovey Tracey, and at Watcombe. The Watcombe clay is of the finest quality. China clay or kaolin is found on the southern side of Dartmoor, at Lee Moor, and near Lustleigh. There is a large deposit of amber close to Ashburton.

Communications.—The main line of the G.W. railway, entering the county in the east from Taunton, runs to Exeter, skirts the coast as far as Teignmouth, and continues a short distance inland by Newton Abbot to Plymouth, after which it crosses the estuary of the Tamar by a great bridge to Saltash in Cornwall. Branches serve Torquay and other seaside resorts of the south coast, and among other branches are those from Taunton to Barnstaple, and from Plymouth northward to Tavistock and Launceston. The main line of the Southern railway between Exeter and Plymouth skirts the north and west of Dartmoor by Okehampton and Tavistock. A branch from Yeoford serves Barnstaple, Ilfracombe, Bideford and Torrington. The branch line to Princetown from the Plymouth Tavistock line of the G.W. company in part follows the line of a very early railway—that constructed to connect Plymouth with the Dartmoor prison in 1810-25, which was worked with horse cars. The only waterways of any importance are the Tamar, which is navigable up to Gunnislake (3 mi. S.W. of Tavistock), and the Exeter ship canal, noteworthy as one of the oldest in England, for it was originally cut in the reign of Elizabeth.

The area of the administrative county is 2,582 sq. mi. Pop. (est. 1938) 741,660. War-time movements caused by evacuation from dangerous areas raised the population of Devon by 10% between Sept. 1939 and Feb. 1941. There were in 1943 ten municipal boroughs, two county boroughs, and 21 urban districts.

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The Old Red reappears in the Cheviots (where it is largely igneous) and on the margins of the Forth and Clyde syncline. Here both Devonian and Dittonian are recognizable by their fossils. The former follows the Silurian conformably, but is frequently separated from the Dittonian by an unconformity. The latter includes conglomerates, lavas, tuffs and lacustrine deposits, with *Mesacanthus*, *Cephalaspis* *lyelli* and *Pteraspis*.

On the Moray Firth, in Caithness, the Orkneys and Shetlands are strata intermediate in age between the Dittonian and Upper Old Red, which are classed as Middle Old Red, but they are more allied to the Upper than to the Lower. In Caithness an unfossiliferous basement series is followed by conglomerate, and arkose, and then by thick beds of bituminous and calcareous flags and sandstones. Characteristic fossils are *Thursus*, *Dipterus valencienensis*, *Mesacanthus*, *Coccosteus decipiens*, *Pterichthys*, *Estheria* and *Palaeospondylus*. A higher horizon, the John o' Groat beds, has a distinct fauna.

The Upper Old Red sandstone of Scotland overlies unconformably the Lower Old Red in the south and the Middle in the north. There are two horizons. The Lower, the Nairn sandstone, contains *Psammosteus tessellatus*, *Astrolophus maxima*, and the Upper, the Alves or Scaat Craig beds, has *Psammosteus pus sulatus*, *Bohrrolophus major* and *Holoptichthys nobilissimus*. Only one form, *H. decoratus*, is common to both.

The Devonian appears to occur in Norway and the Dittonian in Spitzbergen. Upper Old Red with *Holoptichthys* and *Archaeopterus* is found in Bear Island, associated with thin coals. In Nova Scotia and New Brunswick the Dittonian with *Cephalaspis* and *Pteraspis* rests unconformably on the Silurian. The Upper Old Red also occurs in the latter, and in New York State it is represented by the Oneonta beds with *Estheria*, and the Catskill with *Bohrrolophus* and *Holoptichthys*.

In Antarctica, the Upper Old Red age of the Beacon sandstone is indicated by the same two forms.

The marine succession sometimes includes continental intercalations, and even in the marine beds, different facies occur according to the varying conditions under which deposition took place.

Nearest to land were the brackish water and littoral deposits, which may show by red or purple coloration the desert origin of their materials. In deeper water and farther from shore terrigenous mud, now shale or slate, was laid down, and where conditions were favourable, coral reefs or lenticular limestones were formed. At still greater depths and distance from land, calcareous ooze accumulated with thin shelled molluscs, goniatites and simple corals. The position of these different facies was modified by changes in the level of the sea and floor movements. To the former has been attributed the recession of the sea throughout the Northern Hemisphere at the beginning of the period. The shore line of the northern continent then passed south of Ireland, through Cornwall and south Devon, entered northern France near Boulogne, passed by way of Fepin to the north of the massives of the Rhine and Harz, and of Bohemia, then southward to the Dniester region and central Russia, and north-westward to the White sea. In the Middle Devonian an important advance of the sea began and reached its maximum at the close of the Middle or beginning of the Upper Devonian. The shore line of the northern continent then passed across south Ireland, Pembrokehire, the Bristol channel, Middlesex, north Belgium, the Baltic, Finland, and Lapland. In the latter Upper Devonian there was a new retreatment of the sea, and the shore line moved southward again—in some places nearly as far as before, in others, as in Bohemia, still farther.

Parallel to the continental shores, the weight of the terrigenous sediments and accumulated limestones caused a sag of the sea bottom in "geosynclines," and this permitted a still heavier accumulation of deposits.

CENTRAL EUROPE

It is in the Palaeozoic massive of the Ardennes and the Rhineland that the marine Devonian has been most studied. There it has been thrown by the subsequent Almonian movements into

folds dipping to the south, and it is in the troughs of these folds that the Middle and Upper Devonian are found as outliers in the Lower. On the Meuse are two main synclines, that of Namur in the north and that of Dinant in the south. On the southern limit of the latter the base of the system is formed by a conglomerate and arkose. These are covered by the Mondreputis shales with *Spiser sulcatus* (*mercurei*) which are correlated with the Devonian. They are succeeded by the mottled Ognies shales containing *Pteraspis* and, therefore, presumably Dittonian.

The next horizon, the Siegenian is represented in Belgium by the Anor grits and the Montigny Greywacke, and in the Rhineland by the Taunus quartzite and the Hunsrück slates, or their equivalents, the Siegen slates. Then follows the Emsian with, on the Meuse, the Red shales of Vireux, and on the Rhine, the Lower Coblenz beds. A higher horizon is that of the Hierges Greywacke corresponding to the Coblenz quartzite and Upper Coblenz beds.

On the north of the Dinant syncline and near the former coastline, the Lower Devonian is represented only by the Burnet conglomerate. In the south eastern Harz, the Lower Devonian has a deep water ("Hercynian") facies with *Spiser togatus*, *Sp. hercyniae*, *Capulus* and *Phacops secundus*. The same fauna appears in the Konjprus limestone of Bohemia, Brander's F₂ zone.

The Middle Devonian is divided into the Eifelian and the Givetian. At the base of the former is the *Spiser cultrigatus* zone. Then follow the *Calcola* Beds. The Givetian is distinguished by the large brachiopod *Stringocephalus*. The Middle Devonian is usually more calcareous than the Lower and the Givetian than the Eifelian. In the Namur syncline the *Calcola* beds rest directly, except for a conglomerate, on the Silurian. Still further north in Brabant, the Eifelian is absent and the Givetian is only separated from the Silurian by a similar conglomerate. In south-west Westphalia the Eifelian and Lower Givetian consist of sandy clays often more or less calcareous. They have yielded plants and *Archaeodon* and were probably laid down in fresh water. Similarly in the Boulonnais, sandy beds with plants seem to represent the Eifelian as they are overlaid by a limestone with *Stringocephalus*. In the southern Rhineland the middle division consists of deep water shales and limestones. In Bohemia the Eifelian is represented by Barrande's zones G₁, G₂ and G₃, deep water limestones, the Givetian, on the other hand, by the zones H₁, H₂ and H₃, shales and sandstones with plants and *Stringocephalus*. The deep water Middle Devonian has been zoned by species of goniatites. Of these, *Meneceus* and *Tornoceras* are characteristic of the Upper Givetian.

The Upper Devonian has two main divisions, the Frasnian and the Famennian. The former commences by limestone with *Buchiola retrostrata*, succeeded by the Budesheim or Matagne shales, with characteristic goniatites, including *Manticoceras tumescens* and *Tornoceras simplex*, and the bituminous Kellwas limestone. Other Frasnian fossils are *Spiser verneui*, which extends through all the Upper Devonian and *Phyllopastra*. The deep-water Famennian is characterized by the prevalence of the *Clymenia* group. In the lower Famennian it is accompanied by the goniatite genus *Cheiloceras* which marks the horizon of the Neiden shales. The Cypridina shales, laid down in shallower water, contain the small bivalve crustacean *Entomus*—formerly *Cypridina serrato-strata* in large numbers. In the Namur syncline continental conditions prevailed in the upper Famennian with *Holoptichthys* and *Archaeopterus*, though in some places littoral forms like *Cucullaea hardingi* are found. In the Boulonnais the *Stringocephalus* limestone is followed by fossiliferous Frasnian limestone, and then reddish shales with *Spiser verneui* and sandstone comparable with that of Condor. In Bohemia there is no evidence of the Upper Devonian, but in the eastern Alps the whole formation is well represented.

In the south west of England, the Devonian is also strongly folded. The lowest rocks in north Devon and West Somerset are the continental Foreland grits—red sandstones and conglomerates, of which the base is not seen as they form an anticline, they contain only scanty indeterminate fragments of fish and plants. The succeeding Lynton beds appear to include Dittonian beds, with *Pteraspis*, and Siegenian with *Spiser primaevus* and *Sp.*

| | | Typical Fossils | | Meuse Valley | | Rhinecland Localities | Bohemian | North Devon | South Devon and Cornwall | New York State (Marine beds) |
|-----------------|---|---|---|---|-------------------------------------|---|---|---|--|--|
| | | Concomitant | Marine | Dinant syncline | Namur syncline | | | | | |
| Lower Devonian | Fraserian | <i>Holocephalus</i> <i>Bellerophon</i> | <i>Phylloptera dan-</i> <i>maria</i> <i>Osmolites</i> <i>Bellerophon</i> <i>Strophomena</i> <i>Chonetes</i> | Deep water shales | Condroz Sandstones | Misacrus Clypeum beds Nehden shales | Absent | Lower Filton beds Marine nodules Piddwell Down sandstones | Reddish beds with <i>Entonia serrata</i> Nehden and Ithaca Calcareous shales with <i>Nehden</i> fauna | Chenango sandstone Nehden and Ithaca beds |
| | Fraserian | <i>Coccyzium</i> <i>Macrogonia</i> <i>C. dybowskyi</i> | <i>Trematoceras</i> <i>Manilioceras</i> <i>Ductolis retro</i> <i>Rhynchonella</i> <i>Calymene</i> <i>Phylloptera</i> <i>Strophomena</i> | Shales and limestones More massive limestones | Limestones and Dolomites | Kellns Limestone Buddsham shales Ithaca limestone Deep limestone | Absent | Upper Ilfracombe beds | Slates with Buddsham fauna, limestone | Genesee shales Tully limestone |
| Middle Devonian | Givetian | <i>Diplerus</i> <i>Macrogonia</i> | <i>Stringocephalus</i> <i>Macrogonia</i> <i>Cyclophylloids</i> <i>quadrangulum</i> | Massive limestones Givetian and Givetian limestones Marly limestones | Limestone | Masée Limestone Osmolites limestone | Dark shales with plants and <i>Strophomena</i> H. to H. | Lower Ilfracombe beds Strophomena Mylina beds | Limestone | Hamilton calcareous shale |
| | Eifelian | <i>Diplerus</i> <i>Macrogonia</i> <i>Macrogonia</i> <i>Macrogonia</i> <i>Pteridolites</i> <i>Thrinacos</i> | <i>Cornuophylloids</i> <i>Calymene</i> <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> | Marls and limestones Limestones of the Calymene bed <i>Calymene</i> <i>Calymene</i> <i>Calymene</i> | Limestone Nannum Conglomerate | Gurter limestone Wissenbach shales Bullers shales Knoll limestone and mortified limestone | Cephalopod Knoll limestone (C) Tentacles Shales (C) Shales (C) Knoll limestone and mortified limestone | Plant beds Trentishaw grns | Calcareous shales Upper Studdon grns | Marcellus shales Onondaga limestone |
| Upper Devonian | Emusan (Coblentzian in the lower sense) | ? | <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> | Massive greywacke Red shales of the | Absent | Upper Coblentz Coblentz quartzite Lower Coblentz beds | White | Upper Lynton beds | Lower Studdon grns and Upper Meadfoot beds | Onondaga sandstone |
| | Sageanian | ? | <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> | Montgomery greywacke Vaux grns | Absent | Hunterd quartzite Tannus beds Shales | Kongressus Limestone (F) | Middle Lynton beds | Middle Meadfoot beds | Helderberg |
| Coblenzian | Dittman | <i>Pteridolites</i> <i>Cephalopods</i> <i>Macrogonia</i> <i>Macrogonia</i> | <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> | St. Hubert shales Ognes shales | Absent | Shales | Absent | Lower Lynton beds | Lower Meadfoot beds Dartmouth shales | Limestone |
| | Downman | " <i>gastrolites</i> " <i>Cephalopods</i> <i>Lyall</i> | <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> <i>Strophomena</i> | Montreuil shales Haynes Arkose Frycon conglomerate | Absent | Quartzites | Absent | (?) Foreland grns | Porterthorpe calcareous shales | |

hystericus They are overlaid by grits resembling the Forelands, and called collectively the Hangman grits. The lower beds, the Trantishoe grits, have yielded no fossils, but at a higher level are sandstones and shales with plant remains and a scyle of *Coccos tenuis*, followed by littoral beds with casts of *Myahna*, *Cucullaea* and *Naticopsis*, and by calcareous grits with *Stromiocephalus* which must be Givetian. Above these is a thick succession of grits, slates and limestones, the Ilfracombe beds. They include coral reefs with *Cyathophyllum* (*Phacelophyllum*) *caespitosum*, *Endophyllum*, and *Pachypora cervicornis*. At a somewhat higher horizon occur *Helioophyllum helanthoides* and *Spirifer verneuili*. The latter, at least, indicates the Upper Devonian. The higher beds, which are arenaceous, are succeeded by the smooth Morte slates with *Spirifer verneuili*, and then by the Pickwell Down sandstone, a continental deposit corresponding to the Cornioz sandstone.

At the base is a bed of volcanic ash associated with fish remains including *Bothriolepis* and *Holopteryx*. The Pickwell Down sandstone passes up into the littoral Baginbun and Marwood beds. These contain two fossils *Cucullaea unilateralis* and *Ptychotermia dammonensis*, also found in the marine beds in the Upper Old Red of Pembrokeshire and the Coomhola grits of Ireland. Then follow the Pilton beds which extend up into the Carboniferous, which occupies a great syncline crossing Devonshire from east to west. Beyond this the Devonian reappears in Cornwall and south Devon. In south west Cornwall it rests on the Silurian, but the rocks are so dislocated that it is impossible to say whether the formations are conformable or not. The Devonian may be represented by the Poriscatho beds, arenaceous slates which pass up into the smooth Falmouth slates, apparently identical with the Dartmouth slates that form an anticline traversing south Devon and Cornwall. They contain *Cephalaspis* and *Pteraspis*, and appear to be fresh water deposits of Devonian age, except in south Devon, where the presence of *Bellerophon* and *Loxonema* indicates brackish conditions. The succeeding Meadfoot beds have yielded *Spirifer primaevus*, *Sp. hystericus*, and other marine fossils of Siegenian age. Then follow the Staddon grits which include beds of Emsian age, with *Tropidolepis rhenanus* and others at the base of the Middle Devonian, with *Spirifer cultrigatus*.

Next are slates and slaty limestones with *Calceola*. There are also great developments of limestone near Plymouth and Torquay in which both Middle and Upper Devonian are represented, for the fossils include *Spirifer curvatus*, *Stromiocephalus*, *Spirifer verneuili* and *Rhynchonella* (*Hypothyris*) *cuboides*. The Budeheim horizon is found at Trevona bay, in North Cornwall, and Saltern cove, in South Devon, that of the Nehden shales at Port Quin in north Cornwall. Famennian horizons are also represented by strata with *Clymenia*, *Entomis serrato-strata* and *Styloloma*. The Devonian, south of the syncline, is overlapped by beds high up in the Carboniferous limestone, and the overlap increases to the south, but this relation is obscured by overthrusts of the Devonian over the Carboniferous.

Deep under London both continental and marine Upper Devonian are met with. Many horizons of the Devonian occur in Armorican folds of the north-west of France. In the Devonian rocks of southern Europe, the Lower Devonian and Eifelian are represented by limestones and dolomites laid down at moderate depths, the Givetian and Upper Devonian by limestone accumulated in deeper water, with pale reddish or greenish tints, believed to characterize calcareous oozes.

In the Baltic and adjoining areas the Devonian succeeds to the Silurian, but there is then a break (without unconformity) followed by typical Middle Old Red. This is, however, succeeded by marine Frasnian with *Spirifer Anosofskyi*, an eastern form. In the Famennian, continental conditions returned. Further south and east, however, there are marine intercalations, and in central Russia and the Urals, the Famennian is wholly marine. Both the Scotch zones of the Upper Old Red are represented in north-eastern Europe—the Nairn sandstone by the Wenden deposits on the Aa in Livonia, and the Alves by those of the Sjass river near Leningrad.

NORTH AMERICA

The seas on the east and west of the position of the present continent of North America were regions of sedimentation and subsidence, and from them the marine transgression spread over the intervening area. The succession in New York State where the beds have been but little disturbed is given in the table. The Helderbergian consists of deep sea limestones similar to those of the Lower Devonian of Bohemia. It rests conformably on the Silurian, and is succeeded in the east by the Onondaga sandstone which occurs discontinuously as far west as the Mississippi. It resembles the Lower Devonian of the Meuse and Rhine. As the sea deepened and extended, the Onondaga limestone was laid down, which the presence of *Spirifer acuminatus* (*cultrigatus*) would place low in the Eifelian. The limestone is represented by shales in the south, and is later itself replaced by the Marcellus shales which are correlated by their goniatites with the Wassenbach shales of Europe. They are followed by the more calcareous Hamilton shales, with increasing depth of the sea, which, at the end of the Middle Devonian, occupied 38% of the area of the present continent. Although the Hamilton was contemporaneous with the Givetian of Europe, the fauna is quite distinct from that of the *Stromiocephalus* beds, which is, however, found in Manitoba. The affinities of the Hamilton are with southern areas.

The Upper Devonian commences with the Tully limestone, the equivalent of the Ibreg limestone of Europe, followed by the Genesee bituminous and pyritic shale and the Portage beds with three facies, in the west the deep water Naples shales with *Gephyroceras intumescens*, in the east the Ithaca shales and sandstones with *Tropidolepis carinatus*, also found in the Hamilton, and still further east the Oneonta. The Famennian is represented by the continental Catskill beds and the marine Chemung, with *Spirifer verneuili*. In Montana shaly marls with *Clymenia* and *Cheloceras* indicate deeper water.

SOUTH AMERICA AND AFRICA

The most complete succession is found in Bolivia. Resting unconformably on the Ordovician are (1) the Icla sandstone with Silurian fossils near its base, (2) the sandy Icla shales, (3) the Huampampa sandstone, and (4) the Sicasica beds. The fauna of the Icla shales and the Huampampa sandstone is widespread through the Southern Hemisphere—in Parana (Brazil), the Argentine, the Falklands, and the Bokkeveld beds, which overlie the Table Mountain sandstone in South Africa. *Spirifer antarcicus*, *Chonetes falklandicus*, and *Leptocoelia fiabellites* are found throughout. The fauna of the Sicasica beds is essentially Middle Devonian with some lower forms. It has affinities with the Hamilton. The Devonian fossils of the Sahara are related to North and South American forms. The Devonian of the Gold Coast appears to be a littoral facies of the Hamilton, and is linked with the Sicasica by *Homalonotus dehayi*.

The older southern fauna extending from the Sicasica shales to the Bokkeveld beds may be placed at the base of the Middle Devonian or high in the Lower. Its special characters, the scarcity of corals and bryozoa, the number of discoid brachiopods, the absence of limestones and the dark grey, blue and green colouring have been attributed to polar conditions, a view supported by the occurrence of glaciation in the Table Mountain sandstone. Some indeterminate lamellibranchs at the base of the latter may be Silurian like the Icla sandstone, not Devonian. The Bokkeveld passes up into the Witteberg, a series of sands and quartzites containing indistinct plant remains, which are believed to represent a passage into the Carboniferous.

Except for the Caledonian movement at its commencement the Devonian was a time of comparative quiet, but of slow movements, affecting the distribution of land and water and causing unconformities and overlaps.

The granite or granodiorite intrusions of the late Silurian in the north of Great Britain continued into the early Devonian. They were associated with volcanic activity, mainly of an andesitic or basaltic character, and minor intrusions of similar composition. In Devon and Cornwall there were, in later Devonian times, submarine outpourings of spilitic pillow lavas accompanied by tuffs.

They resemble the contemporaneous schists of Germany

ECONOMIC PRODUCTS

There are iron ores of some importance mostly occurring as replacements of limestone. The metalliferous lodes of Cornwall and Devon are largely in rocks of Devonian age, but are the result of Archaean igneous activity. The oil of Ontario has its source in Middle Devonian shales, while that of New York and Pennsylvania may be derived from the black shales of the Upper Devonian.

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DEVONPORT, a seaport, garrison and market town of Devonshire, England, served by the S.R. and G.W.R. Devonport is the seat of one of the royal dockyards, and an important naval and military station. It is situated on the west of Plymouth and the east shore of the Hamoaze (or estuary of the Tamar and the Lynher) at its entrance into Plymouth sound. The "three towns" of Devonport, East Stonehouse (in the middle) and Plymouth now form one unit. Devonport is connected with East Stonehouse by a bridge over Stonehouse pool, an inlet of Plymouth harbour. A ferry across the Hamoaze connects it with the wooded peninsula of Mount Edgcumbe on the Cornish shore, and river steamers ply to Saltash and St Germans higher up the river, at Morice Town a floating bridge connects with Tor point in Cornwall. Devonport, which owes its origin to the royal dockyard on the Hamoaze, begun in 1689 and now known as the "South Yard," was called Plymouth Dock until 1820, when it changed its name to Devonport. The "old town" which grew up around the dockyard is marked by the fortified "lines," known as the Brackfields, now mostly demolished and providing an open space and parade grounds, with Devonport park (37 ac.) at the northern end. Beyond the districts of Stoke or Stoke Damerel, Ford and Morice Town on the Hamoaze to the north. Stoke Damerel, a residential suburb, is the mother parish of Devonport and contains the old parish church of St. Andrew, originally Perpendicular with a 15th century tower. Morice Town is a rapidly growing district which has arisen round Keyham Steam yard, now the "North Yard," the second of the government dockyards, established in 1846, with its own iron and brass foundries, machinery shops, engineer students' shops, and docks and basins along the Hamoaze. St. Budeaux to the north was joined to Devonport in 1914. There are several points of elevation in Devonport, and the prospect from Mount Wise at the southern extremity of the old town overlooking the river and its shore is one of the finest on the south coast. Here, together with a naval signalling station, is the residence of the commander-in-chief or port admiral, of the Plymouth naval command, as well as the headquarters and residence of the general officer commanding the southwestern military area. A national memorial to Capt. R. T. Scott and his four companions of the South Polar expedition was erected there in 1925. From here the Regent, George Square and other naval and military barracks and quarters extend northwards to the St. Budeaux barracks and naval armament depot at Bull point. Stonehouse pool is lined with the new quays, wharves and boat-building yards, at the northern end is the military hospital (1797), facing the naval hospital in Stonehouse. Among the public buildings and institutions of Devonport are the town hall (1822), market house (1852) and public library, close to which is a granite column, built 1824, commemorating the renaming of the town, the Royal United Services and the Royal Dockyard orphanages, and the Prince of Wales's hospital buildings and a Sailors' Rest. Devonport is a station of the western division of the home fleet. The admiralty moorings in the Hamoaze extend for 3 mi. Between the South and the North yards is the Gun Wharf (c. 21 ac.) on the Hamoaze, first laid out in 1718, with armoury, storehouses, etc., the three establishments, with the naval bar-

racks, known as H.M.S. "Drake," being connected by a tunnel. In 1907 an extension of 118 ac. was made to the North yard, including a tidal basin of 10 ac. and closed basin of 35½ ac. (with coaling depot and direct access to the Hamoaze), each with a depth of 32 ft. at low water springs, and affording access to large new graving docks of 700–800 ft. length. The South yard also contains a sail factory and a ropery where a large part of the hempen ropes used in the navy are produced. By the Reform act of 1832 Devonport became a parliamentary borough including East Stonehouse and returning two members. It was incorporated in 1837. In 1914 it amalgamated with Plymouth. The ground on which it stands is largely the property of the St. Aubyn family (Baron St. Leon), as lords of the manor.

DEVONPORT, EAST AND WEST, a town on the N. coast of Tasmania, Australia, on both sides of the mouth of the river Mersey, about 30 mi. NW of Launceston. Pop. 5,151. Devonport ranks as the third port in Tasmania. It is the centre of an important dairy, potatoes and timber area. The limestone used in the Newcastle steel mills is obtained nearby.

DEVONSHIRE, EARLS AND DUKES OF The Devonshire title, now in the Cavendish family had previously been held by Charles Blount (1563–1606), 8th Lord Mountjoy, great-grandson of the 4th Lord Mountjoy (d. 1534), the pupil of Erasmus, he was created earl of Devonshire in 1601 for his services in Ireland (1600–03), but the title became extinct at his death. In the Cavendish line the 1st earl of Devonshire was William (d. 1666), second son of Sir William Cavendish (q.v.), and of Elizabeth Hardwick, who afterwards married the 6th earl of Shrewsbury. He was created earl of Devonshire in 1618 by James I., and was succeeded by William, 2nd earl (1591–1628), and the latter by his son William (1617–1684).

WILLIAM CAVENDISH, 1st duke of Devonshire (1640–1707), English statesman, eldest son of the earl of Devonshire last mentioned, was born on Jan. 25, 1640. In 1661 he entered parliament, and soon showed himself a determined and daring opponent of the general policy of the court. In 1678 he was one of the committee appointed to draw up articles of impeachment against the lord treasurer Danby. In 1679 he was re-elected for Derby, and made a privy councillor by Charles II., but he withdrew from the board with his friend Lord Russell, when he found that the Roman Catholic interest uniformly prevailed. He carried up to the House of Lords the articles of impeachment against Lord Chief-Justice Scroggs, and when the king declared his resolution not to sign the bill for excluding the duke of York, afterwards James II., he moved in the House of Commons that a bill might be brought in for the association of all his majesty's Protestant subjects. He appeared in defense of Lord Russell at his trial, and after his condemnation he offered to exchange clothes with him in the prison, remain in his place, and so allow him to effect his escape. In Nov. 1684 he succeeded to the earldom. He opposed arbitrary government under James II. with the same consistency and high spirit as during the previous reign. An imprudent quarrel at court was punished by a fine of £30,000 which he could not pay, and he was in prison for some time. After his discharge the earl occupied himself with the erection of a new mansion at Chatsworth designed by William Talman, with decorations by Verrio, Thornhill and Grinling Gibbons. The revolution again brought him into prominence. He was one of the seven who signed the original paper inviting the prince of Orange from Holland, and was the first nobleman who appeared in arms to receive him at his landing. He received the order of the Garter, and was made lord high steward of the new court. In 1690 he accompanied King William on his visit to Holland.

He was created marquess of Hartington and duke of Devonshire in 1694.

He had married in 1661 the daughter of James, duke of Ormonde, and was succeeded by his eldest son William as 2nd duke, and by the latter's son William as 3rd duke (vicerey of Ireland, 1737–44). The latter's son William (1720–64) succeeded in 1755 as 4th duke, he married the daughter and heiress of Richard Boyle, earl of Burlington and Cork, who brought Lismore castle and the Irish estates into the family, from Nov. 1756 to May 1757 he

was prime minister, mainly in order that Pitt, who would not then serve under the duke of Newcastle, should be in power. His son William (1748-1811), 5th duke, was the husband of the beautiful Georgiana Spencer, duchess of Devonshire (1757-1806), and of the intellectual Elizabeth Foster, duchess of Devonshire (1757-1824), both of whom Gainsborough painted. His son William, 6th duke (1790-1858), died unmarried. The title passed in 1858 to his cousin William (1808-91), 2nd earl of Burlington, as 7th duke, who, in 1829 was second wrangler at Cambridge, first Smith's prizeman and eighth classic, and subsequently became chancellor of the university.

DEVONSHIRE, SPENCER COMPTON CAVENDISH, 8TH DUKE OF (1833-1908), born at Holker Hall on July 23, 1833, was the son of the 7th duke (then earl of Burlington) and his wife Lady Blanche Howard (sister of the earl of Carlisle). In 1854 Lord Cavendish, as he then was, took a second class in the mathematical tripos at Trinity college, Cambridge, in 1856 he was attached to the special mission to Russia for the new tsar's accession, and in 1857 he was returned to parliament as Liberal member for North Lancashire. At the opening of the new parliament of 1859 the marquis of Hartington (as he had then become) moved the amendment to the address which overthrew the government of Lord Derby. In 1862 he visited the United States, and in 1863 he became first lord of the Admiralty, and then under secretary for war in Lord Palmerston's government, and on the formation of the Russell-Gladstone administration at the death of Lord Palmerston he entered it as war secretary. He retired with his colleagues in July 1866 and used his comparative leisure to visit Germany and to meet Bismarck. On Gladstone's return to power in 1868 he became postmaster general, an office which he exchanged against his own inclination, in 1871, for that of secretary for Ireland. When Gladstone, after his defeat and resignation in 1874, temporarily withdrew from the leadership of the Liberal Party in Jan. 1875, Lord Hartington reluctantly accepted the position of Liberal leader in the House of Commons, Lord Granville being leader in the Lords. W. E. Forster, who had taken a much more prominent part in public life, was the only other possible nominee, but he declined to stand. The new leader of the House was a moderate critic of Disraeli's foreign policy in the near East, but emphatically condemned the conduct of Indian affairs which led up to the first Afghan War of 1878. After the Conservative defeat in the general election of 1880, the queen, in strict conformity with constitutional usage (though Gladstone himself thought Granville should have had the preference), sent for him as leader of the opposition, but Hartington declined the request to form a government, in view of Gladstone's position in the party. Hartington joined the new Gladstone government as secretary of State for India, from which office, in Dec. 1882, he passed to the War Office. His administration was responsible for the expeditions of Gen. Gordon and Lord Wolsley to Khartoum.

He shared the responsibility for sending Gordon to evacuate the Sudan, but it must be said that he repeatedly warned the cabinet of the urgency of the Wolsley relief expedition, and threatened resignation when a decision was delayed. In June 1885 he resigned along with his colleagues, and in December was elected for the Rossendale division of Lancashire, created by the new Reform Bill. Immediately afterwards Gladstone's conversion to home rule for Ireland forced on Lord Hartington the great political decision of his life. His refusal to follow his leader in this course inevitably made him the chief of the new Liberal Unionist Party. He moved the first resolution at the famous public meeting at the opera house in the Haymarket (April 14, 1886), when Lord Salisbury was also on the platform. In the House of Commons Hartington moved the rejection of Gladstone's bill on the second reading. During the electoral contest which followed, no election excited more interest than Lord Hartington's for the Rossendale division, where he was returned by a majority of nearly 1,500 votes.

In the new parliament he held a position much resembling that which Sir Robert Peel had occupied after his fall from power, the leader of a small, compact party, the standing and ability of

whose members were out of all proportion to their numbers, generally esteemed and trusted beyond any other man in the country yet in his own opinion forbidden to think of office. Lord Salisbury's offers to serve under him as prime minister (both after the general election and again in Jan. 1887, when Lord Randolph Churchill resigned) were declined, and Lord Hartington continued to discharge the delicate duties of the leader of a middle party. It was not until 1895, when the differences between Conservatives and Liberal Unionists had become attenuated by changed circumstances, and the habit of acting together, that the duke of Devonshire, as he had become by the death of his father in 1891, entered Lord Salisbury's third ministry as president of the council, an office which carried at that time the responsibility for education. He also presided over the cabinet committee of defence. In 1892 he succeeded his father as chancellor of the University of Cambridge. In that year too he married the widow of the 7th duke of Manchester.

He continued to hold the office of lord president of the council till Oct. 3, 1903, when he resigned on account of differences with Balfour over the latter's attitude towards free trade. As Chamberlain had retired from the cabinet, and the duke had not thought it necessary to join Lord George Hamilton and Ritchie in resigning a fortnight earlier, the defection was unanticipated, and was sharply criticized by Balfour. But the duke had come to the conclusion that while he himself was substantially a free trader, Balfour did not mean the same thing by the term. He necessarily became the leader of the Free Trade Unionists who were neither Balfourites nor Chamberlainites, and his weight was thrown into the scale against any association of Unionism with the constructive policy of tariff reform, which he identified with sheer protection. A struggle at once began within the Liberal Unionist organization between those who followed the duke and those who followed Chamberlain, but the latter were in the majority, and the duke resigned his chairmanship of the Liberal Unionist Association (May 1904), and became president of the new organization, the Unionist Free Food league and the Unionist Free Trade club. In the autumn of 1907 his health gave way, and he went to Egypt. He died on his way home at Cannes on March 24, 1908. He had a firm friendship with the prince of Wales, afterwards Edward VII.

There was no issue of his marriage, and his successor as 9th duke was his nephew VICTOR CHRISTIAN CAVENDISH (1868-1938), who had been Liberal Unionist member for West Derbyshire since 1891, and was treasurer of the household (1900-03), financial secretary to the Treasury (1903-05), civil lord of the Admiralty (1915-16) and governor general of Canada (1916-21), in 1892 he married a daughter of the marquess of Lansdowne. He was succeeded as 10th duke by his son, EDWARD WILLIAM SPENCER CAVENDISH (1895-1950).

See Bernard Holland, *Life of the 8th Duke of Devonshire* (1921).

DEVRIENT, the name of a family of German actors. LUDWIG DEVRIENT (1784-1832), born in Berlin on Dec. 15, 1784, was the son of a silk merchant. He was apprenticed to an upholsterer, but joined a travelling theatrical company, and first appeared on the stage at Gera in 1804 as the messenger in Schiller's *Brant von Messina*. Eventually he obtained a permanent engagement at the dual theatre in Dessau, where he played till 1809. He then went to Breslau for six years. His success in Shakespeare was such that Lifland feared for his own reputation, but generously recommended Devrient as his successor. On Lifland's death Devrient was summoned to Berlin, where for 15 years he was the popular idol. He died there on Dec. 30, 1832. He was equally good in comedy and tragedy. Falstaff, King Lear, Franz Moor, Shylock and Richard II. were among his best parts. Karl von Holtei in his *Reminiscences* has given a graphic picture of his acting.

See F. Funck, *Aus dem Leben zweier Schauspieler, Liflands und Devrients* (Leipzig, 1838), H. Smidt in *Devrient Novellen* (3rd ed. 1882), R. Springer, *Devrient und Hofmann* (1873), Eduard Devrient, *Geschichte der deutschen Schauspielkunst* (Leipzig, 1867), G. Altmann, *Ludwig Devrient* (1926).

Three of the nephews of L. Devrient played an important part in the history of the German stage.—KARL AUGUST DEVRIENT

(1797-1872) was born at Berlin on April 5, 1797. He made his first appearance on the stage in 1819 at Brunswick. In 1821 he received an engagement at the court theatre in Dresden, where, in 1823, he married Wilhelmine Schroder. In 1835 he joined the company at Karlsruhe, and in 1839 that at Hanover. His best parts were Wallenstein and King Lear. He died on April 5, 1872.

His brother, PHILIPP EDUARD DEVRIENT (1801-1877), born at Berlin on Aug. 11, 1801, was from 1844 to 1846 director of the court theatre in Dresden. Appointed to Karlsruhe in 1852, he began a thorough reorganization of the theatre, and not only raised it to a high position, but enriched its repertory by many noteworthy librettos, among which *Die Günst des Augenblicks* and *Verirrungen* are the best known. But his chief work is his history of the German stage, *Geschichte des deutschen Schauspielkunst* (Leipzig, 1849-74). He died on Oct. 4, 1877.

The youngest and the most famous of the three nephews of Ludwig Devrient was GUSTAV EMIL DEVRIENT (1803-1872), born in Berlin on Sept. 4, 1803. He made his first appearance on the stage in 1821, at Brunswick, as Raoul in J. C. F. von Schiller's *Jungfrau von Orléans*. After a short engagement in Leipzig, he received in 1829 a call to Hamburg, but after two years accepted a permanent appointment at the court theatre in Dresden, to which he belonged until his retirement in 1868. He acted several times in London, where his Hamlet was considered finer than John Philip Kemble's or Edmund Kean's. He died on Aug. 7, 1872.

OTTO DEVRIENT (1838-1894), another actor, born in Berlin on Oct. 3, 1838, was the son of Philipp Eduard Devrient. He joined the stage in 1856 at Karlsruhe, and acted successively in Stuttgart, Berlin and Leipzig, until he received a fixed appointment at Karlsruhe in 1863. In 1873 he became stage manager at Weimar, where he gained great praise for his *mise en scène* of Goethe's *Faust*. After being manager of the theatres in Mannheim and Frankfurt, he retired to Jena. In 1884 he was appointed director of the court theatre in Oldenburg, and in 1889 director of dramatic plays in Berlin. He died at Stettin on June 23, 1894.

DE VRIES, HUGO

method of producing new forms was named mutation, as distinct from Charles Darwin's natural selection. He showed that while species vary through natural selection, new species and varieties arise suddenly through mutation. He visited the United States, to investigate the behaviour of *Oenothera* in its natural environment. After his retirement in 1918 from the University of Amsterdam he made his residence, in Lunteren, where he continued his experimental work in producing new forms through many generations of culture. He died on May 21, 1935. His best known works are *Intraclaculare Pangenesis* (1889), *The Mutation Theory* (German, 1900-03; Eng. trans., 1910-11), and *Plant Breeding* (1907; Ger. trans., 1908).

DEW. The word "dew" (OE *deau*, cf Ger *Tau*) is a very ancient one. The *New English Dictionary* gives the moisture, deposited in minute drops upon any cool surface by condensation of the vapour of the atmosphere, formed after a hot day during or towards night and plentiful in the early morning. If the deposit is in the form of ice it is called hoar frost. John Aitken's researches (Trans. Roy. Soc. of Edinburgh, xxii, and Nature, vol. xxxii)

suggest that the words "by condensation of the vapour in the atmosphere" might be omitted because the large dewdrops on the leaves of plants, the most characteristic of all dew phenomena, are largely an exudation of water from the plant itself through the leaf pores and are merely the continuation of the plant's irrigation process for supplying the leaves with water from the soil. The action, set up in full vigour in the daytime, is intended to maintain tolerable thermal conditions of the leaf surface in the hot sun, and continues after sunset.

Nevertheless, the typical experiment to illustrate dew formation is the production of a deposit of minute drops of moisture upon the exterior surface of a glass or polished metal vessel by the cooling of a liquid which it contains. The usual liquids are water cooled by pieces of ice, or ether, volatilized by bubbling air through it. No deposit is formed by this process until the temperature is reduced to a certain critical level which depends upon the state of the surrounding air. The physical analogy between the natural formation of dew and this artificial production is considered so complete that the critical level below which the temperature of a surface must be reduced in order to obtain the deposit is known as the "dew point."

Physicists consider the dew point to be the temperature at which, by being cooled without change of pressure, air becomes saturated with water vapour, because of a reduced capacity of the air at the lower temperature for holding water. It is a well established proposition that the pressure of the existing water vapour remains constant if the air is cooled without change of its total external pressure, hence, the saturation pressure at initial dew point gives the pressure of the water vapour. Tables of pressures of saturated water vapour for various temperatures have been compiled, thus, this mode of determining the dew point is a recognized method of measuring the pressure and amount of water vapour in the atmosphere, it is of fundamental importance in hygrometry. The physical explanation of dew formation is arrived at by determining the manner in which dew-laden objects in the open air have become cooled "below the dew point."

The whole question of radiation was first studied by Macedonio Melloni (1798-1854) and by other physicists but little was added to the explanation given by Wells until 1880 when John Aitken showed that condensation did not take place even when the air was cooled below dew point if all nuclei for condensation had been removed but his most important contribution on this matter was in 1885 when he called attention to the question of whether the water of dewdrops on plants or stones came from the air or the earth, either by plants exuding dewdrops, or by evaporation and subsequent condensation in the lowest layer of the atmosphere. Aitken's views at least showed that the physical processes operative in the evolution of meteorological phenomena are generally complex. The conditions favourable for the formation of dew are: (1) a good radiating surface (2) a still atmosphere, (3) a clear sky (4) thermal insulation of the radiating surface (5) with moist air or some other supply of moisture in the surface layers of air. Aitken's main contribution showed that moisture of the ground and as well as that of the air is important and that the temperature or both had to be considered. On the five

conditions, the first four are essential, but the fifth is important for securing a copious deposit.

The amount of dew deposited may be considerable, and, in tropical countries, is sometimes sufficient to be collected by gutters, but it is not generally regarded as a large percentage of the total rainfall. P. Loeschke probably overestimates a single night's dew deposition on the Loango coast at 3 mm., but measurements show that the aggregate annual deposit of dew corresponds to a depth of 1 to 1.5 m. of water near London (G. Dines), 1.2 m. at Munich (E. Wolny), 0.3 m. at Montpellier (A. Crova) and 1.6 m. at Tenbury, Worcestershire (W. F. Badgley).

The maintenance of "dew ponds" is intimately associated with this matter of total amount. Dew ponds are certain isolated ponds on the upper levels of the chalk downs of the south of England and elsewhere used as a water supply for cattle. Some of them are very ancient, as the title of a book on *Neolithic Dew ponds* (Lon'or, 1904, 1907) by A. J. and G. Hubbard indicates. Their name implies that they depend upon dew and not entirely upon rain for their maintenance. Though the question has not been settled, the balance of evidence suggests that dew deposits do not make any important contribution to the water supply. The construction of dew ponds is, however, still practised on traditional lines. Although there is some difference of opinion on the matter, it seems necessary for a new dew pond to be filled artificially first since it will not function by a natural accumulation of water in the impervious basin.

DEWAN, or **DIWAN**, an Arabic word for finance minister or financial department. In India in the 13th and 14th centuries it meant the revenue ministry, the control of which was one of the functions of the wazir, or chief minister. Akbar, in the 16th century, realising the danger of a minister with unlimited powers, entrusted the financial administration to an official called the diwan, who was assisted by provincial diwans directly responsible to the central government. In the 17th and 18th centuries the term *diwan* was applied to the revenue administration in contradistinction to the *nisamat*, or general administration. In modern India the term *diwan* denotes the civil courts of law.

See Ibn Hasan, *The Central Structure of the Mughal Empire* (Oxford, 1936), and P. Saran, *The Provincial Government of the Mughals* (Allahabad, 1941).

DEWAR, SIR JAMES (1842-1923), British chemist and physicist, was born at Kincardine on Forth, Scot., on Sept. 20, 1842. He was very fond of music as a child, and when he met with an accident which prevented him from playing the flute, he practised making fiddles and so acquired a manual dexterity which served him in good stead in later years. He was educated at Dollar academy, Dollar, Clackmannshire, and Edinburgh university, being first a pupil, and afterward the assistant, of Lyon Playfair, then professor of chemistry, he also studied under Friedrich Kekulé (q.v.) at Ghent in 1867. In 1875 he was elected Jacksonian professor of natural experimental philosophy at Cambridge, and in 1877 he succeeded J. H. Gladstone as Fullenan professor of chemistry in the Royal Institution, London. He was president of the Chemical Society in 1897 and of the British association in 1902, served on the Balfour commission on London water supply (1893-94), and as a member of the committee on explosives (1888-91) invented cordite jointly with Sir Frederick Abel. He was awarded the Rumford medal of the Royal Society in 1894, and the Smithsonian institution, the French Academy of Sciences, the Italian Society of Sciences and the Royal Society of Arts honoured his work. He was knighted in 1904, and died on March 27, 1923.

Dewar's scientific work covers a wide field. His earlier papers deal with organic chemistry, with measurement of high temperatures, with electrophotometry and the chemistry of the electric arc. With J. G. McKendrick, of Glasgow, he investigated the physiological action of light, and examined the changes which take place in the electrical condition of the retina under its influence. The work was done mostly at night since it involved vivisection. With G. D. Livinge of Cambridge he began in 1878 a long series of spectroscopic observations inspired primarily by Sir Joseph Norman Lockyer's claims to have decomposed elements at high

temperatures. The results were published in 1915 as *Collected Papers in Spectroscopy*. With J. A. Fleming, of University college London, he investigated the specific inductive capacity of substances at very low temperatures. Dewar is best known for his work on the liquefaction of the so-called permanent gases (*vs. LIQUEFACTION OF GASES*), and for his researches at temperatures approaching the absolute zero. His interest in this branch of inquiry dates back at least as far as 1874, when he discussed the "Latent Heat of Liquid Gases" before the British association. Subsequently he was stimulated by the work of L. P. Caillaud and R. P. Pictet in 1877, and of Z. F. Wroblewski and K. S. Olszewski a few years later, and by 1891 Dewar had constructed a machine for producing liquid oxygen in quantity. He made use of this liquid for some low temperature experiments on meteorites, and in 1891 showed that both liquid oxygen and ozone are magnetic. He introduced the use of liquefied gases as aids in studies at very low temperatures.

About 1892 the idea occurred to him of using vacuum jacketed vessels for the storage of liquid gases, and so efficient did this device prove in preventing the influx of external heat that it was found possible to preserve the liquids for comparatively long periods, this apparatus which he designed is known as the "Dewar flask," and is invaluable for low temperature work. The principle has been used extensively in the common "thermos bottle," or vacuum flask. He next experimented with a high pressure hydrogen jet by which low temperatures were realized through the Joule-Thomson effect (*see THERMODYNAMICS*), and the successful results thus obtained led him to build at the Royal Institution the large refrigerating machine by which hydrogen was first liquefied in 1898 and solidified in 1899. He investigated the gas absorbing powers of charcoal cooled to low temperatures, and applied them to the production of high vacua and to gas analysis.

With collaborators he also studied the physical and chemical properties of iron and nickel carbonyls, the properties of thin films and atomic heats at low temperatures. Dewar had a fine directing power and did excellent work with competent assistants. His greatest strength was probably in his manipulative skill, and his lectures at the Royal Institution were remarkable for the experimental demonstrations, which he developed into a fine art. The chemical and physical studies are contained in *The Collected Papers*, 2 vol. (1927).

See Royal Institution lecture by H. E. Armstrong (Jan. 1924), also *Journal of the Chemical Society* (London, 1918).

DEWAR VESSEL, or **THERMOS FLASK**, a vacuum vessel invented by Sir James Dewar during his research on the liquefaction of gases (q.v.).

DEWAS, two Indian states, in the Bhopal agency of central India, founded in the first half of the 18th century by two brothers, Punwar Mahrattas, who came into Malwa with the peshwa Bajji Rao in 1728. Their descendants are known as the senior and junior branches of the family, and after 1841 each ruled his own portion as a separate state, though the lands belonging to them are so intimately entangled that even in Dewas, the capital town, the two sides of the main street are under different administrations, and have different arrangements for water supply and lighting. The senior branch has an area of 449 sq. mi., pop. (1941) 89,352, the area of the junior branch is 419 sq. mi., pop. (1941) 83,669. The two chiefs reside in different palaces in the town of Dewas, and each is entitled to a salute of 15 guns.

DEWBERRY, or **TRAILING BLACKBERRY**, any blackberry lacking sufficiently woody fibre in the stems to stand more or less erect. In England and other countries of Europe, applied especially to *Rubus caesius*, a trailing plant, common in woods, hedges and the borders of fields. The leaves have three leaflets, are hairy beneath and of a dusky green, the flowers, which appear in June and July, are white, or pale rose-coloured. The fruit is closely embraced by the calyx and consists of a few drupelets, black with a glaucous bloom, it has an agreeable acid taste. In the eastern, southern and Pacific areas of the United States several trailing native species of *Rubus*, especially *R. flagellaris*, *R. baileyanus*, *R. hispida*, *R. enclensis* and *R. trivialis*, produce excellent fruits, some varieties of which, as the Lucretia (prob. *R.*

boleyanus x *R. argutus*), Young (youngherry) and Boysen (hovsenberry) are extensively cultivated. In the Pacific states various forms of the native trailing blackberry *R. macropetalus*, are cultivated, as the Ideal Wild and Zelniski, while Cascade and Pacific are varieties derived from Zelniski x Logan (see LOGANBERRY) (G M D.)

D'EWES, SIR SIMONDS, BART (1602-1650), English antiquarian, son of Paul D'Ewes of Milden, Suffolk, sat as member for Sudbury in the Long Parliament of 1640. D'Ewes appears to have projected a history of England based on original documents. But though excelling as a collector of materials, he died without publishing anything except an uninteresting tract, *The Primitive Practice for Preserving Truth* (1645), and some speeches. His *Journals of all the Parliaments during the Reign of Queen Elizabeth* was published in 1682. His large collections, including transcripts from ancient records, many of the originals of which are now dispersed or destroyed, are in the Harleian collection in the British Museum. His unprinted diaries from 1621 to 1624 and from 1643 to 1647 the latter valuable for the notes of proceedings in parliament, are often the only authority for incidents and speeches during that period, and are amusing for the glimpses the diarist affords of his own character.

Extracts from his *Autobiography and Correspondence* from the manuscripts in the British Museum were published by J. O. Halliwell Phillips in 1845, by Thomas Hearne in the appendix of his *Historia vitae et regni Ricardi II* (1729) and in the *Bibliotheca topographica Britannica* no. 15, vol. vi (1783), and from a diary of later date, *College Life in the Tin of James I* (1851). His diaries were even twice drawn upon by John Forster and Samuel Gardiner, and by John Sanford in his *Studies and Illustrations of the Great Rebellion*. Some of his speeches have been reprinted in the *Harleian Miscellany* and *Somers Tracts*.

See also W. Notkison (ed.), *The Journal of Sir Simonds D'Ewes* (1913).

DE WET, CHRISTIAN (1854-1922), Boer general and politician, was born on Oct. 7, 1854, at Leeuwkop, Smithfield district (Orange Free State) and later resided at Dewetsdorp. He served in the first Anglo-Boer War of 1880-81 as a field cornet, and from 1881 to 1896 he lived on his farm, becoming in 1897 member of the Volksraad. He took part in the earlier battles of the Boer War of 1899 in Natal as a commandant and later, as a general, he went to serve under Piet Cronjé in the west. His first successful action was the surprise of Sanna's Post near Bloemfontein, which was followed by the victory of Reddersburg a little later. He became the most formidable leader of the Boers in their guerrilla warfare. Sometimes severely handled by the British, sometimes escaping only by the narrowest margin of safety from the columns which attempted to surround him and falling upon and annihilating isolated British posts, De Wet struck heavily where he could and evaded every attempt to bring him to bay. He shared in the peace negotiations of 1902, and visited Europe with the other generals. He wrote an account of his campaigns, an English version of which appeared in Nov. 1902 under the title *Three Years' War*. In Nov. 1907 he was elected a member of the first legislative assembly of the Orange River colony and was appointed minister of agriculture. In 1908-09 he was a delegate to the Closer Union convention. In 1912-13 he supported Gen. James Hertzog in his separatist policy, seceded from the South African party and helped to form the Nationalist party. Soon after the outbreak of World War I, De Wet rebelled against the South African government and was captured at Waterberg on Dec. 1, 1914. On June 10, 1915, he was committed for trial on a charge of high treason, and on June 21 was found guilty on eight of the ten counts. He was sentenced to six years' imprisonment and fined £2,000, but in the following December was released, on undertaking to abstain from political agitation. He died at Bloemfontein on Feb. 3, 1922.

DE WETTE, WILHELM MARTIN LEBERECHEIT (1780-1849), German theologian, was born on Jan. 1, 1780, at Ulla near Weimar. He was educated at Weimar and at Jena, where H. F. J. Paulus inspired his free critical inquiry. In 1807 he became professor at Heidelberg, in 1810 at Berlin where he met Friedrich Schleiermacher. His tutor of conviction to the mother of Karl Sand, the murderer of August von Kotzebue, led

to his dismissal in 1819. After three years' retirement at Weimar, during which he prepared his edition of Martin Luther and wrote the romance *Theodor oder die Weite des Zweifels*, De Wette became professor of theology at Basle university. He died on June 16, 1849.

Johus Wellhausen describes De Wette as "the epoch making opener of the historical criticism of the Pentateuch." He prepared the way for the supplement theory.

His most important works are *Beitrag zur Einleitung in das Alte Testament*, 2 vol. (1806), *Kommentar über die Psalmen* (1811), *Lehrbuch der hebraischen jüdischen Archäologie* (1814), *Über Religion und Theologie* (1815), *Lehrbuch der christlichen Dogmatik* (1815-18), *Lehrbuch der historischen kritischen Einleitung in die Bibel* (O.T., 1817; N.T., 1826), *Christliche Sittenlehre* (1819-21), *Einleitung in das Neue Testament* (1826), *Religion, ihr Wesen, ihre Erscheinungsform, und ihr Einfluss auf das Leben* (1827), *Das Wesen des christlichen Glaubens* (1826), and *Kurzerlassenes exegetisches Handbuch zum Neuen Testament* (1826-28). De Wette also edited Luther's works, 5 vol. (1825-28), and wrote a drama *Die Entsagung* (1823).

DEWEY, DAVID RICH (1858-1942), U.S. economist and statistician, was born in Burlington, Vt., April 7, 1858. He was educated at the University of Vermont, Burlington, and at Johns Hopkins university, Baltimore, Md., and afterward became professor of economics and statistics at the Massachusetts Institute of Technology, Cambridge. He was chairman of the state board on the question of the unemployed (1893), member of the Massachusetts commission on public, charitable and reformatory interests (1897), special expert agent on wages for the 12th census and member of a state commission (1904) on industrial relations. He wrote a *Syllabus on Political History since 1815* (1887), a *Financial History of the United States* (1902), *National Problems* (1907) and *Banking and Credit* (with M. J. Shugrue, 1922). From 1911 to 1940 he was managing editor of the *American Economic Review*. He died Dec. 13, 1942.

DEWEY, GEORGE (1837-1917), U.S. naval officer, was born at Montpelier, Vt., on Dec. 26, 1837. He studied at Norwich university, then at Norwich, Vt., and graduated from the United States Naval academy in 1858, Annapolis, Md. He was commissioned lieutenant in April 1861, and in the Civil War served on the steamship "Mississippi" (1861-63) during Adm. David Farragut's passage of the forts below New Orleans, La., in April 1862 and at Port Hudson, La., in March 1863, took part in the fighting below Donaldsonville, La., in July 1863, and in 1864-65 served on the steam gunboat "Agawam" with the North Atlantic blockading squadron and took part in the attacks on Fort Fisher in Dec. 1864 and Jan. 1865. He became a lieutenant commander in 1865, commander in 1872, captain in 1884 and commodore in 1896.

In Nov. 1897 he was assigned, at his own request, to sea service, and sent to Asiatic waters. In April 1898, while with his fleet at Hong Kong, he was notified by cable that war had begun between the United States and Spain, and was ordered to "capture or destroy the Spanish fleet" then in Philippine waters. On May 1 he overwhelmingly defeated the Spanish fleet under Admiral Montojo in Manila bay, a victory won without the loss of a man of the American ships (see SPANISH-AMERICAN WAR of 1898). Congress, in a joint resolution, tendered its thanks to Commodore Dewey, and to the officers and men under his command, and authorized "the secretary of the navy to present a sword of honour to Commodore George Dewey, and cause to be struck bronze medals commemorating the battle of Manila bay, and to distribute such medals to the officers and men of the fleet of the U.S.N." (see also the following page).

He was a member (1899) of the short-lived Philippine commission, and in 1902 acted as president of the Schley court of inquiry. By special provision Admiral Dewey was not retired, but continued in the service up to his death, being president of the

general board of the navy for the last seven years of his life to the end of his life he continued to urge the building of large battleships, citing their superiority in the battle of Jutland. In 1913 he published his *Autobiography*. He died in Washington, D.C., on Jan. 16, 1917, and was buried in the Arlington National cemetery. His body was transferred March 28, 1925, to the crypt of the Bethlehem chapel of the National Episcopal cathedral in Washington.

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DEWEY, JOHN (1859-1952), U.S. philosopher, psychologist and educator, was born in Burlington, Vt., on Oct. 20, 1859. He graduated from the University of Vermont, Burlington, in 1879 and from Johns Hopkins University, Baltimore, Md., in 1884. Then he went west, and taught philosophy at the universities of Minnesota, Minneapolis, (1888-89), Michigan, Ann Arbor, (1889-94) and Chicago (1894-1904). It was as director of the school of education at the last institution that he first won national fame; he established an experimental school and carried out the ideas of the "new pedagogy." It was in this experience that he came to formulate principles of democratic and occupational instruction which revolutionized educational practice in the U.S., and influenced many teachers in Europe and Asia. For two years he lectured on education and philosophy at the University of Peking, and the Turkish government engaged him to draw up a report on the reorganization of its national schools.

Dewey's outlook on education reflected the industrial revolution and the development of democracy; it reacted strongly against the classical approach and authoritarian methods of aristocratic days when education consisted in learning how to talk about things rather than how to do them. The exodus from the field to the factory, the multiplication of machinery and the growing complexity of urban life required a new curriculum, teaching through practice the arts and discipline of the industrial life. This plea for practicality formed a naturally systematic whole with Dewey's "instrumental" logic, and his lifelong effort to free U.S. philosophy from its sterile preoccupation with German epistemology. In developing his thought out of the German idealism which marked the idealism of his early period—a change caused largely by the influence of William James—he retained from it an enduring sense of the value of intelligence.

The starting point of his system of thought is biological: he saw man as an organism in an environment, remaking as well as made. Things are to be understood through their origins and their functions, without the intrusion of supernatural considerations, even the Schopenhauerian *Will* and the Bergsonian *Élan vital* are mystical phrases which the philosopher will avoid. The only reality is experience, and all experience is of objects in relation. It is true that things are known only as known, but this knowledge, to be real, must be functional rather than conceptual; it must see not so much the abstract nature of the thing, as its actual operations and relations in the world of our living experience. Thought is an organ of response, it is an instrument of behaviour, rather than of knowledge in the older sense ("knowledge about"), every idea, to have meaning, must be a way of dealing specifically with actual stimuli and situations. (Here Dewey anticipated "behaviourism," without falling into its exaggerations.) Thinking begins not with premises, but with difficulties, and it concludes not with a certainty but with a hypothesis that can be made "true" only by the pragmatic sanction of experiment. An idea, then, is true in proportion as it is an effective instrument in the illumination of experience and the realization of desire. Thought should aim not merely to "understand" the world, but to control and refashion it; the Spencian definition of education as the adaptation of the individual to his environment must be replaced by the practice of education as the development of all those capacities in the individual which will enable him to control his environment and fulfil his possibilities.

Further, since the individual is to live in a society, he is to be studied as a citizen (actual or potential) growing and thinking in a vast complex of interactions and relationships, not as a

solitary "self" or "soul." Through education, training and suggestion of a thousand kinds, he is made in the image of his fellows, and his thinking is largely their thinking through him. If this reduces his uniqueness, it extends the limits of his possible development far beyond those within which it was confined by the old theory of unchangeable heredity. Faith in education as the soundest instrumentality of social, political and moral reconstruction is justified by this malleability of the instincts, and this ineliminability of human growth.

Contemporary difficulties, Dewey believed, are the difficulties of a chaotic adolescence, and the disproportion between our powers and our wisdom. "Physical science," he wrote, in a passage that influenced much later thinking, "has for the time being far outrun psychology. We have mastered the physical mechanism sufficiently to turn out possible goods, we have not gained a knowledge of the conditions through which possible values become actual in life, and so are still at the mercy of habit, of haphazard, and hence of force. With tremendous increase in our control of nature, in our ability to utilize nature for human use and satisfaction, we find the actual realization of ends, the enjoyment of values, growing unassured and precarious. At times it seems as though we were caught in a contradiction, the more we multiply means the less certain and general is the use we are able to make of them." (*Influence of Darwin on Philosophy*, p. 71.)

The task of remaking man to a mental and moral level commensurate with the enlarged and intricate world in which his inventions have enveloped him lies upon democracy and education. Democracy not merely in voting but in opportunity equal to all, in education through comradeship, occupation, in industry through the replacement of autocracy with voluntary association, in foreign relations through the replacement of war with conference and law. And education not in theory but in specific and experimental thinking, our social ills are to be handled no longer with majestic abstractions like individualism and socialism, competition and co-operation, dictatorship and democracy, but with restricted inquiries, specific analysis, careful formulation, patient experimentation and piecemeal renovation. We must attack the enemy as Napoleon did—in sections and detail.

The great need, then, is intelligence, and Socrates was not far wrong in counting this as the highest virtue. And again, not intellectuality, which is just the opposite of specific and realistic thought, but that flexibility of mind which can readjust past experience to novel stimuli and purposes. There is no absolute good here, no *summum bonum*, the ethical aim must vary with time and person and place, and only intelligence can specifically and transiently determine it. One thing alone seems universally good, and that is growth. "Not perfection as a final goal, but the ever enduring process of perfecting, maturing, refining, is the aim in living. The bad man is the man who, no matter how good he has been, is beginning to deteriorate, to grow less good. The good man is the man who, no matter how morally unworthy he has been, is moving to become better. Such a conception makes one severe in judging himself and humane in judging others" (*Reconstruction in Philosophy*, p. 177).

It was not till Dewey came in 1904 to join the department of philosophy at Columbia University that his influence began to reach out from pedagogy to the philosophical and social thought of his time. He maintained this position of professor of philosophy at Columbia University until July 1, 1930, when he retired with the title of professor emeritus. In 1937 he visited Mexico as head of a commission investigating the validity of soviet charges against Leon Trotsky who had been granted political asylum in that country. He spent his remaining years in research and died in New York, N.Y., on June 1, 1952.

Dewey's publications include *Leibnitz's Essays Concerning the Human Understanding* (1888), *Psychology* (1887), *Outlines of a Critical Theory of Ethics* (1891), *The Study of Ethics* (1894), *The Psychology of Number*, with Jas. A. McEllan (1895, 1896 and 1909), *Interest as Related to Will* (1896), "Interpretation of the Culture-Epoch Theory," *Nath. Herbert Soc. Yearbook* (1896), *My Pedagogic Creed* (1897), *The Significance of the Problem of Knowledge* (1897), *The Educational Situation* (1902), *Logical Conditions of a Scientific Treatment of Morality* (1903), *Studies in Logical Theory* (1903-09), "The Philosophical Work of Herbert Spencer," *Philadelphia Review*,

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DEWEY, MELVIL (1851-1931), American librarian, was born at Adams Center (N.Y.) on Dec. 10, 1851. He graduated in 1874 from Amherst college, Amherst, Mass., where he became acting librarian. In 1877 he moved to Boston, Mass., there founding and editing the *Library Journal*. He was also one of the founders of the American Library association. In 1883 he became librarian of Columbia college, New York city, and there founded the school of library economy, the first institution established for the instruction of librarians.

This school, which was very successful, was re-established in Albany, N.Y., as the State Library school under his direction, from 1889 to 1906 he was director of the New York State library, from 1889 to 1900 was secretary of the University of the State of New York and from 1904 to 1906 state director of libraries, completely reorganizing the state library, which he made one of the most efficient in the U.S., and establishing the system of travelling libraries and picture collections. His "decennial system of classification" for library cataloguing, first proposed in 1876, is extensively used. Probably more than any other single individual he was responsible for the sound development of library science in the U.S. He died Dec. 26, 1931.

DEWEY, THOMAS EDMUND (1902-), U.S. lawyer and politician, was born March 24, 1902, in Oswego, Mich. Graduated from the University of Michigan, Ann Arbor, Mich., in 1923 he received his law degree from Columbia university, New York city, in 1925, and was admitted to the New York bar the following year.

As U.S. attorney for the southern district of New York, Dewey attained national wide prominence for successful prosecutions of gangsters and criminals. Elected district attorney of New York county in 1937 he ran for governor the following year on the Republican ticket and was defeated by only 64,000 votes. Two years later he ran again for governor of New York, this time winning.

In 1944 Dewey was nominated Republican candidate for the presidency, but lost to Pres. G. D. Roosevelt, who was running for a fourth term. In 1946 Dewey was re-elected governor of New York. He was again nominated Republican candidate for the presidency in 1948. Gov. Earl Warren of California was nominated the GOP vice-presidential candidate, and in the summer and autumn campaigning it was almost universally predicted by the press and by public opinion polls that the Dewey-Warren ticket could not lose. Dewey conducted a so-called "high level" campaign, stressing national unity, while Pres. Harry S. Truman, Democratic candidate to succeed himself, campaigned largely

on the issue that the 80th congress, Republican dominated, had shown itself inimical to labour, the farmer and liberal policies in general. In the election Dewey and Warren were defeated in what was termed one of the greatest political upsets in U.S. history.

Dewey was re-elected governor of New York for a third term in 1950.

DE WINT, PETER (1784-1849), English landscape painter, of Dutch extraction, son of an English physician, was born at Stone, Staffordshire, on Jan. 21, 1784, and died in London on Jan. 30, 1849. He studied under John Raphael Smith, the engraver, and in 1809 entered the academy schools. In 1812 he became a member of the Society of Painters in Water colours, where he exhibited for many years, as well as at the academy. De Wint ranks as one of the chief English water colourists. A number of his pictures are in the Tate gallery and the Victoria and Albert museum, London.

See William Bell Scott, *Our British Landscape Painters* (1876), W. Armstrong, *Memoir of Peter de Wint* (1888).

DE WINTER, JAN WILLEM (1750-1812), Dutch admiral, was born at Kampen, and in 1762 entered the naval service at the age of 12. He distinguished himself by his zeal and courage, and at the revolution of 1787 he had reached the rank of lieutenant. The overthrow of the "patriot" party forced him to fly to France. There he threw himself into the cause of the revolution, took part under Charles Dumouriez and Charles Fiechergu in the campaigns of 1792 and 1793 and was promoted to the rank of brigadier general. When Fiechergu in 1795 overran the Netherlands, De Winter returned with the French army to his native country. The states general now utilized his experience as a naval officer by making him adjunct general for the reorganization of the Dutch navy. In 1796 he was appointed vice admiral and commander in chief of the fleet. He did his best to improve it and on Oct. 11, 1797, he encountered the British fleet under Adm. Adam Duncan off Camperdown. After an obstinate struggle the Dutch were defeated, and De Winter was taken prisoner. He remained in England until December, when he was liberated by exchange. His conduct at Camperdown was declared by a court-martial to have maintained nobly the honour of the Dutch flag.

From 1798 to 1802 De Winter was ambassador to the French republic, and was then again appointed commander of the fleet. He was sent with a strong squadron to the Mediterranean to repress the Tripoli pirates, and negotiated a treaty of peace with the Tripolitan government. He enjoyed the confidence of Louis Bonaparte, when king of the Netherlands, and, after the incorporation of the Netherlands in the French empire, in an equal degree of the emperor Napoleon. By the former he was created marshal and count of Huesen, and given the command of the iron ed forces both by sea and land. Napoleon gave him the grand cross of the Legion of Honour, appointed him inspector general of the northern coasts and in 1811 placed him at the head of the fleet he had collected at the levee. Soon after Lord De Winter became ill and moved to Paris, where he died on June 2, 1812. He was buried in the Pantheon. His heart was enclosed in an urn and placed in the Nicolaas Kerck x Kampen.

DE WITT, CORNELIUS (1625-1671), brother of John de Witt (q.v.), was born at Dor in 1623. In 1650 he became burgomaster of Dor and member of the states of Holland and West Friesland. He was afterward appointed governor of the land of Putten and of Bickeland. He associated himself closely with his brother the grand pensionary, and supported him throughout his career with great ability and vigour. In 1667 as deputy chosen by the states of Holland to accompany Adm. Michael de Ruyter in his famous expedition to Chatham Cornelius de Witt distinguished himself by his coolness and intrepidity. He again accompanied De Ruyter in 1672 and took an honourable part in the great naval night at Southwold bay against the united English and French fleets. Compelled by illness to leave the fleet, he found the Orange party on his return to Dor in the ascendant, and himself and his brother the objects of popular suspicion.

For an account of his imprisonment, trial and death see De Witt, John. (See also DUTCH WARS.)

DE WITT, JOHN (1625-1672), Dutch statesman, was born at Dort, on Sept. 4, 1625, being a member of one of the old burgher regent families of his native town. His father, Jacob, was six times burgomaster of Dort, and for many years sat for the town in the states of Holland. He was a strenuous adherent of the republican or oligarchical states right party in opposition to the princes of the house of Orange, who represented the federal principle and had the support of the masses of the people. John was educated at Leyden and early displayed remarkable talents, especially in mathematics and jurisprudence. In 1645 he and his elder brother Cornelius visited France, Italy, Switzerland and England and on his return he lived at The Hague as an advocate. In 1650 he was appointed pensionary of Dort, which made him the leader of the town's deputation in the states of Holland. In this year the states of Holland found themselves engaged in a struggle for provincial supremacy, on the question of the disbanding of troops, with the youthful prince of Orange, William III. William, with the support of the states general and the army, seized five of the leaders of the states right party and imprisoned them in Loewestein castle, among these was Jacob de Witt. The sudden death of William, at the moment when he had crushed opposition, led to a reaction. He left only a posthumous child, afterwards William III. of Orange, and the principles advocated by Jacob de Witt triumphed, and the authority of the states became predominant in the republic.

It was his father's position which gave John his opportunity, but his own eloquence, wisdom and business ability which caused him to be appointed grand pensionary of Holland on July 23, 1653, at 28. He was re-elected in 1658, 1663 and 1668, and held office until just before his death in 1672. He found in 1653 his country brought to the brink of ruin through the war with England, which had been caused by the keen commercial rivalry of the two maritime states. The Dutch were unprepared and suffered severely through the loss of their carrying trade, and De Witt resolved to bring about peace. He rejected Cromwell's suggestion of the union of England and Holland, but in the autumn of 1654 peace was concluded by which the Dutch made large concessions and agreed to the striking of the flag to English ships in the narrow seas. The treaty included a secret article, which the states general refused to entertain, but which De Witt induced the states of Holland to accept, by which the provinces of Holland pledged themselves not to elect a stadtholder or a captain-general. This Act of Secession was aimed at the young prince of Orange, whose close relationship to the Stuarts made him an object of suspicion to the Protector. De Witt was favourable to this exclusion of William III from his ancestral dignities, but he did not prompt Cromwell.

The policy of De Witt after the peace of 1654 was eminently successful. He restored the finances of the State and extended its commercial supremacy in the East Indies. In 1658-59 he sustained Denmark against Sweden, and in 1662 concluded an advantageous peace with Portugal. The accession of Charles II to the English throne led to the rescinding of the Act of Secession, nevertheless De Witt steadily refused to allow the prince of Orange to be appointed stadtholder or captain general. This led to ill-will between the English and Dutch governments, and to a renewal of the old grievances about maritime and commercial rights, and war broke out in 1665. The grand pensionary himself went to sea with the fleet and inspired all by the example he set of calmness in danger, energy in action, and inflexible strength of will. It was due to his exertions as an organizer and a diplomatist quite as much as to the brilliant seamanship of Admiral de Ruyter, that the treaty of Breda (July 31, 1667), maintaining the status quo was so honourable to the United Provinces. In 1667 he promulgated his eternal edict for the republican administration of Holland. A still greater triumph of diplomatic skill was the conclusion of the Triple Alliance (Jan. 17, 1668) between the Dutch Republic, England and Sweden, which checked the attempt of Louis XIV to take possession of the Spanish Netherlands in the name of his wife, the infanta Maria Theresa.

In 1672 Louis XIV suddenly declared war and invaded the

United Provinces at the head of a splendid army. The voice of the people called William III to the head of affairs, and there were violent demonstrations against John de Witt. His brother Cornelius was (July 24) arrested on a charge of conspiring against the prince. On Aug. 4 John de Witt resigned the post of grand pensionary. Cornelius was put to the torture, and on Aug. 19 sentenced to deprivation of his offices and banishment. His brother came to visit him in the Gevangenpoort at The Hague. A visit crowd, hearing this, collected outside and finally burst in, seized the two brothers and tore them to pieces. Their mangled remains were hung up by the feet to a lamp post. Thus perished, by the savage act of an infuriated mob, one of the greatest statesmen of his age, and of Dutch history.

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DEWLAP, the loose fold of skin hanging from the neck of a cuttle, also applied to similar folds in the necks of other animals and fowls, as the dog, turkey, etc. The American practice of branding cattle by making a cut in the neck is known as a "dewlap brand." The skin of the neck in human beings often becomes pendulous with age, and is sometimes referred to humorously by the same name.

DEW-POINT see DEW

DEWSBURY, market town, county and parliamentary borough, West Riding of Yorkshire, England, on the river Calder, 8 mi. south-south-west of Leeds, on the LNE and LMS railways. Pop. (1938) 52,860. Area 9.8 sq. mi. The parish church of All Saints was for the most part rebuilt in the 18th century, the portions still preserved of the original structure are mainly Early English. The chief industries are the making of blankets, carpets, druggists and worsted yarn, and there are iron foundries and machinery works. Coal is worked in the neighbourhood. The parliamentary borough returns one member. Dewsbury was incorporated in 1862 and was created a county borough in 1913. Edwin, king of Northumbria, had a mansion here in the 7th century. At Kirkstall may be seen the remains of a Cistercian convent (12th century), in an extensive park, where tradition relates that Robin Hood died and was buried.

DEXIPPUS, PUBLIUS HERENNIVS (c. A.D. 210-273), Greek historian, statesman and general, was an hereditary priest of the Eleusinian family of the Kerykes, and held the offices of archon basileus and eponymus in Athens. When the Heruli overran Greece (269), Dexippus was made general and defeated them heavily. A statue was set up in his honour, the base of which, with an inscription recording his services, has been preserved (*Corpus Inscr. Atticarum*, III No. 716). It is remarkable that the inscription is silent as to his military achievements. Photius (*cod.* 82) mentions three historical works by Dexippus, of which considerable fragments remain. (1) *Tā per' Allēkandron*, an epitome of a similarly named work by Arrian, (2) *Σαβέκα*, a history of the wars of Rome with the Goths (or Scythians) in the 3rd century, (3) *Χρονική ιστορία*, a chronological history from the earliest times to the emperor Claudius Gothicus (270), frequently referred to by the writers of the Augustan history. The work was continued by Eupapius of Sardis down to 404. Photius places Dexippus on a level with Thucydides, an opinion by no means confirmed by the fragments (C. W. Müller, *F.H.G.* in 666-687).

DEXTER, HENRY MARTYN (1821-1890), U.S. clergyman and author, was born in Plympton (Mass.), on Aug. 13, 1821. A graduate of Yale and Andover theological seminaries, he was pastor of Congregational Churches in Manchester (N.H.), and Boston, and edited various magazines, including the *Congregational Quarterly* and *Congregationalist*. He died in New Bedford (Mass.), on Nov. 13, 1890. He was an authority on the history of Congregationalism and was a lecturer on that subject.

at the Andover theological seminary in 1877-79. Dexter left his fine library on the Puritans in America to Yale university. Among his works are *At to Roger Williams and His "Banishment" from the Massachusetts Colony* (1876), *The Congregationalism of the Last Three Hundred Years, as Seen in Its Literature* (1880), his most important work, *Common Sense as to Woman Suffrage* (1885), and many reprints of colonial pamphlets. His *The England and Holland of the Pilgrims* (1905) was completed by his son, Morton Dexter.

See American Antiquarian Society, *Proc.* (April 1891)

DEXTRIN or **DEXTRINE** is a term applied to commercial products prepared by heating dry starch for 3 to 4 hours at 135° to 185° C., usually in the presence of traces of acid catalyst or (more rarely) an oxidizing agent. Depending on conditions of manufacture, the products range from white to tan or yellow in colour, show moderate to high solubility in water, and yield pastes or solutions of low viscosity. Principal types include white dextrans (by mild heating with hydrochloric acid), yellow and canary dextrans (stronger heating with acid), and "British gums" (strong heating without acid). Products are chiefly used as adhesives and as sizing agents for textiles and paper.

The term also applies to certain noncommercial acidic or enzymic degradation products from starch, including the crystalline Schardinger dextrans by conversion with the amylase of *B. macerans*, residual or limit dextrans produced by liquefying or saccharifying enzymes, and oligosaccharides resulting from extensive acid hydrolysis. (T. J. SH.)

DEY, an honorary title formerly bestowed by the Turks on elderly men, and appropriated by the janissaries as the designation of their commanding officers (an adaptation of the Turk *das*, a maternal uncle). In the 17th century the deys of the janissaries in Algeria became the rulers of that country (see *ALGERIA History*). From the middle of the 16th century to the end of the 17th century the ruler of Tunisia was also called dey, a title frequently used during the same period by the sovereigns of Tripoli.

DHAMMAPĀLA, the name of one of the early disciples of the Buddha, and therefore constantly chosen as their name in religion by Buddhist novices on their entering the brotherhood. The most famous of the Bhikkhus so named, probably a Tamil, was the great commentator who lived in the latter half of the 5th century A.D. To him we owe the commentaries on seven of the shorter canonical books, consisting almost entirely of verses, and also the commentary on the Netti, perhaps the oldest Pāli work outside the canon. Dharmapāla confines himself rigidly to questions of the meaning of words, and to discussions of the ethical import of his texts. Other unpublished works, besides those mentioned above, have been ascribed to Dharmapāla.

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DHANIS, FRANCIS, BARON (1857-1909), Belgian administrator, born in London and educated at the Belgian Lycée. Mulrum went out to the Congo in 1887, and in 1892-93 commanded an expedition against the slave dealers. He captured 19 succowon 112 three Arab strongholds at Nvanguwe, K'songo and K. thamburi. He was raised to the rank of baron, and in 1895 was made the governor of the Congo State. In 1896 he took command of an expedition to the Upper Nile. His troops, largely composed of the Betele tribes who had only been recently enlisted, and who had been irritated by the execution of some of their chiefs for cannibalism, mutilated and murdered many of their white officers. During 1897-98 he was engaged in a life-and-death struggle with them, eventually he succeeded in breaking up the bands of misanthropic soldiers. In 1899 Baron Dhanis returned to Belgium. He died on Nov. 14, 1909.

See Sidney Lloyd, *The Fall of the Congo Arabs* (1897)

DEANUSHKODI, a seaport of Madras India, on the 14th of Ramanastram, at the junction of tank straits and the Gulf of Manar. The port was brought into being in 1913, when the new

direct route of the South Indian railway to Ceylon was opened. The line is carried by an embankment and a bridge to Dhanushkodi, whence steamers run to Talai Manar (22 miles). Coffee, fish, rice, rubber, tea and cotton goods are exported, but no great influx of trade followed the foundation of the port. The population consists largely of railway employees.

DHAR, an Indian state in the Malwa agency, Central India. It includes many Rajput and Bhil feudatories, and has an area of 1,798 sq mi. The raja is a Ponwar Maharrata. The founder of the present ruling family was Anand Rao Ponwar, a descendant of the great Paramara clan of Rajputs who from the 9th to the 13th century, when they were driven out by the Mohammedans, had ruled over Malwa from their capital at Dhar. In 1743 Anand Rao received Dhar as a fief from Baji Rao, the peshwa, the victory of the Maharratas thus restoring the sovereign power to the family which seven centuries before had been expelled from this very city and country. Towards the close of the 18th and in the early part of the 19th century, the state was subject to a series of spoliations by Sindia and Holkar, and was only preserved from destruction by the talents and courage of Anand Rao's widow. By a treaty of 1819 Dhar passed under British protection. The State was confiscated for rebellion in 1857, but in 1860 was restored, with the exception of the detached district of Barausa which was granted to the begum of Bhopal. The chief has the style of Maharaja and a salute of 15 guns. In 1941 the population was 253,210. The state includes the ruins of Mandu, or Mandogah, the Mohammedan capital of Malwa.

The **TOWN OF DHAR** [pop. [1931] 19,607], is picturesquely situated among lakes and trees surrounded by barren hills, and possesses, besides its old walls, many interesting buildings, Hindu and Mohammedan, some of the most interesting records of great historical importance. The Lal Masjid, or Pillar Mosque, was built by Dilawar Khan in 1405 out of the remains of Jain temples. It derives its name from an iron pillar, supposed to have been originally set up at the beginning of the 13th century in commemoration of a victory, and bearing a later inscription recording the seven days' visit to the town of the emperor Akbar in 1598. The pillar, which was 43 ft. high, is now overthrown and broken. The Kamal Mula is an enclosure containing four tombs, the most notable being that of Shaikh Kamal Ma'ulvi (Kamal ud-din), a follower of the famous 13th-century saint Nuam-ud-din Auliya. The mosque known as Raja Bhoj's school was built out of Hindu remains in the 14th or 15th century; its name is derived from the slabs, covered with inscriptions giving rules of Sanskrit grammar, with which it is paved. On a small hill to the north of the town stands the fort, a conspicuous pile of red sandstone, said to have been built by Mohammed ben Tughlak of Delhi in the 14th century. It contains the palace of the raja.

The town is of great antiquity, and was made the capital of the Paramara chiefs of Malwa by Vamsudra II., who transferred his headquarters thither from Ujjain at the close of the 9th century. During the rule of the Paramara dynasty Dhar was famous throughout India as a centre of culture and learning, but, after suffering various vicissitudes, it was finally conquered by the Mohammedans at the beginning of the 14th century. Subsequently, in the time of Akbar, Dhar fell under the dominion of the Moguls, in whose hands it remained till 1730, when it was conquered by the Maharratas.

DHARAMPUR, native state, India, in the Surat political agency division of Bombay. Area 719 sq mi. Pop. (1941) 123,326. Tributary, with Baruch and Suchan £600. The chief is a Sesodi Rajput. The state contains one town Dharampur (pop. in 1941, 8,182). Only a small part of the state, the climate of which is very unhealthy, is cultivated. Rice, madder, pulse, etc., are grown and there are extensive forests.

DHARMSALA, a hill station and sanatorium of the Punjab, India, situated on a spur of the Dhaul Dhar, 16 mi. north-east of Kangra town, at an elevation of some 6,500 ft. Pop. (1941) 9,653. The spur is thickly wooded with oak and fir trees, behind it the pine-clad slopes of the mountain rise towards the jagged peaks of the higher ranges, snow-clad for half the year, while below stretches the luxuriant cultivation of the Kangra valley.

In 1855 Dharmasala was made the headquarters of the Kangra district of the Punjab in place of Kangra, and became the centre of a European settlement and cantonment, largely occupied by Gurkha regiments. The station was destroyed by earthquake in 1905.

DHARWAR, town and district, British India, in the south ern division of Bombay. The town (pop in 1941, 47,992) is a railway centre, formerly headquarters of the Southern Mahratta railway, now amalgamated with the Madras railway. It contains a jail for juvenile criminals, a mental hospital, a college and two training colleges, and is a centre of the Basle mission.

The district of Dharwar has an area of 4,576 sq miles. In the north and north east are plains of black soil, favourable to cotton-growing, in the south and west are ranges of low hills, with flat fertile valleys between them. The whole district lies high and has no large rivers. In 1941 the population was 1,202,016. The principal products are millets, pulse, cotton and timber. The centres of the cotton trade are Hubli and Gadag, junctions on the Madras and Southern Mahratta railway, which traverses the district in several directions.

The early history of the territory comprised within the district of Dharwar has been to a certain extent reconstructed from the inscription slabs and memorial stones which abound there. From these it is clear that the country fell in turn under the sway of the various dynasties that ruled in the Deccan, memorials of the Chalukyan dynasty, whether temples or inscriptions, being especially abundant. In the 14th century the district was first overrun by the Mohammedans, after which it was annexed to the newly established Hindu kingdom of Vijayanagar, an official of which named Dhar Rao, according to local tradition building the fort at Dharwar town in 1403. After the defeat of the king of Vijayanagar at Talikot (1565), Dharwar was for a few years practically independent under its Hindu governor, but in 1573 the fort was captured by the sultan of Bijapur, and Dharwar was annexed to his dominions. In 1864 the fort was taken by the emperor Aurangzeb, and Dharwar, on the break-up of the Mogul empire, fell under the sway of the peshwa of Poona. In 1764 the province was overrun by Hyder Ali of Mysore, who in 1778 captured the fort of Dharwar. This was retaken in 1791 by the Mahrattas. On the final overthrow of the peshwa in 1817 Dharwar was incorporated with the territory of the East India company.

DHOLE, the "Red Dog" of Asia, *Cuon javanicus*, distinguished from the true dogs (*Canis*) by one molar less in the lower jaw. A rufous brown in colour, the dhole is larger than a jackal and hunts in large packs. It is reported to kill animals as large as the buffalo, but deer are most hunted. *Cuon* is found from India north to Siberia and east to Sumatra and Java.

DHOLPUR, an Indian state in the Eastern Rajputana states agency, with an area of 1,173 sq mi. All along the bank of the river Chambal the country is deeply intersected by ravines, low ranges of hills in the western portion of the state supply inexhaustible quarries of fine grained and easily-worked red sandstone. In 1941 the population of Dholpur was 286,001.

The town of Dholpur is 34 mi S of Agra by rail. Pop (1931) 19,586. The present town, which dates from the 16th century, stands somewhat to the north of the site of the older Hindu town built, it is supposed in the 11th century by the Tonwar Rajput Raja Dholan (or Dhawal) Deo, and named after him Dholdera or Dhawalpur. Among the objects of interest in the town may be mentioned the fortified *saras* built in the reign of Akbar, within which is the first tomb of Sadik Mohammed Khan (d. 1595), one of his generals.

Local tradition affirms that Dholpur was ruled by the Tonwar Rajputs, who had their seat at Delhi from the 8th to the 12th century. In 1527, after a strenuous resistance, the fort was captured by Baber and with the surrounding country passed under the sway of the Moguls, being included by Akbar in the province of Agra. During the dissensions which followed the death of Aurangzeb in 1707, Raja Kalyan Singh Bhadauna obtained possession of Dholpur, and his family retained it till 1761, after which it was taken successively by the Jat raja, Suraj Mal of Bharatpur, by Mirza Najaf Khan in 1775, by Sindia in 1782,

and in 1803 by the British. It was restored to Sindia by the Treaty of Sarai Anjangan, but in consequence of new arrangements was again occupied by the British.

The maharaj rana of Dholpur belongs to the clan of Bamraolia Jats. A sixteenth century ancestor, Singhan Deo, having distinguished himself in an expedition against the freebooters of the Deccan, was rewarded by the sovereignty of the small territory of Gohad, with the title of *rana*. In 1779 the rana of Gohad joined the British forces against Sindia, under a treaty which stipulated that, at the conclusion of peace between the English and Mah rattas, all the territories then in his possession should be guaranteed to him, and protected from invasion by Sindia. This protection was subsequently withdrawn, the rana having been guilty of treachery, and in 1783 Singhan crushed his Jat opponent and seized the whole of Gohad. In 1804, however, the family were restored to Gohad by the British government, but, owing to the opposition of Sindia, the rana agreed in 1805 to exchange Gohad for his present territory of Dholpur, which was taken under British protection. The ruler has a salute of 15 guns. Kurat Singh, the first maharaj rana of Dholpur, as succeeded in 1836 by his son Bhagwant Singh, who showed great loyalty during the Mutiny of 1857, and was created a K.C.S.I. and G.C.S.I. in 1869. He was succeeded in 1873 by his grandson Nehal Singh, who received the C.B. and frontier medal for services in the Tirah campaign. He died in 1901 and was succeeded by his eldest son, Ram Singh. His Highness Lt.-Col. Sir Rais ud-Daula Jai Deo, K.C.S.I., K.C.V.O., the present ruler, is the second son of the maharaj rana Nehal Singh and was born on Feb. 12, 1893. On the death of his brother maharaj rana Ram Singh, his Highness succeeded to the gad in March 1911 and was invested with full ruling powers on Oct. 9, 1913. He has a personal salute of 17 guns.

DHOW, a type of vessel used throughout the Arabian Sea. The language to which the word belongs is unknown. Used of any craft along the East African coast, it is usually applied to the vessel of about 150 to 200 tons burden with a stem rising with a long slope from the water, bows generally have one mast with a lateen sail, the yard being of enormous length. Much of the coasting trade of the Red Sea and Persian Gulf is carried on by these vessels. They were the regular vessels employed in the slave trade from the east coast of Africa.

DHRANGADHRA, native state, India, in the Western Indian States Agency, situated in the north of the peninsula of Kathiawar, Bombay. Area is 1,167 sq mi. Pop (1941) 94,417. Tribute, to the British government and Tunagadh, £3,000. There is a state railway (metre gauge) from Wadhwan through the town of Dhrangadhra to Halvad, a distance of 40 mi, and a short line to the state salt works was opened in 1923. The chief town, Dhrangadhra, has a population (1941) of 21,267.

The chief of Dhrangadhra, who bears the title of Raj Sahib, with the predicate of His Highness, is head of the ancient clan of Jhala Rajputs, who are said to have entered Kathiawar from Sind in the 8th century. The Raj Sahib who succeeded in 1869 was distinguished for the enlightened character of his administration, and the state continues to make progress under its present ruler, who succeeded in 1911. It came into direct relations with the British Government in 1924.

DHULEEP SINGH (1837-1893), maharaja of Lahore, was born in Feb. 1837, and was proclaimed maharaja on Sept. 18, 1843, under the regency of his mother the rani Jindan, a woman of great capacity and strong will, but extremely inimical to the British. He was acknowledged by Ranjit Singh and recognized by the British Government. After six years of peace the Sikhs invaded British territory in 1845, but were defeated in four battles, and terms were imposed upon them at Lahore, the capital of the Punjab. Dhuleep Singh retained his territory, but it was administered to a great extent by the British Government in his name. This arrangement increased the regent's dislike of the British, and a fresh outbreak occurred in 1848-49. The Sikhs were routed at Gujarat, and in March 1849 Dhuleep Singh was deposed, a pension of £40,000 a year being granted to him and his dependents. He became a Christian and elected to live in England. On coming of age he made an arrangement with the British

government by which his income was reduced to £25,000 in consideration of advances for the purchase of an estate, and he finally settled at Elvedon in Suffolk. In 1864 he married Bamba Muller, a German missionary worker in Egypt, by whom he had six children. After her death he married in 1890 an Englishwoman, Adèle Withenill. The maharaja was passionately fond of sport, and his shooting parties were celebrated, while he himself became a *petit sona grata* in English society. The result, however, was financial difficulty and in 1882 he appealed to the government for assistance, making various claims based upon the alleged possession of private estates in the Punjab, and upon the surrender of the Koh-i-noor diamond to the British crown. His demand was rejected, whereupon he started for India, after drawing up a proclamation to his former subjects. But as it was deemed inadvisable to allow him to visit the Punjab, he remained for some time as a guest at the residency at Aden, and was allowed to receive some of his relatives, to witness his abjuration of Christianity, which actually took place within the residency itself. As the climate began to affect his health, the maharaja at length left Aden, and returned to Europe. He stayed for some time in Russia hoping that his claim against England would be taken up by the Russians, but when that expectation proved futile he proceeded to Paris, where he lived for the rest of his life on the pension allowed him by the Indian government. His death from an attack of apoplexy took place at Paris on Oct. 22, 1893.

The maharaja's eldest son, Prince Victor Albert Jay Dhuleep Singh (1866-1918), was educated at Trinity and Downing colleges, Cambridge. In 1888 he obtained a commission in the 1st Royal Dragoon Guards. In 1898 he married Lady Anne Coventry, youngest daughter of the earl of Coventry. He died without issue on June 7, 1918.

DHULIA, town, British India, administrative headquarters of West Khandesh district in Bombay, on the right bank of the Panjra river. Pop. (1941) 53,368. Considerable trade is done in cotton and oil seeds; cotton and wool are woven, cotton ginning and pressing carried on. There is a technical school. A railway connects Dhulia with Chalisgaon, on the main Great Indian Peninsula railway.

DIABASE (US usage) is a medium- to fine grained rock which occurs in sills or dikes, has the mineral composition of basalt and usually has an ophitic texture. Neither age nor condition of preservation is considered in this definition. The rock is in reality an intrusive basalt, and it is only the different mode of occurrence that gives it its different texture. As a matter of fact, a thick flow of basalt may have the same ophitic texture, and the two rocks may appear alike in thin sections. While the essential minerals are augite and labradorite, and a common accessory is magnetite, other minerals may be present as accessories or proves, and if unusual or abundant are mentioned in the name. Thus, we have olivine diabase, hypersthene-diabase, quartz bearing diabase, etc.

Historically, certain rocks, thought to be composed essentially of amphibole, chlorite and feldspar, were called *Grunstene* by Abraham G. Werner and Carl Haidinger in 1787. Alexander Brongniart, in 1807, substituted the term diabase (*diabase*, "a crossing over"), but in 1827 withdrew it in favour of diorite. The discarded term was revived in 1842 by J. F. L. Hausmann after Gustav Rose had shown that most of the *Grunstene* carried pyroxene and not amphibole, and that the feldspar was labradorite or andesine.

F. Zirkel, in 1866 limited the term diabase to rocks composed of pyroxene and labradorite, usually with secondary chlorite or coarse to fine texture and occurring in sheets or dikes. Herr Rosenbusch in 1877 gave essentially the same composition but introduced the age factor and defined diabases as pre-Tertiary rocks, later he said they might extend from early Pliocene to recent times. The texture he defined as interserial porphyritic (ophitic). English usage is to give the name dolerite to rocks which in the US are called diabase. While Alfred Harker in 1902 used the term diabase with its original meaning, as that current in the US, in 1908 he substituted the word dolerite in the denomination, which otherwise was unchanged.

Arthur Holmes in 1920 gave the modern British usage when he defined diabase as an altered dolerite in which the feldspars are saussuritized or albitized, or the pyroxene more or less replaced by hornblende or chlorite.

(A. Jo.)
DIABELLI, ANTON ANTONIO (1781-1858), composer of pianoforte and church music, was born on Sept. 6, 1781, at Mattsee near Salzburg, Austria. He was educated in the convent of Raichenhaslach, it being intended that he should become a priest. He abandoned the idea of taking orders, however, on the secularization of the Bavarian convents in 1803. Diabelli went to Vienna where his piano pieces and arrangements became extremely popular. His other compositions included songs and an opera, *Adam in der Klemme*, while his masses, particularly the *Landmassen*, are widely known in Austria.

With the aid of money he earned as a teacher of the guitar and pianoforte, he was able to become a partner of Peter Cappi, the music publisher, in 1818. Six years later the firm became known as Diabelli and Co., which published for Schubert, Czerny, Strauss, Lanner, and others. On a waltz of Diabelli's, Beethoven wrote his 33 Variations (Op. 120).

DIABETES INSIPIDUS is a disease characterized by the excretion of large volumes of urine of a low specific gravity accompanied by an abnormally great thirst which is probably secondary to the polyuria. It is caused by destruction of the neural lobe of the pituitary gland or by lesions in the supra-optic-hypophyseal tracts, the nervous connections between the hypothalamus and the neural lobe. The condition can be alleviated but not cured by the administration of posterior pituitary extract.

(F. L. A.)
DIABETES MELLITUS is a condition in which the body is unable to metabolize sugars and other food materials efficiently. It is this disease which is commonly termed "diabetes" (*see* METABOLIC DISEASES) and it is believed to be produced when there is insufficient available insulin (*qv*) in the body. The first suggestion that the pancreas (*qv*) is necessary for the complete utilization of carbohydrates in the animal body was made by Johann Conrad von Brunner in 1882. The relationship of the pancreas to diabetes was first suggested in 1788 by Cawley, an English physician. In 1889 J. von Mering and O. Minkowski showed that the complete removal of the pancreas from dogs resulted in a condition which is practically identical with diabetes mellitus in man. Although attempts were made by scores of investigators to secure an antidiabetic substance from the pancreas, this substance, called insulin, was not proved to be present until 1921 (*see* INSULIN). In some cases the diabetic condition may be the direct result of a decrease in the formation and secretion of insulin by the pancreas, while in others the defect may be primarily the result of an altered activity of other glands.

Diabetes is a common disease. There are clear references to it in the ancient literature of Egypt, China and India. At mid century the results of pilot surveys indicated that there are about 1,000,000 known diabetics in the United States and an equal number as yet undetected. No age is exempt, but most patients are over 40 at the onset of the disease. Obese persons more often suffer from diabetes than those of normal weight. There are more male than female diabetics.

Signs and Symptoms—The untreated diabetic patient suffers from extreme thirst, hunger, loss of weight and strength. He excretes abnormally large quantities of urine of high specific gravity (1.030 to 1.050) containing sugar and other substances not usually present. He is very susceptible to infection, and the infection when established is difficult to eliminate.

The diabetic condition is suspected when a patient complains of one or more of these signs or symptoms. A person may be a mild diabetic for a long time before he is aware of his condition. Diabetes as a rule advances comparatively slowly except in the young, in whom its progress is often rapid. Occasionally in children the disease progresses so rapidly that the patient develops in acidosis, often vomits, and may lapse into coma within a few days of what is apparently an acute onset of the disease. The routine analysis of the urine in life-insurance examinations and of those entering the armed forces has resulted in the early diag-

nosis of many cases of unsuspected diabetes. The prognosis of the early case is, of course much better than that of the advanced since treatment can be instituted earlier in the disease. The amount of sugar in the blood under certain standard conditions is a valuable indication of the severity of the disease. The presence in the urine of the acetone bodies resulting from the excessive breakdown of fats is a warning that acidosis and coma are imminent. The presence of these substances in the body can sometimes be suspected from the odour which one of them, acetone, imparts to the breath.

The most characteristic finding is that of sugar in the urine, though it alone is not diagnostic of the diabetic condition. The amount of sugar thus excreted may be small or very great, depending upon the severity of the disease and upon the amount of sugar or starchy food eaten by the patient. Because the diabetic person does not use sugar as readily as a normal person sugar accumulates in the blood and is excreted in the urine. The metabolism of fats is increased to such an extent that the intermediary products, called acetone bodies, are not completely oxidized as in the normal person, and these substances also accumulate in the blood and are excreted in the urine. Two of these acetone bodies are acids and are excreted in combination with alkali, which is thus removed from the body, and so there develops a condition of acidosis that may lead to coma.

The complications of the inadequately treated disease are many and serious. Vision may become impaired. Skin infections of all kinds may occur and prove very intractable. Boils, carbuncles, cellulitis and gangrene are all apt to occur as life advances. There is especial danger of gangrene of the toes and feet. Diabetics are especially liable to tuberculous. Digestive troubles, kidney diseases and diseases of the heart and particularly arteriosclerosis are of common occurrence. But the most serious complication of all is diabetic coma. The onset of this condition is often insidious, but may be indicated by loss of appetite, a rapid fall in the quantity both of urine and of sugar in the urine, and by either constipation or diarrhoea. At first the condition is rather that of collapse than of true coma, though later the patient is completely comatose. He suffers from a peculiar kind of dyspnoea (difficult breathing) and the breath and skin have a sweet ethereal odour. The condition may last from one to three days, only very rarely longer, and was almost invariably the precursor of death in preinsulin days.

Treatment—Patients suffering from diabetes mellitus are treated by dietetic measures, and if the condition is of moderate or severe intensity, by the administration of insulin. Before the discovery of insulin the methods of treatment introduced by Frederick Madison Allen and by Elliott P. Joslin, of drastic restrictions in diet, prolonged the lives of many severe diabetics.

Several important principles underlie the dietetic treatment of this disease. The diet must supply sufficient calories to keep the patient's weight constant at the proper level. Protein, preferably as lean meat, eggs and milk, must not be reduced below a certain minimum value. If proteins are unduly reduced, the tissue proteins of the patient's body are drawn upon. Some diabetics are recommended a diet rich in fat substances, while others are given a diet high in starchy foods. Excess of sugar is excreted in the urine, and the amount of sugar so excreted can readily be determined by chemical analysis. Tables are available showing what substitutions may be made in the diet without changing the sugar available to the body.

The diabetic diet should consist as far as possible of easily available seasonable foods along the line of a normal diet. It is much more satisfactory for the patient to obtain the essentials of his diet from among these common foods than to be largely dependent upon specially prepared diabetic foods. The diabetic diet need not be monotonous.

Insulin, which is distributed as a sterile, slightly acid solution, is injected hypodermically. There is no substitute for insulin. The amount necessary depends upon the severity of the disease, upon the quantity and nature of the diet, and upon the activity of the individual. In general, enough insulin is given to reduce the high concentration of sugar in the blood of the diabetic to the

level of that of a normal person. It is given every day, usually before breakfast, and sometimes again later in the day.

If the diet is unbalanced with respect to the relative amounts of proteins, fats and carbohydrates, or if there is a serious lack of insulin a diabetic may pass into coma. The treatment of coma before insulin was available was to put the patient to bed, supply fluids, heat and stimulants, and give sugar by mouth or by vein. These general measures are in large part still necessary. Insulin has proved a specific remedy in the treatment of this condition, and when it is given early enough and in large doses, the results have been very successful.

A very serious condition may be produced by an overdose of insulin. A low concentration of sugar in the blood (hypoglycaemia) will result. It may be avoided on the physician's part by a careful balancing of diet against dosage of insulin, and on the patient's part by a close and intelligent observance of the diet, together with a thorough understanding of the premonitory symptoms of the beginning of a hypoglycaemic reaction. The symptoms of slight hypoglycaemia are sudden hunger, fatigue, a peculiar restlessness often described by the patient as a feeling of 'inward trembling,' pallor or flushing of the face and an increased pulse rate, a particularly valuable sign in children. If the overdose of insulin is large, and corrective measures are not taken, the patient may show profuse perspiration, tremor, emotional disturbances, collapse and unconsciousness. The treatment of mild or moderate degrees of hypoglycaemia consists of the administration of carbohydrate in any convenient form such as ordinary sugar or candy or diluted corn syrup. In severe cases a sterile solution of dextrose is given intravenously by a physician.

Prognosis—Before the use of insulin fewer than 20% of patients suffering from severe diabetes lived more than ten years. Children, who usually have the disease in a severe form, seldom lived for more than a year. With the increasing knowledge of the disease and its treatment, it was estimated, 25 years after the discovery of insulin, that the life expectancy of a diabetic child was only ten years less than that of a healthy nondiabetic child. Diabetic women on a careful dietary regime, receiving insulin and other necessary treatment, can now bear healthy babies. Most persons who have diabetes can keep well and lead successful and useful lives, but constant and intelligent attention to the details of treatment by both patient and physician are necessary.

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(C. H. B., F. T. W.)

DIABOLO, a game played with a sort of top, in the shape of two cones joined at their apices, which is spun, thrown and caught by means of a cord strung to two sticks. The idea of the game appears originally to have come from China, where a top (*Koungen*), made of two hollow pierced cylinders of metal or wood joined by a rod, often of immense size, was made by rotation to hum with a loud noise, and was used by pedlars to attract customers. From China it was introduced by missionaries to Europe, a form of the game, known as "the devil on two sticks," appears to have been known in England toward the end of the 18th century.

At intervals occasional attempts were made to revive the game of spinning a top of this sort on a string, but it was not till 1906 that the sensation of 1812 began to be repeated. A French engineer, Gustave Philippiat, discovering some old implements of the game, had experimented for some time with new forms of top with a view to bringing it again into popularity, having devised the double-cone shape, and added a miniature bicycle tire of rubber round the rims of the two ends of the double cone, with other improvements, he named it "diabolo." The use of celluloid in preference to metal or wood as its material appears to have been the result of a suggestion of C. B. Fry, who was consulted by the inventor on the subject.

The game of spinning, throwing and catching the diabolo was rapidly elaborated thereafter.

DIACONICON, in the Greek Church, the name given to a chamber on the south side of the central apse, where the sacred utensils, vessels, etc. of the church were kept. In the reign of Justin II (565-574), owing to a change in the liturgy, the diaconicon was located in an apse at the east end of the south aisle, a similar apse at the east end of the north aisle was used as the prothesis (*q v*)—the place where the elements of the Communion were prepared. In the churches in central Syria, of slightly earlier date, there is only one apse and the diaconicon is rectangular (T F H)

DIADOCHI, *se*, "Successor" (Gr *διαδοχισταί*), the name given to the Macedonian generals who fought for the empire of Alexander after his death in 323 B C. The name includes Antigonus and his son Demetrius Poliorcetes, Antipater and his son Cynander, Seleucus, Ptolemy, Eumenes and Lysimachus. The kingdoms into which the Macedonian empire were divided under these rulers are known as Hellenistic. The chief were Asia Minor and Syria under the Seleucid dynasty (*q v*), Egypt under the Ptolemies (*q v*), Macedonia under the successors of Antigonus Gonatas, Pergamum (*q v*) under the Attalid dynasty. Gradually these kingdoms were merged in the Roman empire (See MACEDONIAN EMPIRE) (X)

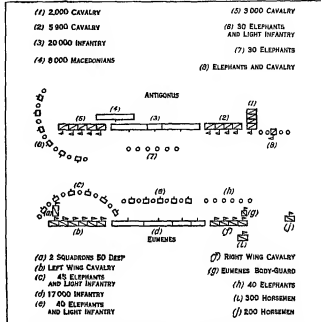
DIADOCHI, WARS OF (323-281 B C) The wars of the Diadochi, or Successors, though outwardly civil wars ending in the disruption of the Alexandrine empire, were inwardly the birth pangs of a new civilization begotten by Persian gold set into circulation through strife. Few periods in history have produced so many great generals, the reason being that the chief participants in these wars, namely, Antipater, Craterus, Perdiccas, Ptolemy, Lysimachus, Seleucus and Eumenes had all been selected by Alexander and trained in his campaigns.

To the Death of Perdiccas, 321 B C—Alexander died in June 323, but before the year was out civil war was raging throughout Greece. This conflagration was known as the Lamian war, and to quell it Antipater sent for Craterus then in Cilicia on his way back to Greece with Alexander's discharged veterans. On his arrival he met the Grecian allied forces on the plains of Crannon and routed them. Free of this menace, Antipater and Craterus, fearing the growing power of Perdiccas, entered into a league with Ptolemy, who was nervous lest Perdiccas should attempt to dispossess him of Egypt. Nor were his fears unfounded, for in the spring of 321 Perdiccas, accompanied by Philip Arrhedeus, the weak minded half-brother of Alexander, marched against Egypt, whereupon Craterus and Neoptolemus invaded Asia, both being killed in a battle with Eumenes. Perdiccas did not, however, live to hear of this victory, for on the Pelusiac branch of the Nile his men mutinied and assassinated him. The battle fought by Eumenes is mainly of strategical interest, since Perdiccas and Eumenes held a central position and were threatened by Antipater from the west and by Ptolemy from the south. Antipater's plan was first to smash Eumenes and hold off Perdiccas, secondly to concentrate against the latter. Perdiccas attempted to counter this plan by sending Eumenes to hold back Antipater's two generals whilst he fell upon Ptolemy. Both coalitions aimed at destroying each other in detail, the one working on interior lines and the other on exterior. From the very outset of this war we find strategy dominating tactics, the reason being that all the generals concerned are men of high military ability.

To the Death of Eumenes, 316 B C—By the death of Perdiccas the preponderance of power was thrown into the hands of Antipater, Ptolemy and Antigonus. As Antipater had just uttered a reverse, Antigonus, seeing Eumenes without an ally, marched against him. Eumenes, robbed of the fruits of his victory, was faced by a mutinous army. Putting to death the ringleaders he turned to meet Antigonus, whereupon his cavalry under Apollonides deserted to the enemy. Thus compelled to flee, to seek refuge in the fortress of Nora, which was at once besieged by Antigonus. Meanwhile Antipater died, but shortly before his death he set aside his son Cynander and appointed as his successor Polyperchon. Antigonus, hearing of the difference between these two, saw a chance of increasing his dominion, and to the quit of the siege he proposed favourable terms to Eumenes, who was at

once bought over by Polyperchon, who sent to him the Argyraspides (Silver Shields), a formidable body of Alexander's veterans. A series of manoeuvres now took place, the two antagonists coming into contact in Media. Eumenes had 35,000 foot, 6,100 horse, and 114 elephants, and Antigonus 82,000 foot, 8,500 horse and 65 elephants. The orders of battle of the two armies are given in the diagram.

The tactics of this battle are interesting. Antigonus, seeing that Eumenes had deployed his best horsemen on his right, drew up



PLAN OF THE FIRST BATTLE BETWEEN EUMENES AND ANTIGONIS

1,000 horse archers and 1,000 lancers in columns of squadrons so that they could "charge in manner of a running fight, wheeling off one after another, and so still renew the fight by fresh men." He did this to hold his enemy's main attack. Eumenes, to protect his left wing, drew up his elephants in a demi lune, from which it may be inferred that this wing was to be refused. Antigonus in order to protect his right wing, which was to deliver the main attack, extended his elephants in a semi-circle on its outer flank.

Antigonus advanced with his right leading, but not being able to encounter the elephants he wheeled outwards and poured showers of arrows on to his enemy's left flank. Eumenes, withdrawing a force of cavalry from his right, fell upon the flank and rear of Antigonus's right wing and pursued it into the mountains. The phalanxes now clashed together, the Silver Shields carrying all before them. Antigonus was advised to retire, but he was too good a soldier to take this course. He noticed that the pursuit of Eumenes and the movement of the Silver Shields had created a gap between the phalanx and the left wing cavalry. Through this gap he charged, and struck Eumenes' right flank in rear driving it from the field. The battle was indecisive, and during the night both armies retired. Eumenes was now compelled to disperse his force in order to live. Antigonus, determining to take advantage of this, abandoned the main road for a little-known desert track. Learning of this, Eumenes lit fires "within the compass of 70 furlongs," which so completely deceived Antigonus that he abandoned the track, this allowed Eumenes to concentrate his forces. The armies now met, that of Antigonus numbering 22,000 foot, 900 horse, and 65 elephants, and that of Eumenes 35,700 foot, 6,050 horse, and 114 elephants (See plan below).

Eumenes, hearing that Antigonus was with his right wing, faced him with his left, in front of which he drew up in a half-moon formation, the bulk of his elephants linking them up with light infantry. In his centre he marshalled his targeteers in front, the Silver Shields behind them, and the "foreigners" in rear. In front of the targeteers he extended a line of elephants and light troops, his right wing being ordered "to retire leisurely as he fought, and

diligently to observe the events of the other side." As the elephants advanced on each other a tremendous dust was raised, under cover of which Antigonus sent out a force of cavalry to pass round the enemy's flank and seize his baggage camp. Eumenes charged forward through the dust, a large number of his horse deserting him. He was followed by the Silver Shields who once again carried all before them, but on account of the flight of Eumenes' cavalry they were surrounded by the enemy's. Learning that their baggage and wives were in the enemy's hands they were thrown into consternation. Thereupon Antigonus offered to hand their camp back to them if they would desert and surrender Eumenes. This they agreed to do, and after a week's captivity Eumenes was put to death by his guard.

To the Death of Heracles, 310 B.C.—Whilst Eumenes was warring in Asia, Olympias, the mother of Alexander, put to death Philip Arrhidaeus. Thereupon Cassander, who by bribery had won over many of Polysperchon's soldiers, besieged her in the fortress of Pydna. In the spring of 316, with Roxana and her child (Alexander's widow and son), she surrendered to him and shortly after was assassinated. The death of Eumenes having freed Antigonus from opposition in Asia, he made the assassination of Olympias an excuse to destroy Cassander. Through self preservation, Lysimachus, Ptolemy and Seleucus formed an alliance against him, and in 314, to weaken Cassander, Antigonus promised freedom to the Grecian cities. The result of this was that the Aetolians entered into alliance with him, and Cassander was forced to march against them. Meanwhile Seleucus gained over Babylonia and founded the Seleucid dynasty.

In 311, Cassander having defeated the Aetolians, a temporary peace was patched up, the terms of which were: That Cassander was to hold Macedonia until Roxana's child should come of age, Lysimachus to govern Thrace, Ptolemy to retain Egypt, and Antigonus to rule all the provinces of Asia. No sooner was this peace agreed upon than Cassander assassinated Roxana and her child, whereupon Polysperchon, influenced by Antigonus, espoused the cause of Heracles the pretender, proclaiming him Alexander's son by his mistress Barsine. Cassander, whose position was insecure, offered Polysperchon complete control of the Peloponnese if he would put Heracles out of the way, which was promptly done.

To the Death of Antigonus, 300 B.C.—To punish Cassander, in 307 B.C., Antigonus sent his son Demetrius to the Peraeaeus. The Athenians mistaking his fleet for that of Ptolemy allowed him to enter the port, whereupon Athens opened her gates to him. The next three years were passed by Demetrius in a series of campaigns. At the battle of Gaza, 312 B.C., he was defeated by Ptolemy and Seleucus, captured and at once released. Concentrating his main cavalry force in his right wing, Ptolemy protected it against Demetrius' elephants by a palisade pointed with iron spikes, in front of which he placed his light infantry. As the elephants advanced they were plied with darts, and when they struck the iron spikes they were thrown into such confusion that the Demetrians lost heart and withdrew.

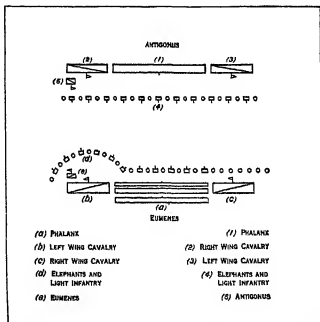
In 308 B.C. Demetrius, realizing that Ptolemy's strength lay in his command of the sea, defeated him in a naval battle off Cyprus, and in the following year he set sail for Rhodes, the siege of which was the greatest exploit of his eventful life. At this siege every type of device was made use of by besieged and besieger. Demetrius employed 30,000 artificers and workmen to build his towers and engines, Helepolis, the largest tower he built, required 3,400 men to move it. He constructed a ram 180ft long which was moved on wheels by 1,000 men. In place of ramming his enemy's war galleys, he cleared their decks by ventable broadsides of missiles, and Plutarch tells us that he built galleys of 13 banks of oars, and some of even 15 and 16 which "were as wonderful for their speed as for their size." Nevertheless, in spite of his inventive genius, in the autumn of 302 B.C. he was compelled to raise the siege, for Ptolemy, still controlling the seas, resupplied the city.

Returning to Athens, in April 301, as he was marching into Thessaly to meet Cassander, Demetrius was recalled to Asia by Antigonus. The reason for this was that Ptolemy, Seleucus and

Lysimachus, fearing that should Cassander be defeated Greece would be added to the kingdom of Antigonus, determined to relieve the pressure by attacking Antigonus in Asia. In the spring of 300 B.C. the opposing forces met at Ipsus, in Phrygia. Demetrius with the main force of cavalry charged Antiochus, the son of Seleucus, routed him, and then pursued him. Seeing what had happened Seleucus blocked his return by a line of elephants, and then in place of charging Antigonus threatened him with attack, so giving time to a large of the enemy who wished to desert to come over. This the large body did, and when a strong force of the enemy drew up to charge Antigonus, one of those about him cried out "Sir, they are coming upon you!" To which the old general replied dryly "What else should they do?" and was at once smitten down by a multitude of darts. His kingdom was then broken up, chiefly to the profit of Seleucus.

To the Death of Seleucus, 281 B.C.—In 296 B.C. Cassander died, and Demetrius returning to Greece became master of Macedonia. There he prepared to invade Asia, which threat resulted in an alliance between Seleucus, Ptolemy and Lysimachus. Demetrius, forsaken by his troops, surrendered himself to Seleucus, who kept him a prisoner until his death in 283 B.C. In 277 B.C. his son Antigonus Gonatas regained the throne of Macedonia, and his descendants, the Antigoni kings, held it until the battle of Pydna, in 168 B.C. In 283 B.C., Ptolemy, king of Egypt, died at the age of 84, and two years later, at the battle of Corin, Lysimachus, at the age of 80, was killed by Seleucus, who himself was murdered by Krennos, the eldest son of Ptolemy, in 281 B.C. Thus perished the last of the Diadochi.

The Art of War of the Period—In spite of their many brilliant episodes, the wars of the Diadochi constituted a period of military decadence. The first cause for this was the sudden loss of Alexander's genius, the second, the imitation by the Suc-



PLAN OF THE SECOND BATTLE BETWEEN EUMENES AND ANTIGONUS 316 B.C.

cessors of his actions without understanding them, and, lastly, the immense influx of Persian gold.

When Alexander died his art died with him, and though several of his generals showed true knowledge of the art of war and on occasion actually improved on his minor tactics, they lacked his vision, and after his death the glamour they had gathered was lost and only a dream was left, which as years passed by grew fainter and more obscure. Eumenes was an able leader, full of resources and craftiness, yet in his first battle with Antigonus he merely copied the Alexandrine tactics in place of breathing out their spirit. He made his right wing the decisive attack, as Alexander had done, but Alexander always struck at his enemy's command,

the decisive point, and as Antigonus was commanding his own right wing Eumenes should have attacked him with his left. In his second battle he does not repeat this mistake, which shows how little of essential value is learned even by intelligent soldiers until disaster hammers knowledge home.

The Persian gold, with which Alexander intended to develop his empire, was spent in war. The mercenary now came into his own, and not only was he bought and sold on the battlefield, which if it did not destroy discipline destroyed all reliance in it, but he changed the art of leadership and of military organization. A mercenary army will serve any master for pay, and when a general is forced to hire mercenaries he looks for the most formidable type of troops. In this day the sarissa armed hoplites were of this category, consequently a man who looked for employment as a mercenary knew that as a hoplite he would command higher pay than as an archer or a peltast. The result was a disruption of Philip of Macedon's organization and a steady return to the Spartan tactics.

In the army of Alexander leadership was based on heroism, but in the armies of the Diadochi it was based on pay. The result of this was that heroism was replaced by craft. Warfare, in a low and underground way became more intellectual, and leadership had to follow suit. The leader was no longer a hero but a diplomatist, and as he led by gold in place of by valour, he crept behind his men or, more frequently still, hired a hero to lead them and from a safe distance instructed him what to do. Thus the mercenary separated leadership from command, and the whole art of war changed. Another influence of gold was that warfare became mechanized. Gold stimulated invention, invention stimulated industry and industry was applied to war. Projectile weapons came more and more into use, and as they were difficult to move on the battlefield they induced generals more and more to adopt defensive tactics. The antitaphant palisades at the battle of Gaza are an example of this.

The whole tendency of this period is one from prowess to cunning. Under the Diadochi we see strategy steadily coming to the fore. Antipater and Ptolemy go into league against Perdiccas, and their movements, as well as their ideas, are combined. At the battle of Ipsus it is the same, and out of these various transient combinations may be seen evolved from cunning a definite conception of the balance of power, in the making and unmaking of which more and more does command of the sea play a decisive part. Ptolemy holds it, then Antigonus attempts to wrest it from him, such was the cause of the siege of Rhodes. Each king wants to secure his frontiers, and the only one who succeeds in doing so is Ptolemy—as long as he can command the sea. With this command Egypt is virtually an island. Surrounded by deserts, it is all but unassailable save from the sea. The result of this security is immense prosperity, which gives birth to an economic and ethical outlook on war. Ptolemy from a leader step into the position of a modern commander, a true general in chief. He is a statesman, and he understands that clinics may be used as a weapon—witness his treatment of Demetrius after the battle of Gaza, and this was not an isolated case. He knows the value of his immense resources, and to him they are weapons of war. He saves Rhodes by means of dried peas, and not by pikes, and plans campaigns while his generals fight his battles. Thus we see, in many unlooked-for ways, how the unleashing of the power of gold transformed civilization and with it the art of war.

The Foundations of Modern Europe.—The influence on western civilization of these 40 years of incessant war was profound. Alexander had dreamed of a world empire through a fusion of races and, curious as it may seem, it was through the wreck of his empire that this idea took form. At his death Greece and Persia disappeared and the Hellenistic world was established in their stead, a world of decadence and of progress which was destined to fertilize Rome and, later on, Arabia. As Greece had transmuted the barbaric fustels of the Orient into rich gold, so the East once more seized upon the jewels of Greece and wore them into mystic cabalistic webs into its gnosticism and theologies. Without Alexander and his successors there would have been no Christian religion nor would there have been an Arabian

civilization—in fact the world today would not be the world we know. (J F C F)

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DIAGENESIS. After deposition, a sediment may be materially altered or modified. These modifications may occur before burial at the interface between sea water and the sediment after burial but before consolidation or after consolidation either at normal temperatures and pressures or at elevated temperatures and pressures. To those changes which take place in a newly deposited sediment, prior to its consolidation, either at or below the sediment water interface, the term diagenesis is applied. Changes in the sediment produced by higher temperatures and pressures are properly called metamorphic. There is some uncertainty where diagenesis leaves off and metamorphism begins. Some writers would restrict diagenesis to reactions taking place on the sea floor and would use the term epigenesis for those changes which occur after consolidation and uplift but prior to the advent of truly metamorphic conditions. The changes or processes operating on a sediment clearly overlap and form a continuum so that it is commonly difficult, from a study of the results alone, to be sure in which stage a particular feature was produced.

Diagenetic changes are brought about mainly by chemical reaction of the solid particles of the sediment with the surrounding fluid, either the superjacent medium from which the sediment was deposited or the fluids trapped in the intergranular voids or pores of the sediment. The processes, solution and reprecipitation and exchange of ions between solid and liquid, alter the physical properties and the chemical or mineralogical composition of the sediment.

Included among the changes are compaction—which is largely physical and results in decrease of porosity of the rock, cementation, usually by the precipitation of interstitial cement, recrystallization (such as conversion of aragonite to calcite), replacement (such as the conversion of precipitated calcium carbonate to dolomite, the double carbonate of calcium and magnesium), selective solution of some components, and the regeneration and growth of others.

Among the many products of diagenetic action are the authigenic minerals which grew in the sediment after deposition. These may occur as secondary overgrowths on pre-existing detrital grains or as crystals without detrital cores. The quartz and feldspars of some sandstones commonly show authigenic overgrowth, both may occur also as small authigenic euhedra in limestones. Some concretions, most glauconite, much dolomite, the chlorite and clay mica of shales and some cherts have been attributed in part to diagenesis. (F J P)

DIAGHILEV, SERGEI PAVLOVICH (1872-1929), Russian ballet producer, was born in the province of Novgorod, Russia, March 19, 1872. After studying law and music he organized art exhibitions in St. Petersburg (Leningrad). In 1899 he founded the review *Mir Iskusstva* ("The World of Art"), to which K. A. Somov and L. Bakst contributed and which exercised a powerful influence on Russian art. From 1907 onward he occupied himself with musical and theatrical productions and organized a number of Russian concerts in Paris, there he produced in 1908 and 1909 Russian operas (*Boris Godunov* and *The Maid of Pskov*) and ballets. Subsequently he organized successful ballet and opera seasons in London, Paris, Berlin, the U.S. and elsewhere. One of his most successful operatic productions was that of Modest Musorgsky's *Khovantschina*. In England the originality of his conceptions may be said to have effected a revolution in choreographic art and further put new life into stage dancing which by the end of the 19th century had degenerated into a spectacular show of little artistic significance. Among his numerous successful ballets may be mentioned *Carnaval* (music by Schumann), *Scheherazade* (music by Rimsky-Korsakov), *Petrushka* (music by Stravinsky), *La Boutique Fantasque* (music by Rossini) and *The Three-cornered Hat* (music by De Falla)—to name but a few of

a very large number. In 1904 Diaghilev produced a valuable book on the painter D. Levitsky. A collection of photographs and drawings illustrating the ballet, *Les Biches*, was published in 1924 by B. Koshino. (See also **BALLET**.) He died at Lido, Aug. 19, 1929.

DIAGNOSIS Man, because of his physical and mental ills has from time immemorial turned to the physician for aid. In the past a certain mystery or magic was associated with medical diagnosis. The modern physician, however, proceeds in a logical, rational manner, avoiding the supernatural but calling for aid not only upon medicine but also upon chemistry, physics and bacteriology. While many who are ill recover without treatment, thanks to what the ancients called the *vis medicatrix naturae*, the healing power of nature, the first step toward successful treatment is a correct diagnosis.

In making a diagnosis the physician consciously or subconsciously follows certain definite mental processes. First, he recognizes the problem which the patient presents, second, he collects data that more clearly outline the problem, third, he thinks over the facts and the possible solutions, fourth, he reasons out the implications of the suggested solutions, and lastly, he compares the actual facts with the suggestions to see if there is an identity between the facts established and the suggested solutions. These facts are obtained from the anamnesis, or history, from the physical and physical examination and from laboratory tests and the data obtained from the employment of instruments of precision such as the X-ray, the electrocardiograph, the electroencephalograph and similar instruments.

These are the methods of diagnosis whether the disease is to be treated by medical or by surgical procedure. The methods of medical and surgical diagnosis are one and the same, only the methods of treatment vary.

Patient's History—The importance of a careful history has been recognized from the earliest times. Rufus of Ephesus who practised during the reign of Trajan (c. A.D. 100), wrote a work *On the Interrogation of Patients*, which still remains one of the classics of medical literature.

In the history, the influence of heredity is often of great importance since certain physical characteristics of individuals are transmitted from one generation to another. The thin, gracile, sthenic type is more prone to develop certain diseases than is the heavy, muscular, phlegmatic individual who, in turn, is more likely to suffer from certain other diseases. High blood pressure and diabetes mellitus show a marked tendency to appear in successive generations of the same family. Cancer and tuberculosis show a marked hereditary tendency. Nervous and mental diseases are particularly prone to appear in certain families. Some diseases of the nervous system are always hereditary, familial or congenital. Friedreich's disease and Huntington's chorea are hereditary. Wilson's disease is familial, meningocele, spina bifida and many cases of hydrocephalus are congenital. Psychoneuroses show a marked familial tendency as do certain psychoses, notably manic-depressive psychoses.

Not only should the family history be carefully noted but the past history of the patient himself. Certain diseases of childhood may give the clue that indicates the correct diagnosis. For instance, the history of enlarged glands of the neck, or even of scrofula, during childhood suggests that the cough from which the adult patient suffers is caused by pulmonary tuberculosis.

The patient's occupation and habits, moreover, may offer clues to diagnosis. Certain occupations present definite health hazards. Those who work in an atmosphere of dust, such as coal miners, metalworkers, stone-masons and woodworkers inhale dust particles which lodge in the lungs and may later produce severe pulmonary disease. Workers in chemical plants may suffer from acute or chronic poisoning, and painters are prone to develop lead poisoning unless proper precautions are observed. Nursery workers who spray plants with solutions of arsenic, mercury and other poisonous ingredients are subject to hazards from the exposure. It is also important to know where the patient has lived or till live. Malaria is very common in the Mediterranean area but very rare in Labrador.

The excessive use of alcohol and tobacco has long been recognized as a cause of disease. Chronic alcoholism causes certain types of psychoses. Cirrhosis of the liver, while probably resulting from a nutritional deficiency and not from a direct action of alcohol on the liver cells, nevertheless is closely associated with the abuse of alcohol, as the old designation "gin drinker's liver" indicates. More than one-half of the cases of cirrhosis of the liver in the United States are seen in alcoholics. The excessive use of tobacco plays its role in the production of disease, particularly of the vascular system. Tobacco causes, in many individuals, a constriction of the capillaries of the skin with a lowering of skin temperature, while other individuals develop cardiac irregularities from excessive smoking. The patient's eating habits, his favourite foods, foods that agree or disagree with him suggest possible diagnoses. The patient with hyperacidity of the stomach cannot eat pickles, while the man with too little acidity enjoys them. So much for the patient himself.

History of the Illness—Next, the physician investigates the history of the patient's illness. He inquires as to the symptoms, general or local, if local, where localized. Since the local symptoms are most commonly pain the physician wishes to know where it is located, whether it is constant or occasional, whether it is sharp or dull, whether it remains localized or travels to another region. In many diseases, such as angina pectoris, duodenal ulcer, intermittent claudication and tabes dorsalis, an accurate description of the pain, its location, duration, periodicity and the conditions under which it appears or disappears, is often sufficient to indicate the diagnosis. The duration or chronicity of the disease is always investigated. Some diseases are acute some are chronic, some tend to spontaneous recovery, others never recover, with or without assistance. Lobar pneumonia is an acute disease in which recovery or death occurs in a few days. A patient who has been ill a month or longer is not suffering from uncomplicated lobar pneumonia. Conversely, diabetes mellitus is a chronic disease in which complete recovery rarely if ever occurs. A patient who has had sugar in the urine which later completely disappeared probably does not have diabetes.

History taking is an art of inestimable value. Some physicians estimate that the history itself contributes 50% to the correct diagnosis, others raise the percentage as high as 75. Hippocrates, the father of medicine, has left case histories of patients described so accurately that 2000 years later we can read a history and make the correct diagnosis.

Physical Examination—Having obtained the history of the patient and of the disease, the physician next proceeds to examine the patient, using his trained senses of sight, touch, hearing and smell. In this physical examination he employs four methods: (1) inspection, (2) palpation, (3) percussion, and (4) auscultation.

Inspection—This is the oldest of these methods and practically the only one employed by ancient and mediaeval physicians, aided at times by palpation. It is, however, remarkable how much the trained eye can reveal without even questioning the patient. Sir Arthur Conan Doyle, who was a physician, tells us that Sherlock Holmes was inspired by one of his teachers, Dr. Joseph Bell, whose uncanny powers of observation made an indelible impression upon the young medical student. Jean Nicholas Corvisart, the celebrated physician of Napoleon I, while examining a portrait one day remarked, "If the painter has been accurate, the original of this picture died of heart disease." Subsequent investigation proved he was correct.

Inspection alone may be sufficient to diagnose diseases causing alterations in the patient's appearance, such as acromegaly which produces marked enlargement of the jaws, nose and frontal bone or leprosy which of course causes thickening of the tissues of the face so that the patient's face usually resembles that of a lion—the leonine facies. The expression of the face is characteristic of certain diseases. In Parkinson's disease the face is often singularly devoid of expression, resembling the so-called Parkinsonian mask. In paralysis of the facial nerve, Bell's palsy, the patient is unable to close his eye and to show his teeth on the affected side. The gait of the patient may be characteristic of a certain disease, such

as tabes dorsalis, hemiplegia or paralysis agitans

The eyes may be protruded or sunken, the pupils may be irregular not of the same size in each eye, may not constrict when exposed to light—all of these abnormalities having especial significance. Inspection of the blood vessels of the neck, the carotid artery and the jugular vein may reveal irregularities in the beat of the heart so characteristic as to indicate the diagnosis. Inspection of the chest may reveal a marked difference in size and inequality of respiratory movements on the two sides, and the apex beat of the heart reveals by its position whether the heart is enlarged and by its character whether the heart is irregular. An enlarged stomach, liver or spleen or a tumour in the abdomen are often readily seen on careful inspection.

The ancients devoted a great deal of attention to the pulse and wrote many tomes on the subject. Paul of Aegina, who practised during the 7th century A.D., distinguished 62 varieties of pulse. While the modern physician thinks that many of these varieties were figments of the imagination, he has found that certain diseases are almost invariably associated with a certain type of pulse and that certain heart diseases have pulses that are slow or fast, small or bounding, regular or irregular.

Palpation—By palpation, the physician confirms what is seen on inspection. Firmness or softness, irregularity in outline or of the surface of an enlarged organ may not be apparent on inspection alone. Pain may be elicited on pressure and oedema of the ankles, which has been suspected on inspection, is confirmed when pressure with the finger produces a pitting which persists. Palpation may reveal tenderness over the gall bladder in gall-bladder disease and tenderness on pressure over the appendix is diagnostic of appendicitis unless the symptoms and the other findings disagree with this diagnosis. Palpation is of great value in the diagnosis of suspected fractures revealing abnormal motility of the bones or crepitation. After palpation the physician proceeds to percussion.

Percussion—Percussion, or tapping with the fingers, was discovered by Leopold Auenbrugger and described in his *Invention Noveborum*, one of the classics of medical science, published in 1761. Auenbrugger, the son of an innkeeper in Graz, learned as a boy to tell how much wine there was in a cask by tapping on the end. As a physician he discovered he could tell which side of the chest contained fluid by tapping on it and that he could determine the size of the heart, the presence of fluid, pneumonia and other disease processes by this method.

Percussion of the chest reveals whether the lungs are air-containing or consolidated, whether pneumonia or pulmonary tuberculosis should be suspected, as well as whether fluid in the chest or thickening of the pleura or air in the chest may be present. Percussion is important in determining the position and the size of the heart, liver, spleen and stomach. Its value is greatly enhanced by auscultation.

Auscultation—Auscultation, or listening, was the discovery of René Theophile Hyacinth, Laennec, a pupil of Corvisart, who introduced percussion into medical practice in France. Laennec, according to his biographer, was watching a group of children playing on a corm in the courtyard of the Louvre. One youngster "rattled the beam with a pin and the other" "it ran. pressed against the beam yielded every time he scratched. Laennec, on his way to see a patient, had no inspiration. On reaching the patient's house he took a sheet of paper, rolled it into a cylinder, applied one end to his ear and the other end to the patient's chest. To his delight he heard the heart sounds perfectly and at that moment the stethoscope was discovered. He described his instrument and its value in his *De Auscultation médiée*, published in 1819. The stethoscope remains one of the indispensable aids in the diagnosis of disease of the lungs and heart. With it the physician determines whether the breath sounds are normal or whether there are signs of inflammation, bronchitis, consolidation or cavitation in the lungs. He also can tell whether the heart sounds are normal or whether there is disease of the myocardium (lesions of the four sets of heart valves). (See APPENDIX A.)

Instruments of Precision—After the physical examination has been finished, the physician turns to instruments of precision

for additional aid.

Sanctorius (1561-1636), professor at Padua, was the first physician to employ instruments of precision in the practice of medicine. Galileo, watching the swinging of the lamp in the cathedral of Pisa, counted its oscillations by feeling his pulse and established the law of the isochronism of the pendulum. Sanctorius, his colleague and friend, reversed the process and timed the pulse by the swinging of a pendulum employing a weight attached to a cord. The length of the cord, which was adjusted until the rate of the oscillation agreed with that of the pulse, was measured on a scale and this taken as the pulse rate. Sanctorius also employed the thermometer, probably invented by Galileo, to determine the patient's temperature and weighed his patients on a steelyard to measure accurately the effect of food, exercise and various activities upon what he called the insensible perspiration. His steelyard was a forerunner of the basal metabolism instruments now so widely employed in medicine.

Although Sanctorius published his method of estimating the pulse and determining the temperature in 1625 and his work on insensible perspiration in 1614, only the latter made much impression upon medical thinking. Accurate timing of the pulse first became a recognized procedure when Sir John Floyer published in 1707 his *Pulse Watch*, in which he stated he at first employed a sea minute glass such as was used by mariners "but because that was not portable, I caused a Pulse Watch to be made which runs 60 Seconds, and I placed it in a Box to be more easily carried, and by this I now feel Pulses."

Registration of the temperature lagged even further behind, the first systematic recording dating from 1852 when Ludwig Traube published the first temperature curve in fever from the Leipzig clinic.

Sir James Mackenzie (1853-1925), while a general practitioner in Burnley, Eng., devised an instrument with which he could simultaneously register the pulse waves in the radial artery at the wrist and in the jugular vein in the neck. By comparing the two sets of curves, the jugular pulse indicating the action of the auricles and the radial pulse the changes in the ventricles, he demonstrated the mechanism by which irregularities of the pulse were produced and made some of the most noteworthy contributions in the history of cardiology.

Blood Pressure—Taking the blood pressure is an important feature in the examination of the patient. While the skilled physician in the past could tell whether the blood pressure was elevated by palpating the pulse, this method was inexact and often misleading. In 1896 Scipione Riva Rocci devised the instrument in use today, a rubber bag surrounded by a cuff, which is pumped up until the pulse disappears at the wrist—the systolic pressure. Later it was found that by listening at the bend of the elbow, systolic pressure as well as diastolic pressure could be estimated. The systolic pressure is the pressure during the systole or the beat of the heart, the diastolic pressure that during diastole or the pause or the heart between beats.

Although there is still much discussion regarding the normal systolic and diastolic pressures, it is safe to state that a systolic pressure of more than 140 mm of mercury and a diastolic of more than 100 mm is elevated.

Electrocardiograph—No study of the heart or circulation is complete without the records obtained with the electrocardiograph. Augustus D. Waller in 1887 showed that an electrical current produced by the beating of the heart could be demonstrated in man by attaching electrodes to the body and connecting them with a capillary electrometer. Willem Einthoven in 1903 substituted for the capillary electrometer a string galvanometer of his own design, and the electrocardiograph became a practical clinical instrument. In the original instrument the feeble current coming from the body through the arms and leg was carried into a quartz string placed in a magnetic field. Each heartbeat causes a vibration of the string whose movements are photographed on a moving film or sensitized paper—the electrocardiogram. Later improvements consisted of employing tubes similar to those used in radio which step up the weak current until it moves a more sturdy string than the original delicate quartz fibre, or even marks directly upon

prepared paper. The latter method avoids the inconvenience of photography and allows the physician to watch the record as it is being written.

The information obtained from study of the electrocardiogram is amazing. It shows whether the heart is enlarged, where the enlargement occurs, whether the heart action is irregular and where the irregularity originates, whether an occlusion of a coronary vessel is present and if so where the occlusion is located, whether a slow rate is physiological or caused by heart block. It also indicates high blood pressure, thyroid disease and certain types of malnutrition.

Electroencephalograph—One of the latest instruments of precision, the electroencephalograph, was first described in 1929 by Hans Berger of Jena. It records the electrical activity of the human brain and has been of especial value in the diagnosis of epilepsy and in the location of lesions of the brain, such as tumours, abscess or haemorrhage.

X rays—No method of examination has given greater aid in the field of general diagnosis than the X-rays or Röntgen rays, discovered by Wilhelm Konrad Röntgen in 1895. Three months after the discovery the *Journal of the American Medical Association* wrote, somewhat pessimistically, "Half an hour is the shortest exposure possible and most require one hour. The electric apparatus required is so expensive, \$100 and upward, that few surgeons can use it yet in their private practice." After that time the X-ray was improved so that exposures require only fractions of minutes but, needless to say, the cost of the apparatus has enormously increased.

The original X rays were photographs made on sensitive plates. With the development of fluoroscopy, X ray diagnosis became even more helpful. When a patient is placed in front of the X-ray tube and behind the fluorescent screen, the physician sees clearly the outlines of the body, can watch the heart beat and note any irregularities, and can watch the lungs expand in respiration and observe whether this expansion is normal. When the patient swallows a gruel containing barium or any other substance opaque to the X ray, the physician can follow by the shadow it casts its course from the mouth through the oesophagus, stomach and into the intestines. The X ray demonstrates the structure of the bones of the body and lesions of the bone such as defects of structure, fractures, tumours, arthritis and inflammations. It reveals the size of the heart, irregularities and defects of the heart, pulmonary diseases such as bronchitis, pulmonary tuberculosis, collapse and abscess of the lungs, tumours of the lung, thickening of the pleura, fluid in the pleural cavity, enlargement of the liver, spleen and kidneys and stones in the kidneys, gall-bladder, bladder and pancreas.

The employment of contrast mediums, opaque solutions casting shadows, greatly enlarged the scope of X ray diagnosis. This method made possible the demonstration of bronchiectasis of the lungs, diverticula and cancer of the oesophagus, ulcers and cancer of the oesophagus, stomach and intestines, and lesions of the kidneys, ureters and bladder. Similarly, the employment of tetraiodo phenolphthalein, introduced by Everts A. Graham and W. H. Cole in 1924, a dye which is excreted in the gall bladder and casts a shadow, demonstrates enlargement of the gall-bladder and lack of function or the presence of gall stones. Ventriclegraphy, introduced by Walter E. Dandy in 1918, consists of introducing air into the ventricles of the brain and then taking an X ray of the skull. The resultant picture shows the size and location of the ventricles which may be displaced or distorted by a tumour or abscess of the brain. (See RADIOLOGY.)

Basal Metabolism Tests—Another method of examination, the basal metabolic test, is of great value in certain patients. The method employed consists of estimating the amount of oxygen consumed in a certain amount of time. When more oxygen than normal is consumed, the metabolic rate is increased, when less, it is decreased. It is of especial value in the diagnosis of thyroid disease. In hyperthyroidism or exophthalmic goitre the metabolic rate is increased, in hypothyroidism, decreased. (See NUTRITION Metabolism.)

Other Instruments—In addition to these instruments of pre-

cision, the physician also has at his disposal the ophthalmoscope which permits inspection of the retina, the bronchoscope, which shows the interior of the bronchi, the gastroscope, which gives a clear view of the interior of the stomach, the laryngoscope, for studying the larynx and vocal cords, the cystoscope which visualizes the interior of the bladder, and the proctoscope, which demonstrates lesions of the rectum and sigmoid.

Laboratory—After the physician has completed the physical examination and his examination with instruments of precision he turns next to the laboratory for study of the blood, urine, body fluids, secretions and any tissue which was removed for microscopic examination. The blood is examined the number of red cells and white cells are counted the haemoglobin or colouring matter of the red blood cells is determined the white blood cells are then stained and the relative percentage of the different types estimated. In the anaemias, the number of red cells is decreased, in polycythaemia increased. In most infectious diseases the number of white blood cells is increased, but in some infectious diseases a decrease in the number of white blood cells is a characteristic feature. In the leukaemias, the number of white blood cells is often tremendously increased. The clotting time of the blood is delayed in haemophilia, the formation of the clot is often abnormal in purpura. The blood platelets, a third type of blood cell, are markedly diminished in numbers in purpura haemorrhagica. Blood typing is of the greatest importance in certain conditions and in connection with treatment by transfusion. Estimations of the sedimentation rate of the red blood cells are routine in many physicians' offices.

The blood serum yields important information in many diseases. It contains substances in syphilis which produce a positive Wassermann reaction and specific agglutinins in typhoid fever which agglutinate the typhoid bacillus (Widal reaction) and specific agglutinins in brucellosis (undulant or Malta fever), tularemia and other less common infections. Blood cultures are a routine in many infectious diseases and may demonstrate the presence in the circulating blood of the typhoid bacillus, the pneumococcus, the meningococcus and the streptococcus, to mention a few well-known examples.

Studies of the blood chemistry are of great importance in many diseases. In diabetes, for example, the amount of sugar in the blood is greatly increased, and in nephritis (Bright's disease), the kidney being unable to excrete properly, the blood values for urea, ureic acid, protein and creatinin may rise sharply. In hypothyroidism, the blood cholesterol may be diminished and in hypothyroidism, greatly increased. In many diseases a study of the patient is incomplete without certain determinations of the blood chemistry.

By means of the stomach tube, the physician is able to study the gastric contents. The most important finding is the degree of acidity present. In gastric or duodenal ulcer the gastric acidity is usually much increased, in cancer of the stomach decreased, while in pernicious anaemia there is no acid present.

Functional Tests—These tests are assuming increased importance in diagnosis. The functional capacity of the heart is tested by noting the increase in the heart rate and in the blood pressure following exercise, and also by recording the time necessary for both to return to their normal values. Tests for the function of the kidneys are carried out by noting the rate at which the dye phenolsulphonphthalein when injected in the cubital vein is excreted in the urine and by the urea clearance test in which the blood urea and the amount of urea present in 75 cc of blood is estimated. Functional tests for the liver employ the injection of dyes intravenously, such as bromsulphalein which is entirely withdrawn from the circulation by the liver in normal persons in 30 min. Carbohydrate function tests are performed by giving the patient 100 g of glucose by mouth on an empty stomach. Normally the blood sugar rises sharply from the normal of 100 mg per 100 cc to 120 mg or 150 mg, then falls sharply and is down to its original level in two hours. In diabetes mellitus it may rise to two or three times its normal value and remain quite high for two, three or even four hours.

Cutaneous, or skin tests, are valuable in diagnosis. When the skin is scratched and a drop of tuberculin is placed on the spot, an area of redness with induration of the skin appears in from 24 to 48 hours in persons who have or have suffered from tuberculosis (Von Pirquet test). This test is of especial value in children. Similarly, when a drop of diphtheria toxin is employed, individuals who have no immunity to diphtheria show a reaction (Schick test). A similar test is employed in the allergic diseases, notably asthma and hay fever, where the offending material, such as milk, wheat, horse serum, ragweed pollen, etc., causes a reaction.

In many patients an examination of pathological sections for

bacteria may be a deciding point in diagnosis. The exudate from an inflamed tonsil, pharynx or nostrils when stained by proper methods may reveal the diphtheria bacillus or the streptococcus as the cause of the disease. Cultures of such secretions or from the urine, faeces, pus or sputum demonstrate the organism even more conclusively. The demonstration of a single tubercle bacillus in the sputum makes positive, often, a suspicion of pulmonary tuberculosis.

Final Diagnosis.—The physician has now collected his data. This is the most painstaking and laborious stage in his search for the correct diagnosis. He now thinks over the facts that he has obtained and the suggested solutions—sugar in the urine, for instance, would suggest diabetes mellitus. Then he considers the implications of the suggestions, thus a diabetic patient in addition to sugar in the urine should have an abnormal amount of sugar in the blood, should give a history of excessive thirst, excessive urination and loss of weight.

The physician next arrives at the last stage of the mental processes required in making a diagnosis. He compares the actual facts with the suggestions that have occurred to him to see if there is an identity between them and the suggested solutions. If further study brought out the existence of all of the above symptoms, the actual facts would agree with the suggested solution. The diagnosis would be diabetes.

This is the method pursued by the physician in making a diagnosis. While the task of collecting data on the patient, the history, the physical examination, special examinations and laboratory tests require accurate observation, the above process of correct reasoning is, in the last analysis, more important. To assemble the data, to make use of the relevant and to discard the irrelevant and to pass final judgment or make a diagnosis often require a mental ability of the highest order. It is the final test of the physician's diagnostic ability. False diagnosis often result not from false data but from faulty interpretation.

(R. H. M.)

DIAGONAL, in geometry, a line joining the intersections of two pairs of sides of a rectilinear figure (Gr. *diá*, through, *gōnē*, a corner).

DIAGORAS, of Melos, surnamed the Atheist, poet and sophist, flourished in the second half of the 5th century B.C. Religious in his youth and a writer of hymns and dithyrambs, he became an atheist because a great wrong done to him was left unpunished by the gods. In consequence of his blasphemous speeches, and especially his criticism of the Mysterics, he was condemned to death at Athens, and a price set upon his head (Aristoph. *Clouds*, 850, *Birds*, 1073 and Schol.). He fled to Corinth, where he is said to have died. His work on the Mysteries was called *ἄθρησκα* or *ἄθρησις* (*athreska* or *athresis*), in which no probability attracted the Parganian divinity.

DIAGRAM, a figure drawn so that geometrical relations among its parts illustrate relations among the objects represented by the figure, supplemented sometimes by numerical or other entries on the figure itself to show relations not represented graphically by the figure. The purpose of a diagram is to present vividly to the eye the principal relations on which one desires to fix attention and even sometimes to show by measurements on the figure, the exact numerical values of certain important quantities associated with the object which it represents. Owing to the generality of the concept, diagrams are useful for a great variety of specific purposes.

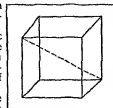
Mathematical Diagrams.—In mathematical treatises diagrams are used principally to help the reader follow the reasoning. Figures are drawn to represent to the eye the relations among the parts involved in a proposition to be proved and in the auxiliary propositions employed in the demonstration. In the proof itself attention is directed from the relations which are relevant to the matter in hand so that the demonstration is made general and is quite independent of the extraneous properties involved in the form of the particular figure employed. The construction of the

figure is usually so well defined in words that the reader could easily draw one for himself if the author did not supply it. Such a diagram is a good one if it sets forth clearly those features which are involved in the proposition to be demonstrated.

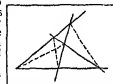
Diagrams in Chemistry and Crystallography.—John Dalton (*q. v.*) published many diagrams setting forth his conception of the configurations of the atoms in a large number of common chemical compounds, and the method has since been widely used by chemists. It has been found that there are many pairs of substances such that the two substances in a given pair have the same molecular formula while they differ widely in some of their properties. This difference of properties, where there is identity of molecular formulae and where we are forced to admit the same atomic linking, can be explained only by ascribing the difference to a different space distribution of the atoms in the molecule. This has given rise to the development of a branch of chemistry dealing with stereo isomerism, a subject in which the space diagrams of the positions of atoms play an important rôle in the explanation of structure. Similarly, in crystallography (*q. v.*) diagrams are likewise employed freely in the explanation of crystal structure. In recent years we have had a like analysis of atomic structure itself by means of diagrams. It is important to remember that in many cases such diagrams are suggestive only of certain selected relationships in the subject—not at all literal portrayals as in architecture (see *DRAWING, ENGINEERING*), or where tangible objects are shown with measurements.

Diagrams Showing Measurements.—In a different way, diagrams may be used for purposes of measurement, they are then called *metrical diagrams*. The plans and designs of architects and engineers, necessarily drawn to scale and made as accurate as possible, are employed in determining dimensions of the objects represented, by measuring the lengths of corresponding lines in the diagrams. Such diagrams serve a purpose beyond that of mere illustration, they afford a means of actual measurements relating to the objects themselves. They are strongly contrasted with diagrams of illustration, which are suggestive merely and need not show the forms of the parts provided only their relevant connections are properly exhibited. Of the latter kind are many diagrams in the mathematical subject of analysis situs (see *TOPOTOCY*) and also those employed to show electrical connections, as in the descriptions of radio receivers. Geographical maps afford examples of diagrams of another sort. In these the distances and relative positions among places on the earth are exhibited by their positions on the maps. By means of colours important features of various areas are often indicated, as, for instance, their political connections, or their geological character, or the distribution of rainfall or other climatic features, or the distribution of terrestrial magnetism or the variation of elevation above sea level. The heights of places above sea level are often indicated also by the insertion of numbers on the map to indicate the number of feet above sea level of each place indicated. Another (and more effective) method, that in which a line called a contour line is drawn through a place or places having the same height above sea level. When such contour lines are drawn sufficiently close together so that each one then is marked in one or more places with a number to denote the height above sea level of the places marked, when it is used we may obtain from one precise information concerning the elevation of the surface of the country. In this method the diagram is partly graphical and partly symbolic and so things are presented by the contour lines and accompanying numbers which are not shown by the relations among the parts of the diagram itself.

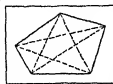
Diagrams for Objects Having Three Dimensions.—It is possible to use a system of diagrams for the graphical representation of the relations among any set of magnitudes involving more than two variables. In particular to represent the relations among the parts of an object having a distribution in three dimensions, we may employ two or more diagrams, each of them showing the relations of parts in a single plane or plane section of the object. Thus construction engineers employ plans and elevations and sections in different planes. In such a system of diagrams a definite indication must be given of the way in which the diagrams



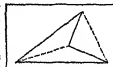
DIAGONAL OF CUBE



DIAGONALS OF A COMPLETE QUADRILATERAL



DIAGONALS OF A PENTAGON



DIAGONALS OF A REENTRANT QUADRILATERAL

are severally related to the structure as a whole and to each other. Examples of this type are afforded by the plans for buildings or for bridge construction. (See BRIDGES, DRAWING, ENGINEERING.) But it is also possible to represent solids and other figures in three dimensions by means of a single diagram drawn in a plane. One of the objects of descriptive geometry (*qv*) is to develop methods for attaining this end. The stereoscope (*qv*) furnishes a means for the use of two diagrams for the representation of three dimensional objects in such a way that their forms are readily recognized. The two diagrams are two plane projections of the bodies taken from separated points of view which are very near to each other. These two plane figures are nearly alike, their difference being due to the difference in point of view. When these two figures are placed in the stereoscope one of them is seen with one eye and the other with the other eye, in such a way that we intuitively identify the corresponding parts of the two figures. In pure geometry the method of projections, which underlies the diagrams used in the stereoscope, has led to many extensions of the science. In fact on it are founded the principles and results of projective geometry (*qv*).

Diagrams in Mechanics—It is probably in mechanics (*qv*), both theoretical and applied, that diagrams have been used for the greatest variety of specific purposes. Their application to statics is particularly convenient, owing to the fact that there is no motion of parts in a statical system. Consequently there has arisen an important branch of knowledge under the name of graphic statics. In the *diagram of configuration* it is convenient to represent the objects by points and to denote their relative positions by means of the relative positions of these points. This method is also applicable to the case of bodies in motion, the diagram of configuration then representing the relative positions of the objects at a given instant. If several diagrams of configuration are constructed, one for each of several given instants of time, then, by a comparison of these diagrams, it is possible to see the relative displacements which have taken place in the various intervals of time involved, but the system of configurations will not give the details of the motion during the interval between two consecutive instants for which diagrams of configuration have been constructed. As an example of a different kind, let us consider the diagram in fig. 1. This is a parallelogram formed from two directed lines AB and AC , issuing from a common point A , by drawing the related lines CD and BD . Attention is also placed on the directed diagonal AD issuing from A . We may use AB to denote a force applied to an object at A , the direction of AB representing the direction in which the force acts and the length of AB denoting the magnitude of the force. Similarly, AC will denote, in magnitude and direction, another force operating upon the same object at A . In mechanics it is shown that these two forces operating upon the body at A are equivalent, so far as their effect upon A is concerned, to a single force operating in the direction of the diagonal AD and of a magnitude represented by the length of AD . Thus a single diagram enables us readily to find the (so called) resultant force AD which is equivalent to the two given forces AB and AC .

Now BD is equivalent, in direction and length, to AC . Hence we might think of the resultant force AD as the third side of the triangle determined by the given forces AB and BD , where it is understood that the force represented by BD operates at A . Then we may call ABD the *triangle of forces*, whereas $ABDC$ would be called the *parallelogram of forces*. Now the triangle of forces is capable of a ready generalization, which we shall describe by aid of fig. 2. Let several forces all operate upon an object at A , and let the magnitudes and directions of these forces be respectively those which are indicated by the directed lines AB , BC , CD , DE , placed end to end as in the figure. (These lines may or may not be in one plane.) Then AE will represent, both in magnitude and direction, a single force which is equivalent, in its effect upon the object at A , to the combined effects of the several forces denoted by AB , BC , CD and DE , respectively. This figure $ABCDE$ is called a *polygon of forces*. If there is added to the

system of given forces already described a single force EA acting upon A but having the direction and magnitude denoted by EA , then the new system of forces will be in equilibrium in the sense that their combined effect upon the object A will be to leave that object undisturbed in position. The diagram afforded by the polygon of forces furnishes one of the most important means in mechanics for the analysis of the relations of forces.

Now the meaning of a diagram depends upon the point of view from which one considers it. This is well illustrated by the diagrams afforded by figs. 1 and 2, as we shall now show by giving interpretations of them in terms of velocities and accelerations. If AB and AC in fig. 1 denote velocities, both in magnitude and in direction, then AD denotes the resultant velocity. Thus if AB denotes the velocity of a ship relative to the earth and if AC denotes the velocity with which one is walking relative to the deck of the ship, then AD will represent, both in magnitude and in direction, the velocity of the walker relative to the earth. The combination, or *composition*, of several velocities is represented in a similar way by the polygon in fig. 2. Again, if AB and AC in fig. 1 denote accelerations, then AD denotes the resultant acceleration which is equivalent to a combination of the two given accelerations, and this may of course be extended to the case of the polygon of accelerations. These diagrams afford one of the most important means for the investigation of velocities and accelerations.

Work and the Indicator Diagram—If AB , in fig. 3, represents the path of a moving body and if for each position P of that body the force acting upon it, in the line of motion and opposed to its motion, is represented in any convenient scale by the length of the perpendicular PO from AB to the curve COB , then the area of the figure $ABCO$ represents (in a corresponding scale) the work required to be done upon the moving body during its motion from A to B .

If the piston of an engine is moving back and forth along the line AB in fig. 4 and if the area $ABDE$ represents the work done on the piston in moving from A to B while the area $ABDC$ represents the work done by the piston against retarding forces on its return stroke, then the area $CFDE$ will represent the effective work which may be accomplished by the piston thrust in a single back and forth motion. The figure by means of which this effective work done by the piston is shown is known as the *indicator diagram* of the motion of the piston. It is of fundamental importance in analysing the effective working capacity of the engine.

Other Diagrams—Brief definitions of various other diagrams will now be given. In an *Argand diagram* the complex numbers $x+iy$ are represented by corresponding points (x, y) with reference to a system of rectangular co-ordinates in a plane. An *automatic diagram* is one which is constructed automatically by a machine to show the related variations of two variables, as, for instance, the change of temperature with time during the day,

in these cases the completed diagram often consists of a graph drawn automatically upon specially prepared co-ordinate paper. In many cases of this sort a piece of paper is made to move (uniformly or otherwise) in a given direction, let us say horizontally, while a tracing pencil set is made to move vertically across it, the height of the tracing point varying proportionately to the magnitude of the quantity whose variation is to be registered. Machines of this sort are employed for the automatic registration of phenomena of many kinds, from those in meteorology and the theory of magnetism and electricity to those connected with the movements of plants and animals.

An *entropy diagram* shows the change of entropy in a thermodynamic cycle. *Euler's diagram* gives a graphic representation of logical relations, circles or other figures being used to denote (by their enclosed surfaces) the classes of objects to which given pred-

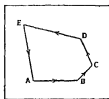


FIG. 2

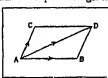


FIG. 1

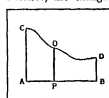


FIG. 3

icates apply, many other logical relations have also been denoted by various diagrams. In a *frame diagram* the positions of joints are shown by points and the connecting links by lines, it is often united with a diagram of forces showing the components of force through the various joints. *Hertz's diagram* represents the changes of temperature, pressure and moisture of a given mass of air when its volume is changing adiabatically, and *Neuhoff's diagram* is analogous to it. In *Newton's diagram* colours are represented by points, with weights attached to them to denote intensities of luminosity, while the arrangement of points is such that those which are on the same straight line can be produced by the mixtures of two colours. The *Poisson diagram* is a certain collocation of points employed in mathematics in the study of functions. In two *reciprocal diagrams* each point of junction of lines in either diagram corresponds to a closed polygon in the other.

A *strain diagram* is a figure which shows the relation between the amount of stress applied by pressure or otherwise to a test piece of material and the strains which it undergoes on account of this stress. It is usually drawn automatically by means of an instrument attached to the machine and the piece being tested, the deformations being amplified by aid of a suitable mechanism. A *stress diagram* is a figure in which each joint of a framework is represented by a funicular polygon (such a figure as is formed by a string supported at the ends and acted on by several pressures), while each link in the frame is represented by a line belonging to one or more of the funicular polygons, it is also called a *funicular diagram*. A *variation diagram* sets forth the changes in the indicator diagram of an engine for successive strokes of the piston, it is used to determine whether the governor is acting properly. The word *diagram* is also used in numerous other combinations many of which are self explanatory.

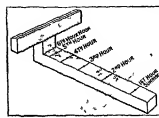
Diagrams appear in literature mainly as incidental to the subjects in connection with which they are employed, as has been indicated in the course of the article. Consequently the bibliographies are to be found by consulting the articles dealing with these subjects. (R D CA, 'C')

DIALA, the largest tributary of the Tigris rises in the Persian highlands near Mervan and, for a short distance south of Haleboja, forms the Perso-Iraq frontier. It joins the Tigris just south of Baghdad. After leaving the Jebel Hamra the river runs over shingle deposits and is extensively used for irrigation. The principal canals are the Beled Ruza and the Khorassan on the left bank and the Khazra and its branches on the right. Baquba lies at the end of the Khorassan canal, 52 miles from the mouth. This region is extremely fruitful and the river is navigable as far as this point from December to April. The metre gauge railway operating from Baghdad to Kirkuk runs along the valley of the Diala and offers a further outlet for the development of this well watered region.

DIAL and DIALING Dialing, sometimes called gnomonics, treats of the construction of sundials, that is of those instruments either fixed or portable, which determine the divisions of the day (Lat *die*) by the motion of the shadow of some object on which the sun's rays fall. It must have been one of the earliest applications of a knowledge of the apparent motion of the sun, though for a long time men would probably be satisfied with the division into morning and afternoon as marked by sun rise, sun set and the greatest elevation.

History.—The earliest mention of a sundial has been thought to be found in Isaiah xxxviii 8 "Behold, I will bring again the shadow of the degrees, which is gone down in the sundial of Ahaz, ten degrees backward." But a more correct translation may be "down the steps of Ahaz, 10 steps backwards." The date of this would be about 700 years before the Christian era, but there is no evidence that there was a sundial. The earliest of all sundials of which we have any certain knowledge is a \perp -shaped Egyptian dial in the Berlin museum, in which the upright of the \perp throws longer or shorter shadows along the horizontal limb which is divided into six hours. Another early classical type was the

hemicycle, or hemisphere, of the Chaldean astronomer Berosus, who probably lived about 300 B.C. It consisted of a hollow hemisphere placed with its rim perfectly horizontal, and having a style, the point of which was at the centre. So long as the sun remained above the horizon the shadow of the point would fall on the inside of the hemisphere, and the path of the shadow during the day would be approximately a circular arc. This arc, divided into 12 equal parts, determined 12 equal intervals of time



AFTER A RESTORATION BY BRUNNEN FROM ORIGINAL IN BERLIN MUSEUM
FIG. 1—EARLY EGYPTIAN SUNDIAL OF PERIOD OF THOTMES III c. 1500 B.C.

In the morning the crosspiece was turned to the east and in the afternoon to the west.

For that day now, supposing this were done at the time of the solstices and equinoxes, and on as many intermediate days as might be considered sufficient, and then curve lines drawn through the corresponding points of division of the different arcs, the shadow of the bead falling on one of these curve lines would mark a division of time for that day, and thus we should have a sundial which would divide each period of daylight into 12 equal parts. These equal parts were called *temporary hours*, and, since the duration of daylight varies from day to day, the temporary hours of one day would differ from those of another, but this inequality would probably be disregarded at that time, and especially in countries where the variation between the longest summer day and the shortest winter day is much less than in our climate.

The dial of Berosus remained in use for centuries. The Arabians, as appears from the work of Albategnius, still followed the same construction about the year A.D. 900.

Herodotus recorded that the Greeks derived from the Babylonians the use of the gnomon, but the great progress made by

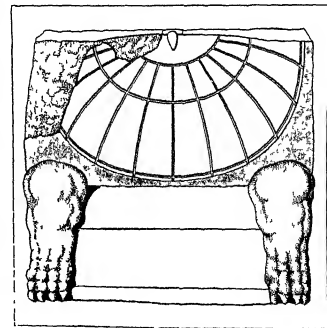


FIG. 2—HEMICYCLIC DIAL FOUND IN POMPEII IN 1854

the Greeks in geometry enabled them, in later times to construct dials of great complexity and ingenuity. Ptolemy's *Almagest* treats of the construction of dials by means of his *analemma*, an instrument which solved a variety of astronomical problems. The constructions given by him were sufficient for regular dials, that is, horizontal dials or vertical dials facing east, west, north, or south, and these are the only ones he treats of. It is certain, however, that the ancients were able to construct declining dials, as is shown by that most interesting monument of ancient gnomonics—the Tower of the Winds at Athens. This is a regular

octagon, on the faces of which the eight principal winds are represented, and over them eight different dials—four facing the cardinal points and the other four facing the intermediate directions. The date of the dials is apparently coeval with that of the tower, for there has been found at Tenos a marble block with similar dials inscribed with the name of Andronicus Kyrresthes, the builder of the tower. The hours are still the temporary hours or *hēctemoria*.

The first sundial erected at Rome was in the year 290 B.C., and this Papirus Cursor had taken from the Samnites, but the

may reasonably suppose that the new sundials came into general use during the 14th and 15th centuries.

Among the earliest of the modern writers on gnomonics was Sebastian Munster (*q.v.*), who published his *Horologiorum* at Basle in 1531. He gives a number of correct rules, but without demonstrations. Among his inventions was a moon-dial. A dial

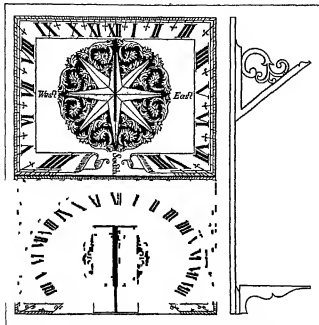


FIG. 3.—PORTABLE ANALEMMATIC SUNDIAL OF THE 16TH CENTURY. This consists of two dials. When they have been so adjusted that the two readings agree, the correct time is indicated.

first dial actually constructed for Rome was made in 164 B.C., by order of Q. Marcus Philippus. Vitruvius mentions 13 kinds of dials, including portable dials, the most interesting examples of which are the "Ham" dial, excavated at Herculaneum and the adjustable circular dial in the Lewis Evans collection at Oxford.

The Arabians were much more successful. They attached great importance to gnomonics, the principles of which they had learned from the Greeks, but they greatly simplified and diversified the Greek constructions. One of their writers, Abu'l Hassan, who lived about the beginning of the 13th century, taught them how to trace dials on cylindrical, conical, and other surfaces. He even introduced *equal* or *equinoctial* hours which were used for astronomical purposes while the temporary hours alone continued in use.

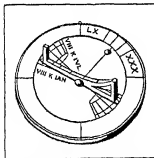


FIG. 4.—ROMAN PORTABLE DIAL. Portable dials were generally of pocket size. The one above dates from about A.D. 250 and has adjustments for the seasons and for latitude from 30° to 60°.

The great and important step already conceived by Abu'l Hassan, and perhaps by others, of reckoning by *equal* hours, was probably adopted between the 13th to the beginning of the 16th century. The change would necessarily follow the introduction of striking clocks in the earlier part of the fourteenth century, for, however imperfect these were, the hours they marked would be of the same length in summer and in winter, and the discrepancy between these equal hours and the temporary hours of the sundial would soon be too important to be overlooked. Now, we know that a striking clock was put up in Milan in 1336, and we

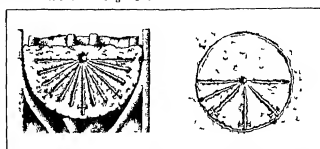


FIG. 5.—EARLY SUNDIALS WITH TIDE LINES (LINES WITH CROSSES) MARKING THE FOUR TIDES INTO WHICH THE SAXONS DIVIDED THEIR DAY.

Left Earliest English Sundial Bewcastle Cross. Right Saxon Sundial at Daplingworth, Gloucestershire.

adapted for use as a moon-dial when the moon's age is known, may be seen in Queens' college, Cambridge.

During the 17th century drilling was a special branch of education. The great work of Clavius, a quarto volume of 800 pages, was published in 1612, and may be considered to contain all that was known at that time.

In the 18th century clocks and watches began to supersede sundials, and the latter gradually fell into disuse, except dials in a garden or in remote country districts, where the old dial on the

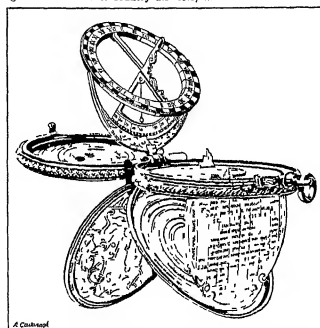


FIG. 6.—DRAKE'S PORTABLE DIAL BY HUMPHREY COLE, A.D. 1569.

The Equatorial Dial is set for latitude by the quadrant and in the meridian by the magnetic compass. The instrument includes a tide table, a nocturnal, a diagram of planetary aspects and a circumferenter.

church tower still serves as an occasional check on the modern clock by its side.

General Principles.—The daily and the annual motions of the earth are the elementary astronomical facts on which dialling is founded. That the earth turns upon its axis uniformly from west to east in 24 hours and that it is carried round the sun in one year at a nearly uniform rate is the correct way of expressing these facts. But the effect will be precisely the same, and it will suit our purpose better and make our explanations easier, if we adopt the ideas of the ancients of which our senses furnish apparent confirmation, and assume the earth to be fixed. Then, the sun and

stars revolve round the earth's axis uniformly from east to west once a day—the sun lagging a little behind the stars, making its day some four minutes longer—so that at the end of the year it finds itself again in the same place, having made a complete revolution of the heavens relatively to the stars from west to east.

The fixed axis about which all these bodies revolve daily is a line through the earth's centre, but the radius of the earth is so small, compared with the enormous distance of the sun, that, if we draw a parallel axis through any point of the earth's surface, we may safely look on that as being the axis of the celestial motion. The error in the case of the sun would not, at its maximum, that is, at 6 A.M. and 6 P.M., exceed half a second of time, and at noon would vanish. An axis so drawn is in the plane of the meridian, it points to the pole, and its elevation is equal to the latitude of the place.

The diurnal motion of the stars is strictly uniform, and so would that of the sun be if the daily retardation of about four minutes, spoken of above, were always the same. But this is constantly altering, so that the time, as measured by the sun's motion, and also consequently as measured by a sundial, does not move on at a strictly uniform pace. This irregularity, which is slight, would be of little consequence in the ordinary affairs of life, but clocks and watches being mechanical measures of time could not, except by extreme complication, be made to follow it.

A clock is constructed to mark uniform time in such wise that the length of the clock day shall be the average of all the solar days in the year. Four times a year the clock and the sundial agree exactly, but the sundial, now going a little slower, now a little faster, will be sometimes behind, sometimes before the clock—the greatest accumulated difference being about 16 minutes for a few days in November. The four days on which the two agree are April 15, June 15, Sept 1 and Dec 24.

Clock time is called *mean time*, that marked by the sundial is called *apparent time*, and the difference between them is the *equation of time*. It is given in most calendars and almanacs, frequently under the heading 'clock slow' or 'clock fast.' When the time by the sundial is known, the equation of time will once enable us to obtain the corresponding clock time, or vice versa.

The general principles of dialling will now be readily understood. The problem before us is the following—A rod or style, as it is called, being firmly fixed in a direction parallel to the earth's axis, we have to find how and where hour-lines of reference must be traced on some fixed surface behind the style so that when the shadow of the style falls on a certain one of these lines we may know that at the moment it is solar noon—that is, that the plane through the style and through the sun then coincides with the meridian, again, that when the shadow reaches the next line of reference it is 1 o'clock by solar time or which comes to the same thing, that the above plane through the style and through the sun has just turned through the 24th part of a complete revolution, and so on for the subsequent hours, the

hours before noon being indicated in a similar manner.

The position of an intended sundial having been selected, the surface must be prepared, if necessary, to receive the hour lines. The style must be accurately fixed in the meridian plane, and must make an angle with the horizon equal to the latitude of the place. The latter condition will offer no difficulty, but the exact determination of the meridian plane which passes through the point where the style is fixed to the surface is not so simple.

The position of the XII o'clock line is the most important to determine accurately, since all the others are usually made to depend on this one. We cannot trace it correctly on the dial until

the style has been itself accurately fixed in its proper place. When that is done the XII o'clock line will be found by the intersection of the dial surface with the vertical plane which contains the style, and the most simple way of drawing it on the dial will be by suspending a plummet from some point of the style whence it may hang freely, and waiting until the shadows of both style and plumb line coincide on the dial. This single shadow will be the XII o'clock line. In one class of dials, namely, all the vertical ones, the XII o'clock line is simply the vertical line from the centre, it can, therefore, at once be traced on the dial face by using a fine plumbline. The XII o'clock line being traced, the easiest and most accurate method of tracing the other hour lines would, at the present day when good watches are common, be marking where the shadow of the style falls, when 1, 2, 3, etc., hours have elapsed since noon, and the next morning by the same means the forenoon hour lines could be traced, and in the same manner the hours might be subdivided into halves and quarters, or even into minutes. But formerly, when watches did not exist, the tracing of the I, II, III, etc., o'clock lines was done by calculating the angle each would make with the XII o'clock line.

Dials received different names according to their position—*Horizontal dials*, when traced on a horizontal plane, *Vertical dials*, when on a vertical plane facing one of the cardinal points, *Vertical declining dials*, when on a vertical plane not facing a cardinal point. *Inclining dials*, when traced on planes neither vertical nor horizontal (these were further distinguished as *reclining* when leaning backwards from an observer *proclivity* when leaning forwards). *Egnontial dials*, when the plane is at right angles to the earth's axis, etc.

There are many early vertical south dials of great archaeological interest on the walls of English churches. The simplest of all are the Anglo-Saxon dials, in which the day is divided into four tides of three hours each. A good example may be seen at Daglingworth. In the dial on Buxton Cloisters of the 7th century, hour lines have been intercalated between the early use lines, which are marked with crosses. Upon church walls of the Early English period scratch dials or mass dials of various types are often found. In their simplest form they consist of a few hour lines radiating from a central hole in which a wooden style would have been inserted. A vertical noon line is always present. Lines at right angles to it would have been for 6 A.M. and 6 P.M., and one half way between the former and the noon line would have been for 9 A.M. Occasionally a circle of holes takes the place of the hour lines.

In the commonest type of horizontal dials the dial plate is of metal, as well as the vertical piece upon it, and they may be purchased ready for placing on the pedestal, the dial with all the

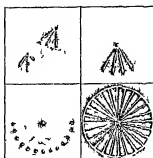


FIG 7—SCRATCH DIALS COMMON UPON EARLY ENGLISH CHURCH WALLS

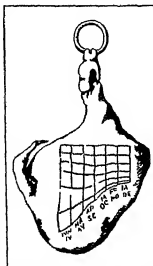


FIG 8—HAM DIAL c. A.D. 50. The index on the left having been brought over the vertical line of the appropriate month casts a shadow on the oblique hour lines.

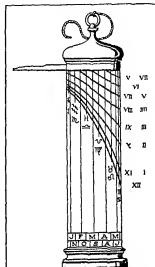


FIG 9—CYLINDER OR SHEPHERD'S DIAL A.D. 1521.

The artist has shown all the months of the year on one side of the cylinder. In modern examples of the dial used in the Pyramids the lines for 6 months only would appear on one side.

hour lines traced on it and the style plate firmly fastened in its proper position, or cast in the same piece with the dial plate.

When placing it on the pedestal care must be taken that the dial be perfectly horizontal and accurately oriented. The levelling will be done with a spirit level and the orientation will be best effected either in the forenoon or in the afternoon by turning the dial plate till the time given by the shadow (making the small

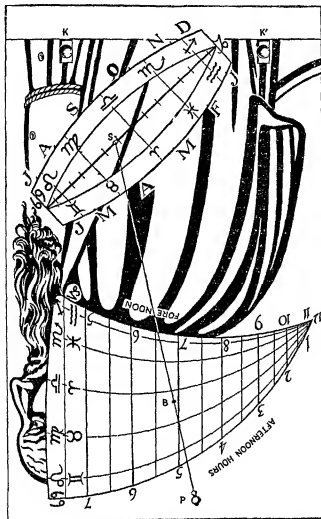


FIG 10—THE CAPUCHIN A FLAT ALTITUDE DIAL OF THE 17TH CENTURY. In use the end S of the plumb line SP is moved along a slot to the day of the month and the bead B' is shifted to the hour 12. The sights KK', at the upper edge are then pointed at the sun and the bead on the plumb line will show the hour. In Sir John Findlay's Collection.

correction mentioned above) agrees with a good watch whose error on solar time is known. It is, however, important to bear in mind that a dial, so built up beforehand, will have the angle at the base equal to the latitude of some selected place, such as London, and the hour lines will be drawn in directions calculated for the same latitude. Such a dial, therefore, could not be used near Edinburgh or Glasgow, although, it would, without appreciable error, be adapted to any place whose latitude did not differ more than 20 or 30m from that of London. ✓

Portable Dials were made generally of a small size, so as to be carried in the pocket, and these, so long as the sun shone, answered the purpose of a watch. The description of the portable dial has often been mixed up with that of the fixed dial, as if it had been merely a special case, and the same principle had been the basis of both, but although some are like the fixed dials, with the addition of some means for orientating the dial, others depend on the very irregularly varying zenith distance of the sun

Portable dials fall into two main classes *Altitude Dials* and *Compass Dials*

I *Altitude Dials* find the time from the altitude of the sun, allowance being made for the season of the year. An early example was the Roman Hm dial excavated at Herculaneum under the Vesuvian muds of the eruption of A.D. 79. It is marked with the months of July and August and must therefore be more recent.

thru 27 B.C. It was only serviceable in one latitude. A more useful type of altitude dial "for all climates," as Vitruvius describes it, is a Roman dial of about A.D. 250 in the Lewis Evans collection, which has adjustments both for the seasons and for latitude from 30° to 60°. Another form of altitude dial is known as the Shepherd's dial or Cylander dial. The earliest description of them is by Hermannus Contractus (1013-1054), and they are still in use among the peasants in the Pyrenees.

FIG 11—ENGLISH RING DIAL WHICH ALLOWS FOR CORRECTIONS FOR DAYS OF THE YEAR AND FOR LATITUDE ADJUSTMENT

presented by vertical lines, and the gnomon is moved to the appropriate line, the dial being so placed that the shadow falls perpendicularly and the hour read on the hour line.

A very neat and ingenious flat altitude dial *on a Card* is attributed by Ozanam to a Jesuit Father, De Saint Rigaud, but it



FIG 12—ASTRONOMICAL RING DIAL MADE BY ELIAS ALLEN
The outer ring shows approximate latitudes of Amsterdam, The Hague, Hamburg, Helioburg, Vienna, Lisbon, and Rome.

The sliding ring is for adjustment for the latitude of the place, and the hour lines run diagonally for correction for the season of the year.

In the Universal Astronomical Ring dial a metal ring represents the meridian, and is suspended

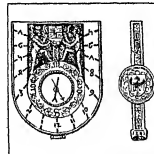


FIG 13 —THE OLDEST KNOWN COM
PASS DIAL. A.D. 1451

This was probably made at Nuremberg, and is now at Innsbruck

equatorial circle

II *Compass Dials* made their appearance in the 15th century, some 150 years after the description of the magnetic compass by Peter Peregrinus. In their simplest form they consist merely of a horizontal dial and a compass; but to these numerous acces-

is monotonic and \mathcal{L} is complete, due to these numerous hypotheses

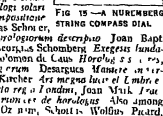
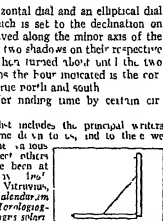
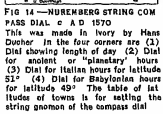
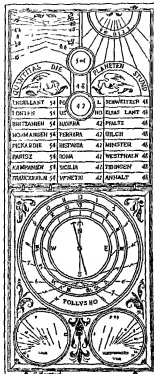
series were added in rapid succession, the most important being an adjustment for change of latitude, a plummet for levelling, subsidiary vertical and other dials for showing the various kinds of hours in use, a wind rose, volvelles for showing the phases of the moon or for use as adjustable calendars. These and other devices exercised the ingenuity of the master craftsmen of Augsburg and Nuremberg, who vied with one another in the construction of a beautiful series of timepieces, which passed into all the countries of Europe. They were made of metal, wood, or ivory and the gnomons were either of metal or of a strong but could be threaded through holes so as to vary the inclination with the latitude.

A second type of compass dial is the Equatorial dial, in which the plane of the dial is at right angles to the style and can be adjusted parallel to the equator. It is the simplest of all dials. A circle, divided into 24 equal arcs, is placed at right angles to the style, and hour divisions are marked upon it. Then, if care be taken that the style point accurately to the pole and that the noon division lies in the meridian plane, the shadow of the style will fall on the other divisions, each at its proper time. The divisions must be marked on both sides of the dial, because the sun will shine on opposite sides in the summer and in winter.

Equatorial dials were very widely used in the 17th and 18th centuries and were sometimes combined with geared clock movements, by which the hour and minute could be read on a clock face.

The Analemmatic Sundial differs from other portable sundials in that it can be set for finding the time without a compass. It includes two dials, an ordinary horizontal dial and an elliptical dial with a perpendicular gnomon which is set to the declination on a scale of months and days engraved along the minor axis of the ellipse. The elliptical dial is graduated in hours and minutes for each month. The elliptical dial is "true" turned about until the two readings agree, when his happens the hour indicated is the correct one and the real line is true north and south.

Nocturnal's were not used for finding time by certain circumpolar stars.



Lühre, Walper, in German, Paterson, Michael, Muller, in English, Foster Well, Collins, Leadbetter, Jones Leybourn, Emerson, Ferguson, Evans and Sir J Findlay See also Gatty, *Book of Sundials* (enlarged, 1900), Horne *Scratch Dials* (Taunton, 1917), Diecher, *Theorie der Sonnenuhren und Zeitmessung* (1925) (H Go, R T G)

DIALECT, a characteristic manner of speech, so any variety of a language is from *Gr* *dialexos*, conversation, manner of speaking) In its widest sense languages which are branches of a common or parent language are its "dialects" as Attic, Ionic, etc. In various Romance languages of Latin Where there have existed side by side, as in England, various branches of a language, such as the languages of the Angles, the Jutes or the Saxons, and the descendant of one particular language has predominated, the traces of the others remain in the "dialects" of the districts where once the original language prevailed Thus "dialect" varieties of a language need not, historically, represent degradations A "literary" accepted language, such as modern English, represents the original language spoken in the Midlands, with accretions of various sources, while the present-day "dialects" preserve traces of the original local variety of the language See the articles on languages. (English, French, etc.)

DIALECTIC (DIALECTICS), a logical term, generally used in common parlance in a contemptuous sense for verbal or purely abstract disputation devoid of practical value (from Gr *διαλεκτος*, discourse, debate, *ἡ διαλεκτική, ἡ τέχνη*, the art of debate). According to Aristotle, Zeno of Elea "invented" dialectic, the art of disputation by question and answer, while Plato developed it metaphorically in connection with his doctrine of "Ideas" as the art of analysing ideas in themselves and in relation to the ultimate idea of the Good (*Republic* viii). The special function of the so called "Socratic dialectic" was to show the inadequacy of popular beliefs. Aristotle himself used "dialectic," as opposed to "science," for that department of study which examines the presuppositions lying at the back of all the particular sciences. Each particular science has its own subject matter and special principles (*ἰδίαι ἀρχαί*) on which the superstructure of its special discoveries is based. The Aristotelian dialectic, however, deals with the universal laws (*κοιναὶ ἀρχαί*) of reasoning, which can be applied to the particular arguments of all the sciences. The sciences, for example, all seek to define their own species, dialectic, on the other hand, sets forth the conditions which all definitions must satisfy whatever their subject matter. Again, the sciences all seek to find general laws, dialectic, on the contrary, seeks to find the laws, and the kind of necessity to which they can attain. To this general subject matter Aristotle gives the name "Topics" (*τόποι*, *loci*, *communes loci*). "Dialectic" in this sense is the equivalent of "logic." Aristotle also uses the term for the science of probable reasoning as opposed to demonstrative reasoning (*ἀποδεικτική*). The Stoics divided *λογική* (logic) into rhetoric and dialectic, and from their time till the end of the middle ages dialectic was either synonymous with, or a part of, logic.

In modern philosophy the word has received certain special meanings. In Kierkegaard (terminology) *Dialektik* is the name of that portion of the *Kritik der reinen Vernunft* in which Kant discusses the impossibility of applying to "things in themselves" the principles which are said to govern phenomena. In the system of Hegel the word resumes its original Socratic sense, as the name of that intellectual process whereby the inadequacy of popular conceptions is shown. The word, together with other Hegelian terminology, is taken over by Karl Marx (qv, for "Marxism dialectic").

DIALOGUE, in the widest sense, is the recorded conversation of two or more persons. As a literary form it is a carefully prepared exposition by means of invented conversation, of contrasting philosophical positions or intellectual attitudes, or it is an element in drama and fiction.

The oldest known dialogues are the Sicilian mimes, written in dithyrambic prose by Sophron of Syracuse in the early 5th century BC. Although none of these have survived, their nature may be inferred from the few mimes of Herodas (Herondas), an Alexandrian of the 3rd century BC. They depict brief realistic scenes

of everyday life involving common character types. Although Plato knew and admired the Sicilian myths, the form of philosophic dialogue that he had perfected by 400 B.C. was sufficiently original to be an independent literary creation. With due attention to characterization and the dramatic situation from which the discussion arises, it develops dialectically the main tenets of Platonic philosophy. To Lucian in the 2nd century A.D., the dialogue owes a new tone and function. His influential *Dialogues of the Dead* with their coolly satirical tone inspired innumerable imitations in England and France during the 17th and 18th centuries, of these, the best known are works of the same name by Bernard de Fontenelle (1683) and François Fenelon (1712). The revival of interest in Plato during the Renaissance encouraged numerous imitations and adaptations of the Platonic dialogue. In Spain, Juan de Valdes used it to discuss problems of philology (1533) and Vincenzo Carducci, theories of painting (1633). In Italy, dialogues on the Platonic model were written by Torquato Tasso (1580), Giordano Bruno (1584) and Galileo Galilei (1632). The Renaissance also adapted the dialogue form to uses unsuspected by either Plato or Lucian. It was widely used in the teaching of languages by the direct method.

In the 16th and 17th centuries, dialogue lent itself easily and frequently to the presentation of controversial religious, political and economic ideas. Bishop George Berkeley's *Dialogues Between Hylas and Philonous* (1713) are perhaps the best of the English imitations of Plato.

The best known 19th-century examples of the form are Walter Savage Landor's *Imaginary Conversations* (1824-29), sensitive recreations of historical personages. G. Lowes Dickinson's *A Modern Symposium* (1905) and André Gide's *Imaginary Interiors* (1944) illustrate the continued appeal of this ancient form in the 20th century.

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DIALYSIS (*Gr. dial*, through *lysis*, to loosen), a process first employed by Thomas Graham (1861) to separate colloidal particles from those of ionic or small molecular dimensions (crystalloids). If such a mixture is placed in a sack made of parchment, cellophane or cellophane, or in a drum provided with a bottom of such material, and suspended in water, the ions and small molecules pass through the membrane, leaving the colloidal particles in the drum or sack.

The process is a slow one and may, in some cases, be accelerated by heating or by an electric field (electrodialysis). The separation depends upon the difference in size between the colloidal and crystalline constituents, the membrane having pores of intermediate size. (See COLLOIDS) (A. E. A.)

DIAMAGNETISM Some substances, like iron, are attracted strongly by the pole of a magnet and are said to be ferromagnetic, others are attracted weakly and are paramagnetic, still others are repelled and these are called diamagnetic. In 1778 S. J. Brugmans observed for the first time the repulsive action of bismuth and antimony in the strong nonuniform field of an electromagnet.

In 1845 and the following years Michael Faraday examined a great many substances and found many of the elements and most of the compounds to be diamagnetic, it was he who first used the words diamagnetic and paramagnetic. The most highly diamagnetic substance known is bismuth, in a nonuniform field its repulsive force is measured by its susceptibility, -0.00013 , a value very small compared to the (paramagnetic) susceptibility often found in iron, $+500$. Diamagnetic materials are composed of atoms that have completed electron shells (see ATOM) and no permanent magnetic moments. The electrons circulating in such atoms are either speeded up or slowed down by the application of a field, and the resulting change in magnetization, the "induced" moment, opposes the field. This opposition of the magnetic field and the induced magnetism is characteristic of diamagnetism (See MAGNETISM) (R. M. B.)

DIAMANTE, FRA, Italian fresco painter of the 15th century was a Carmelite friar, a member of the Florentine community of that order. He was the principal assistant of Fra Filippo Lippi in the execution of frescoes at the cathedrals of Prato and of Spoleto, which Diamante completed after his master's death in 1469. Fra Filippo left a young son in the care of Diamante (see LIPPI).

DIAMANTE, JUAN BAPTISTA (1640?-1684?), Spanish dramatist, was born at Castillo about 1640, entered the army and began writing for the stage in 1657. Like many other Spanish dramatists of his time, Diamante is deficient in originality and his style is riddled with affectations, *La Desgraciada Ragnel*, which was long considered to be his best play, is really Mira de Amescua's *Judá de Toledo* under another title, and the earliest of Diamante's surviving pieces, *El Honrador de su padre* (1658), is virtually a free translation of Corneille's *Le Cid*. Diamante was the introducer of French dramatic methods into Spain.

DIAMANTINA (formerly called Tejuco), a mining town of the state of Minas Gerais, Brazil, in the northeastern part of the state, 3,710 ft. above sea level. Urban population of the *município* (1950) 57,550. Diamantina is built partly on a steep hillside overlooking a small tributary of the Jequitinhonha river (where diamond washing was once carried on), and partly on the level plain above.

The town is roughly but substantially built, with broad streets and large squares. It is the seat of a bishopric, with an episcopal seminary, and has many churches, a lunatic asylum, a theatre, military barracks, hospitals and a secondary school. There are several small manufactures including cotton weaving, tanning and shoemaking, and diamond cutting is carried on. Diamantina is the commercial centre of an extensive region, and is noted for its wealth. The present name of the town was assumed (instead of Tejuco) in 1838, when it was made a *cidade*. (See MINAS GERAIS)

DIAMANTINO, a small town of the state of Mato Grosso, Brazil, near the Diamantina river, about 6 mi. above its junction with the Paraguary, in $14^{\circ} 24' 33''$ S, $56^{\circ} 8' 00''$ W. The population of the municipality in 1950 was 6,286, mostly Indians. It stands in a broken sterile region 1,837 ft. above sea level and at the foot of the great Mato Grosso plateau. The first mining settlement dates from 1730, when gold was found in the vicinity. On the discovery of diamonds in 1746 the settlement drew a large population and for a time was very prosperous.

The mines failed to meet expectations, however, and the population declined, it grew slowly after 1880. Ipeacuanha and vanilla beans are the principal articles of export.

DIAMETER, in geometry, a straight line passing through the centre of a conic section and terminated by the curve (from the *Gr. dia*, through, *metron*, measure). The principal diameters of the ellipse and hyperbola coincide with the axes and are at right angles, conjugate diameters are such that each bisects chords parallel to the other.

The diameter of a quadric surface is a line at the extremities of which the tangent planes are parallel. Newton defined the diameter of a curve of any order as the locus of the centres of the mean distances of the points of intersection of a system of parallel chords with the curve.

The word is also used as a unit of linear measurement of magnetizing power.

In architecture, the term is used with reference to the lower part of the shaft of a column. It is employed by Vitruvius (iii, 2) to determine the height of a column, and it is generally the custom to fix the lower diameter of the shaft by the height required and the order employed.

Thus the diameter of the Roman Doric should be about one-eighth of the height, that of the Ionic one-ninth and of the Corinthian one-tenth. (See CIRCLE, CONIC SECTION, ELLIPSE, HYPERBOLA, ORDER, PARABOLA.)

DIAMOND, mineral universally recognized as chief among precious stones, it is the hardest, the most impishable and also the most brilliant of minerals. These qualities alone have made it

supreme as a jewel since early times, and yet the real brilliancy of the stone is not displayed until it has been faceted by the art of the lapidary (*q.v.*) and this was scarcely developed before the year 1746. The consummate hardness of the diamond, in spite of its high price, has made it most useful for purposes of grinding, polishing and drilling. Numerous attempts have been made to manufacture the diamond by artificial means, and these attempts have a high scientific interest on account of the mystery which surrounds the natural origin of this remarkable mineral. Its physical and chemical properties have been the subject of much study, and have a special interest in view of the extraordinary difference between the physical characters of the diamond and those of graphite (blacklead) or charcoal, with which it is chemically identical, and into which it can be converted by the action of heat or electricity.

The name *Adamas* "the invincible," was probably applied by the Greeks to hard metals, and thence to corundum (emery) and other hard stones. According to Charles William King, the first undoubted application of the name to the diamond is found in Manilius (A.D. 16)—*Sic Adamas, punctum lapidis, pretiosior auro*,—and Pliny (A.D. 100) speaks of the rarity of the stone, "the most valuable of gems, known only to kings." Pliny described six varieties, among which the Indian, having six pointed angles, and also resembling two pyramids (*turbines*, whip tops) placed base to base, may probably be identified as the ordinary octahedral crystal (fig. 1). The diamond (*Vahalom*) in the breastplate of the high priest (Ex xxxix. 11) was certainly some other stone, for it bore the name of a tribe, and methods of engraving the true diamond cannot have been known so early. The stone can hardly have become familiar to the Romans until introduced from India, where it was probably mined at a very early period. But one or other of the remaining varieties mentioned by Pliny (the Macedonian, the Arabian, the Cyprian, etc.) may be the true diamond, which was in great request for the tool of the gem engraver. Later Roman authors mentioned various rivers in India as yielding the *Adamas* among their sands. The name *Adamas* became corrupted into the forms *adamant*, *diamant*, *diamant*, *diamond*, but the same word, owing to a mediaeval misinterpretation which derived it from *adamas* (compare the French word *amant*), was also applied to the lodestone.

Scientific Characters.—Diamond is almost always found in single crystals, which show no signs of previous attachment to any matrix, the stones were, until the discovery of the South African mines, almost entirely derived from sands or gravel, but owing to the largeness of the mineral it is rarely, if ever, water-worn, and the crystals are often very perfect. The crystals are long to the cubic system, generally assuming the form of the octahedron (fig. 1) but they may, in accordance with the principles of crystallography, also occur in other forms symmetrically derived from the octahedron, e.g. the cube, the rhombic figure known as the rhombic dodecahedron (fig. 2), or the 48-faced figure known as the hexakis octahedron (fig. 3), or in combinations of these. The octahedron faces are usually smooth, most of the other faces are rounded (fig. 4). The cube faces are rough with protruding points. The cube is sometimes found in Brazil, but is very rare among the South African stones, and the dodecahedron is perhaps more common in Brazil than elsewhere. The crystals are sometimes tetrahedral in aspect. There are also "twins" of diamond in which two octahedra (fig. 5) are united by contact along a surface parallel to an octahedron face, sometimes they interpenetrate. They are generally first etched along the plane of union. The crystals often display triangular markings, which are veins or pits upon the octahedron faces (fig. 6). They have



FIGS 1-4—DIAMOND CRYSTALS. From left to right octahedron eight faced, rhombic dodecahedron, 12 faced, hexakis octahedron, 48 faced and rounded.



FIG 5—TWIN DIAMOND SHOWING TWO OCTAHEDRA JOINED ALONG A SURFACE PARALLEL TO AN OCTAHEDRON FACE.

probably been produced by the action of some solvent. The actual arrangement of the carbon atoms in the crystal has now been ascertained by means of X-ray investigations.

Diamond possesses a brilliant "adamantine" lustre, but this tends to be greasy on the surface of the natural stones and gives the rounded crystals somewhat the appearance of drops of gum. Absolutely colourless stones are not so common as cloudy and faintly coloured specimens, the usual tints are grey, brown, yellow or white, and asrarites, red, green, blue and black stones have been found. The colour can sometimes be removed or changed at a high temperature, but generally returns on cooling. It is therefore more probably due to metallic oxides than to hydrocarbons.

Sir William Crookes has, however, changed a pale yellow diamond to a bluish green colour by keeping it embedded in radium bromide for 11 weeks. Diamond may break with a conchoidal fracture, but the crystals always cleave readily along planes parallel to the octahedron faces, of this property the diamond cutters avail themselves when reducing the stone to the most convenient form for cutting, a sawing process, however, has now been introduced, which is preferable to that of cleavage. It is the hardest known substance (though tantalum, or an alloy of tantalum, now competes with it) and is chosen as ten in the mineralogist's scale of hardness, the Borneo stones are said to be harder than others. The specific gravity ranges from 3.56 to 3.59, generally about 3.52. The coefficient of expansion increases very rapidly above 750°, and diminishes very rapidly at low temperatures, the maximum density is attained when a temperature of about -42° Centigrade is reached.

Brilliance and "Fire."—The very high refractive power (index = 2.417 for sodium light) gives the stone its extraordinary brilliancy, for light incident within a diamond at a greater angle than 24½° is reflected back into the stone instead of passing through it, the corresponding angle for glass is 40°. The very high dispersion (index for red light = 2.406, for blue light = 2.460) gives it the wonderful "fire"—or display of spectral colours. Unlike other cubic crystals, diamond experiences a diminution of refractive index with increase of temperature. It is very transparent for Röntgen rays, whereas paste imitations are opaque. It is a good conductor of heat, and therefore feels colder to the touch than glass and imitation stones. The diamond has also a somewhat greasy feel. The specific heat increases rapidly with rising temperature up to 60° C., and then more slowly. Crystals belonging to the cubic system should not be birefringent unless strained; diamond often displays a double refraction particularly in the neighbourhood of inclusions, both liquid and solid, this is probably due to strain, and the spontaneous explosion of diamonds has often been observed. Diamond differs from graphite in being a bad conductor of electricity, it becomes positively electric by friction. The electric resistance is about that of ordinary glass, and is diminished by exposure to Röntgen rays; the dielectric constant (10) is greater than that which should correspond to the specific gravity.

The phosphorescence produced by friction has been known since the time of Robert Boyle (1663); the diamond becomes luminous in a dark room after exposure to sunlight or in the vacuum of radium, and many stones phosphoresce beautifully (generally with pale green light) when subjected to the electric discharge in a vacuum tube. Some diamonds are more phosphorescent than others, and different rates of electrical display different times. The combustibility of the diamond was predicted by Sir Isaac Newton on account of its high refractive power. It was first established experimentally by the Florentine acroleinicians in 1694. If oxygen or air gas and burns at about 850°, and only continues to do so if maintained at a high temperature, but in the absence of oxidizing agent it may be raised to a much higher temperature. It is, however, insoluble at the temperature of the electric arc but becomes blackened superficially. Experiments on the combustion of diamond were made by Smithson Tennant (1797) and Sir Humphry Davy (1816), with the object of proving that

it is pure carbon. Diamond is insoluble in acid and alkalis, but is oxidized on heating with potassium bichromate and sulphuric acid.

Uses of the Diamond.—The use of the diamond for other purposes than jewellery depends upon its extreme hardness. It has always been the only material used for cutting or engraving the diamond itself. The employment of powdered bort (*qv*) and the lapidary's wheel for faceting diamonds was introduced by L. von Berquen of Bruges in 1476. Diamonds are now employed not only for faceting precious stones, but also for cutting and drilling glass, porcelain, etc., for fine engraving such as scales, in dentistry for drilling, as a turning tool for electric light carbons, hard rubber, etc., and occasionally for finishing accurate turning work. It is also used for bearings in watches and electric meters. The best glaziers' diamonds are chosen from crystals such that a natural curved edge can be used. For rock drills, and revolving saws for stone cutting, either diamond, bort or carbonado (*qv*) is employed, set in steel tubes, discs or bands. Rock drilling is the most important industrial application, and for this owing to its freedom from cleavage, the carbonado is more highly prized than diamond. Another application of the diamond is for wire drawing, a hole tapering towards the centre is drilled through a diamond, and the metal is drawn through this. No other tool is so durable, or gives such uniform thickness of wire.

Distribution and Mining.—The most important localities for diamonds have been (1) India, where they were mined from the earliest times till the close of the 19th century, (2) South America, where they have been mined since the middle of the 18th century, and (3) South Africa, to which almost the whole of the diamond-mining industry has been transferred since 1870.

Indian Diamonds.—The diamond is here found in ancient sandstones and conglomerates, and in the river gravels and sands derived from them. The sandstones and conglomerates belong to the Vindhyan formation and overlie the old crystalline rocks. The diamantiferous beds are well defined, often not more than 1 ft in thickness, and contain pebbles of quartzite, jasper, sandstone, slate, etc. The mines fall into five groups situated on the eastern side of the Deccan plateau. The mining has always been carried on by natives of low caste, and by primitive methods which do not differ much from those described by the French merchant, Jean Baptiste Tavernier (1659-89), who paid a prolonged visit to most of the mines between 1638 and 1665 as a dealer in precious stones.

At some of the Indian localities spasmodic mining has been carried on at different periods for centuries, at some the work which had been long abandoned was revived in recent times, at others it has long been abandoned altogether. Many of the large stones of antiquity were probably found in the Kollur group, where Tavernier found 60,000 workers in 1645 (?), the mines, according to native accounts, having been discovered about 100 years previously. Golconda was the fortress and the market for the diamond industry at this group of mines, and so gave its name to them. Very few Indian diamonds now find their way out of the country, and so far as the world's supply is concerned, Indian mining of diamonds may be considered extinct. The first blow to this industry was the discovery of the Brazilian mines in Minas Geras and Baía.

Brazilian Diamonds.—Diamonds were found about 1725 at Tejuco (now Diamantina) in Minas Geras, and the mining became important about 1740. The Rio Abaeté district was worked on a considerable scale between 1785 and 1807, but is now abandoned. Diamantina is at present the most important district, it occupies a mountainous plateau, and the diamonds are found both on the plateau and in the river valleys below it. The mountains consist here of ancient laminated micaceous quartzite, which is in parts a flinty sandstone known as itacolumite, and in parts a conglomerate. The diamond is found under three conditions: (1) in the gravels of the present rivers, embedded in a ferruginous clay cemented conglomerate known as *cascalho*, (2) in terraces occupying higher levels, (3) in plateau deposits embedded in the red clay which cements the larger blocks. The terraces are probably a first concentration of the plateau material by the old rivers, and the *cascalho* a second concentration by the

modern rivers

In recent years the Minas Geras mines have been rivalled by the yield in Baía. The diamond here occurs in river gravels and sands associated with the same minerals as in Minas Geras, since 1844 the richest mines have been worked in the Serra de Cincoara, where the mountains are intersected by the River Para-guassu and its tributaries, it is said that there were as many as 20,000 miners working here in 1845, and it was estimated that 54,000 carats were produced in Baía in 1853. But the enormous development of the South African mines, which in 1906 supplied about 90% of the world's produce, has thrown the Brazilian production into the shade.

African Diamonds.—The first discovery was made in 1867 by Dr W. G. Atherstone, who identified as diamond a pebble obtained from a child in a farm on the banks of the Orange river and brought by a trader to Grahamstown, it was bought for £500 and displayed in the Paris Exhibition of that year. In 1869 a stone weighing 83½ carats was found near the Orange river, this was purchased by the earl of Dudley for £25,000 and became famous as the "Star of South Africa." A rush of prospectors at once took place to the banks of the Orange and Vaal rivers, and resulted in considerable discoveries, so that in 1870 there was a mining camp of no less than 10,000 persons on the "River Diggings." In the River Diggings the mining was carried on in the coarse river gravels, and by the methods of the Brazilian negroes and of gold placer miners. A diggers' committee limited the size of claims to 50 ft square, with free access to the river bank, the gravel and sand were washed in cradles provided with screens of perforated metal, and the concentrates were sorted by hand on tables by means of an iron scraper.

But towards the close of 1870 stones were found at Jagersfontein and at Dutoitspan, far from the Vaal river, and led to a second great rush of prospectors, especially to Dutoitspan, and in 1871 to what is now the Kimberley mine in the neighbourhood of the latter. At these spots the diamantiferous area was a roughly circular patch of considerable size, and in some it occupied the position of one of those depressions or "panes" so frequent in South Africa. These "dry diggings" were therefore at first supposed to be alluvial in origin like the river gravels, but it was soon discovered that, below the red surface soil and the underlying calcareous deposit, diamonds were also found in a layer of yellowish clay about 5 ft thick known as "yellow ground." Below this again was a hard bluish-green serpentine rock which was at first supposed to be barren bed rock, but this also contained the precious stone, and has become famous, under the name of "blue ground," as the matrix of the South African diamonds. The yellow ground is merely decomposed blue ground. In the Kimberley district five of these round patches of blue ground were found within an area little more than 3 m in diameter, that at Kimberley occupying ten acres, that at Dutoitspan 23 acres. There were soon 50,000 workers on this field, the canvas camp was replaced by a town of brick and iron surrounded by the wooden huts of the natives, and Kimberley became an important centre.

It was soon found that each mine was in reality a huge vertical funnel or crater descending to an unknown depth, and filled with diamantiferous blue ground. At first each claim was an independent pit 20 ft square sunk into the blue ground, the diamantiferous rock was hoisted by buckets and windlasses, and nowadays are left across the pit to provide access to the claims. But the roadways soon fell in, and ultimately haulage from the claims could only be provided by means of a vast system of wire ropes extending from a triple staging of windlasses erected along the entire edge of the mine, which had by this time become a huge open pit, the ropes from the upper windlasses extended to the centre and those from the lower tier to the sides of the pit, covering the whole mass like a gigantic collier or rust steel ropes. The buckets of blue ground were hauled up these ropes by means of horse wheels, and in 1875 steam winding engines began to be employed. By this time also improved methods in the treatment of the blue ground were introduced. It was carried off in carts to open spaces, where an exposure of some weeks to the air was found to pulverize

the hard rock far more efficiently than the old method of crushing with mallets. The placer miner's cradle and rocking trough were replaced by puddling troughs stirred by a revolving comb worked by horse power, reservoirs were constructed for the scanty water-supply, bucket elevators were introduced to carry away the tailings, and the natives were confined in compounds. For these improvements co operation was necessary, the better claims, which in 1872 had risen from £100 to more than £4,000 in value, began to be consolidated, and a mining board was introduced.

In a very few years, however, the open pit mining was rendered impossible by the mud rushes, by the falls of the masses of barren rock known as "reef" which were left standing in the mine and by landslips from the sides, so that in 1883, when the pit had reached a depth of about 400 ft., mining in the Kimberley crater had become almost impossible. By 1889, in the whole group of mines, Kimberley, Dutoitspan, De Beers and Bultfontein, open pit working was practically abandoned. Meanwhile mining below the bottom of the pits by means of shafts and underground tunnels had been commenced, but the full development of modern methods dates from the year 1889 when Cecil Rhodes and Alfred Beit, who had already secured control of the De Beers mine, acquired also the control of the Kimberley mine, and shortly afterwards consolidated the entire group in the hands of the De Beers Company (see KIMBERLEY).

The scene of native mining was now transferred from the open pit to underground tunnels, the vast network of wire ropes disappeared, and with it the cosmopolitan crowd of busy miners working like ants at the bottom of the pit. In place of all this, the visitor to Kimberley encounters at the edge of the town only a huge crater, silent and apparently deserted, with no visible sign of the great mining operations which are conducted far below the surface.

A vertical shaft through the basalt, shale and granite is sunk in the vicinity of the mine, and from this horizontal tunnels are driven into the pipe at different levels separated by intervals of 40 feet. Through the blue ground itself on each level a series of parallel tunnels about 120 ft. apart are driven to the opposite side of the pipe, and at right angles to these, and 36 ft. apart, another series of tunnels. When the tunnels reach the side of the mine

For the extraction and treatment of the blue ground the De Beers Company in its great winding and washing plant employs labour saving machinery on a gigantic scale. The ground is transferred in trucks to the shaft where it is automatically tipped into skips holding 96 cu ft. (six truck loads), these are rapidly hoisted to the surface, where their contents are automatically dumped into side tipping trucks, and these in turn are drawn away in a continual procession by an endless wire rope along the tram lines leading to the vast "distributing floors." These are open tracts upon which the blue ground is spread out and left exposed to sun and ram until it crumbles and disintegrates, the process being hastened by harrowing with steam ploughs, this may require a period of three or six months, or even a year. The stock of blue ground on the floors at one time in 1905 was nearly 4,500,000 loads. The disintegrated ground is then brought back in the trucks and fed through perforated cylinders into the washing pans, the "hard blue" ground which has resisted disintegration on the floors, and the lumps which are too big to pass the cylindrical sieves, are crushed before going to the pans. These are shallow cylindrical troughs containing muddy water in which the diamonds and other heavy minerals (concentrates) are swept to the rim by revolving toothed arms, while the lighter stuff escapes near the centre of the pan. The concentrates are then passed over sloping tables (pulsator) and shaken to and fro under a stream of water which effects a second concentration of the heaviest material.

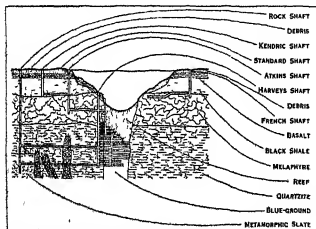
Until recently the final separation of the diamond from the concentrates was made by hand picking, but even this has now been replaced by machinery, owing to the remarkable discovery that a greased surface will hold a diamond while allowing the other heavy minerals to pass over it. The concentrates are washed down a sloping table of corrugated iron which is smeared with grease and it is found that practically all the diamonds adhere to the table, and the other minerals are washed away. At the large and important Premier mine in the Transvaal the Elmore process, used in British Columbia and in Wales for the separation of metallic ores, has been also introduced. In the Elmore process oil is employed to float off the materials which adhere to it, while the other materials remain in the water, the oil being separated from the water by centrifugal action.

In all the South African mines the diamonds are not only crystals of various weights from fractions of a carat to 150 carats, but also occur as microscopic crystals disseminated through the blue ground. In spite of this, however, the average yield in the profitable mines is only from 0.2 carat to 0.6 carat per load of 1,600 lb., or on an average about 1½ grs. per ton. The annual output of diamonds from the De Beers mines was valued in 1906 at nearly £5,000,000, the value per carat ranging from about 35 to 70 shillings.

Pipes similar to those which surround the Kimberley have been found in other parts of South Africa. One of the best known is that of Jagersfontein, which was really the first of the dry diggings (discovered in 1870). This large mine is near Fauresmith and 80 m. to the south of Kimberley. In 1905 the year's production from the Orange River Colony mines was more than 320,000 carats, valued at £938,000. But by far the largest of all the pipes hitherto discovered is the Premier mine in the Transvaal, about 700 m. to the east of Kimberley. This was discovered in 1902 and occupies an area of about 75 acres. Comparatively few of the pipes which have been discovered are at all rich in diamonds, and many are quite barren, some are filled with "hard blue" which, even if diamantiferous, may be too expensive to work.

The most competent South African geologists believe all these pipes to be connected with volcanic outbursts which occurred over the whole of South Africa during the Cretaceous period (after the deposition of the Zimwé beds) and drilled the enormous craters through all the later formations. One of the great part of Cape Colony have been discovered what are probably similar pipes filled with agglomerates, breccias and tuffs, and some with basalt lavas.

The River Diggings on the Vaal river are still worked upon a small scale, but the production from this source is so limited that they are of little account in comparison with the mines in the blue



FROM GARDNER WILLIAMS, "DIAMOND MINES OF SOUTH AFRICA" (MAGILL & CO.)

FIG. 7.—SECTION OF THE KIMBERLEY DIAMOND MINE IN SOUTH AFRICA. From vertical shafts sunk near the mine, horizontal tunnels are driven into the pipe of blue ground, at least 40 ft. apart, the excavated material being brought up through the rock shafts.

they are opened upwards and sides are so as to form a large chamber, and the overlying mass of blue ground and debris is allowed to settle down and fill up the gallery. On each level of this process is carried somewhat farther back than on the level below (fig. 7), material is thus continually withdrawn from one side of the mine and extracted by means of the rock shaft on the opposite side, while the superincumbent debris is continually sinking and is allowed to fall deeper on the side farthest from the shaft as the blue ground is withdrawn from beneath it. In 1905 the main shaft had been sunk to a depth of 1,600 ft. at the Kimberley mine.



SOUTH AFRICAN DIAMOND MINES

- 1 Looking down into the Premier diamond mine Transvaal
- 2 A general view of the De Beers diamond mine at Kimberley
- 3 Mine cars which bring in the diamond bearing gravel at the Kimberley mines in Orange Free State
- 4 Washing plant with pans for washing blue ground
- 5 Greased tables (pulsators) for separating diamonds
- 6 Sorting diamonds



BY COURTESY OF HARRY WINSTON, INC., OWNERS OF THE JONKER DIAMOND

JONKER DIAMOND NUMBER ONE

Colour photograph of Jonker Diamond Number One which is mounted in a platinum nookless set with baguette diamonds. The stone is the largest emerald cut diamond in existence, with a weight of 125.25 carats and is shown in actual size. It has a magnificent bluish white colour, and is expertly cut to bring out the maximum of its brilliancy and fire. Jonker Diamond Number One is the largest of 12 stones cut by Lazare Kaplan & Sons, Inc. from the 726 carat rough Jonker diamond, which was found in 1934 at Elandsfontein, Pretoria by Jacobus Jonker, an impoverished South African prospector.

ground. The stones, however, are good, since they differ some what from the Kimberley crystals it is probable that they were not derived from the present pipes. Considerable finds of diamonds were reported in 1905 and 1906 from gravels at Somabula near Gwelo in Rhodesia. Diamonds have also been reported from kimberlite "pipes" in Rhodesia.

The South African output in 1926 was 3,000,000 carats. Diamonds have been found in considerable numbers in sand near Luderitz bay in South West Africa (1908), the output from this district in 1926 was 515,000 carats. The Congo has become an important source since the first discovery in 1903, the diamonds are found in alluvial deposits of the River Kasai and its affluents. The output in 1926 was 1,108,000 carats from Belgian Congo, and 150,000 carats from Angola. Other African localities are the Gold Coast and Tanganyika.

Other Localities.—In addition to the South American localities mentioned above, small diamonds have also been mined since their discovery in 1890 on the River Mazaruni in British Guiana, and finds have been reported in the gold washings of Dutch Guiana. The output from British Guiana in 1926 was 182,000 carats. Borneo has possessed a diamond industry since the island was first settled by the Malays. Australia has yielded diamonds in alluvial deposits near Bathurst (where the first discovery was made in 1851) and at other places in New South Wales, in South Australia, in Victoria, in Western Australia, and in Queensland. In Tasmania also diamonds have been found in the Corinna gold fields. Europe has produced few diamonds. They have been found (1829) in the gold washings of Bissersk, and at other spots in the Urals. Also in Lapland and Siberia. In North America small stones have been found in alluvial deposits, mostly auriferous, in Georgia, North and South Carolina, Kentucky, Virginia, Tennessee, Wisconsin, California, Oregon and Indiana. Considerable interest attaches to the diamonds found in Wisconsin, Michigan and Ohio near the Great Lakes, for they are here found in the terminal moraines of the great glacial sheet which is supposed to have spread southwards from the region of Hudson bay.

Origin of the Diamond in Nature.—It appears from the foregoing account that at most localities the diamond is found in alluvial deposits probably far from the place where it originated. The minerals associated with it do not afford much clue to the original conditions, they are mostly heavy minerals derived from the neighbouring rocks, in which the diamond itself has not been observed.

There are only a few localities at which the diamond has been supposed to occur in its original matrix—in India, in Minas Gerais, and at Inverell in New South Wales, but the evidence is certainly not sufficient to establish the presence of an original matrix. Finally there is the remarkable occurrence in the blue ground of the African pipes.

There has been much controversy concerning the nature and origin of the blue ground itself, and even granted that (as is generally believed) the blue ground is a much serpentinized volcanic breccia consisting originally of an olivine-biotite rock (the so called kimberlite), it contains so many rounded and angular fragments of various rocks and minerals that it is difficult to say which of them may have belonged to the original rock, and whether any were formed *in situ*, or were brought up from below as inclusions. Carvill Lewis believed the blue ground to be true eruptive rock, and the carbon to have been derived from the bituminous shales of which it contains fragments. The Kimberley shales, which are penetrated by the De Beers group of pipes, were, however, certainly not the source of the carbon at the Premier (Transvaal) mine, for at this locality the shales do not exist. The view that the diamond may have crystallized out from solution in its present matrix receives some support from the experiments of W. Luzzi, J. Friedländer, R. von Hasslinger and J. Wolff. E. Cohen, who regarded the pipes as of the nature of a mud volcano, and the blue ground as a kimberlite breccia altered by hydrothermal action, thought that the diamond and accompanying minerals had been brought up from deep seated crystalline schists. Other authors have sought the origin of the diamond in the action of the hydrated magnesian silicates on hydrocarbons derived from

bituminous schists, or in the decomposition of metallic carbides.

Of great scientific interest in this connection is the discovery of small diamonds in certain meteorites, both stones and irons, e.g., in the stone which fell at Novo Urei in Penza, Russia, in 1886, in a stone found at Carcote in Chile, and in the iron found at Cañon Diablo in Arizona. Graphitic carbon in cubic form (chitonite) has also been found in certain meteoric "irons," and is now generally believed to be altered diamond. The claim by H. Moissan to have produced the diamond artificially, by allowing dissolved carbon to crystallize out at a high temperature and pressure from molten iron, coupled with the occurrence in meteoric iron, has led Sir William Crookes and others to conclude that the mineral may have been derived from deep seated iron containing carbon in solution (see the article GEMS, SYNTHETIC).

On the other hand, the occurrence in meteoric stones, and the experiments mentioned above, show that the diamond may also crystallize from a basic magma, capable of yielding some of the metallic oxides and ferro-magnesian silicates, a magma, therefore, which is not devoid of oxygen. This is still more forcibly suggested by the remarkable eclogite boulder found in the blue ground of the Newlands mine, not far from the Vaal river, and described by T. G. Bonney. The boulder is a crystalline rock, and is studded with diamond crystals, a portion of it is preserved in the British Museum (Natural History). Similar boulders have also been found in the blue ground elsewhere. It seems therefore that a holo-crystalline pyroxene garnet rock may be one source of the diamond found in blue ground. Some regard the eclogite boulders as derived from deep seated crystalline rocks, others as concretions in the blue ground. None of the inclusions in the diamond gives any clue to its origin.

Finally, then, both experiment and the natural occurrence in rocks and meteorites suggest that diamond may crystallize not only from iron but also from a basic silicate magma, possibly from various rocks consisting of basic silicates. The blue ground of South Africa may be the result of the serpentinization of several such rocks, and although now both brecciated and serpentinized some of these may have been the original matrix. A circumstance often mentioned in support of this view is the fact that the diamonds in one pipe generally differ somewhat in character from those of another, even though they be near neighbours.

History of Diamonds.—All the famous diamonds of antiquity must have been Indian stones. The first author who described the Indian mines at all fully was the Portuguese Garcia de Orta (1565), who was physician to the viceroy of Goa. Before that time there were only legendary accounts like that of Sindbad's "Valley of the Diamonds," or the tale of the stones found in the brims of serpents. V. Ball thinks that the former legend originated in the Indian practice of sacrificing cattle to the evil spirits when a new mine is opened, birds of prey would naturally carry off the flesh, and might give rise to the tale of the eagles carrying diamonds adhering to the meat.

The following are some of the famous diamonds of the world.—A large stone found in the Golconda mines and said to have weighed 787 carats in the rough, before being cut by a Venetian lapidary, was seen in the treasury of Aurangzeb in 1665 by Tavernier, who estimated its weight after cutting as 280 (?) carats, and described it as a rounded rose-cut stone, tall on one side. The name *Great Mogul* has been frequently applied to this stone. Tavernier states that it was the famous stone given to Shah Jahan by the emir Jumla. The *Orloff*, stolen by a French soldier from the eye of an idol in a Brahmin temple, stolen again from him by a ship's captain, was bought by Prince Orloff for £90,000, and given to the empress Catharine II. It weighs 194½ carats, is of a somewhat yellow tinge, and is among the Russian Crown jewels. The *Koh-i-nor*, which was in 1739 in the possession of Nadir Shah, the Persian conqueror, and in 1813 in that of the raja of Lahore, passed into the hands of the East India Company and was by them presented to Queen Victoria in 1850. It then weighed 186½ carats, but was recut in London by Amsterdam workmen, and now weighs 106½ carats. There has been much discussion concerning the possibility of this stone and the *Orloff* being both fragments of the *Great Mogul*. The Mozul Baber in his memoirs (1526)

relates how in his conquest of India he captured at Agra the great stone weighing 8 mshkals, or 320 rats, which may be equivalent to about 187 carats. The Koh-i-nor has been identified by some authors with this stone and by others with the stone seen by Tavernier. Tavernier, however, subsequently described and sketched the diamond which he saw as shaped like a bisected egg, quite different therefore from the Koh-i-nor. Nevil Story Maskelyne has shown reason for believing that the stone which Tavernier saw was really the Koh-i-nor, and that it is identical with the great diamond of Baber, and that the 280 carats of Tavernier is a misinterpretation on his part of the Indian weights. He suggests that the other and larger diamond of antiquity which was given to Shah Jahn may be one which is now in the treasury of Teheran, and that this is the true Great Mogul which was confused by Tavernier with the one he saw. (See Ball, Appendix I to Tavernier's *Travels* (1889), and Maskelyne, *Nature*, 1891, 44, p. 555.)

The *Regent* or *Pitt* diamond is a magnificent stone found in either India or Borneo, it weighed 410 carats and was bought for £20,400 by Pitt, the governor of Madras, it was subsequently, in 1717, bought for £80,000 (or, according to some authorities, £135,000) by the duke of Orleans, regent of France, it was reduced by cutting to 136½ carats, was stolen with the other Crown jewels during the Revolution, but was recovered and is still in France. The *Akbar Shah* was originally a stone of 116 carats with Arabic inscriptions engraved upon it, after being cut down to 71 carats it was bought by the gajwar of Baroda for £35,000. The *Nizam*, now in the possession of the nizam of Hyderabad, is supposed to weigh 177 carats, but it is only a portion of a stone which is said to have weighed 440 carats before it was broken. The *Sancy*, weighing 53½ carats, is said to have been successively the property of Charles the Bold, de Sancy, Queen Elizabeth, Henrietta Maria, Cardinal Mazarin, Louis XIV., to have been stolen with the *Pitt* during the French Revolution, and subsequently to have been the property of the king of Spain, Prince Demidoff and an Indian prince.

The *Great Table*, a rectangular stone seen by Tavernier in 1642 at Golconda, was found by him to weigh 242½ carats, Maskelyne regards it as identical with the *Darya-i-nur*, which is also a rectangular stone weighing about 186 carats in the possession of the shah of Persia. Another stone, the *Taj-e-mah*, belonging to the shah, is a pale rose pear shaped stone and is said to weigh 146 carats.

Coloured Indian diamonds of large size are rare, the most famous are a beautiful blue brilliant, 67½ carats, cut from a stone weighing 112½ carats brought to Europe by Tavernier. It was stolen from the French Crown jewels with the *Regent* and was never recovered. The *Hope*, 44½ carats, has the same colour and is probably a portion of the missing stone. It was so-called as forming part of the collection of H. T. Hope bought for £18,000, and was sold again in 1906 (resold 1909). Two other blue diamonds are known weighing 132 and 12 carats, which may also be portions of the French diamond. The *Dresden Green*, one of the Saxon Crown jewels, 40 carats, has a fine apple green colour. The *Florentine*, 13½ carats, one of the Austrian Crown jewels, is a very pale yellow.

The most famous Brazilian stone was the *Star of the South*, found in 1853, when it weighed 354½ carats and was sold for £40,000, when cut it weighed 125 carats and was bought by the gajwar of Baroda for £80,000.

The *Largest Diamond*.—Many large stones have been found in South Africa, some are yellow but some are as colourless as the best Indian or Brazilian stones. The most famous are the following—The *Star of South Africa*, or *Dudley*, mentioned above, 83½ carats cut, 46½ carats cut. The *St. Louis*, 288½ carats rough, 170 carats cut. Both these were found in the river diggings. The *Porter Rhodes* from Kimberley, of the finest water, weighed about 150 carats. The *Victoria*, 180 carats, was cut from an octahedron weighing 477½ carats, and was sold to the nizam of Hyderabad for £400,000. The *Tiffany*, a magnificent orange yellow stone, weighs 175½ carats cut. A yellowish octahedron found at De Beers weighed 428½ carats and yielded a brilliant of 28½ carats. Some of the finest and largest stones

have come from the Jagersfontein mine, one, the *Jubilee*, found in 1895, weighed 6¼ carats in the rough and 239 carats when cut. Until 1905 the largest known diamond in the world was the *Excelsior*, found in 1893 at Jagersfontein by a native while loading a truck. It weighed 969½ carats, and was ultimately cut into ten stones weighing from 68 to 13 carats. But all previous records were surpassed in 1905 by the *Cullinan Diamond* more than three times the size of any known stone, which was found in the yellow ground at the newly discovered Premier mine in the Transvaal. It was purchased by the Transvaal Government in 1907 and presented to King Edward VII. It was sent to Amsterdam to be cut, and in 1908 was divided into nine large stones, the four largest weighing 516½ carats, 309½ carats, 92 carats and 62 carats respectively, and a number of small brilliants. The *Jonker diamond*, weighing 726 carats, was found in Elandsfontein in 1934, and was sold in May, 1935, to an American for about £150,000.

Diamonds are invariably weighed in carats. One English carat = 3.17 grains = 2.055 grams. One metric carat (now nearly universally used) = 200 grains or 200 milligrams. (See CARAT.)

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DIAMOND MATCH COMPANY, THE, largest match company in the United States, was incorporated on December 26, 1930, under the laws of the State of Delaware, succeeding an Illinois corporation of the same name. It is engaged in the manufacture and the sale of matches, of match making machinery, of lumber and lumber products, and of other similar products.

The company holds a minority interest in the British Match Corporation Limited, of Great Britain and, with that firm and several others, in the Fdly Match Company, Limited, located in Canada.

The properties of The Diamond Match Company and its subsidiaries include factories in nine different States of the Union, namely New York, Maine, Massachusetts, Ohio, Wisconsin, New Jersey, Utah, Washington and California, they include also large timber tracts in the States of Maine, Georgia, Idaho, California and Washington, 64 lumber yards owned and operated in the Sacramento valley, California, and 22 in the New England States, and in addition a large card board plant, printing and book match assembly plant at Springfield, Massachusetts.

The following figures give a comprehensive view of the extensive financial operation of the company: the total current assets as of December 31, 1939, were \$7,448,793.33, the total assets, \$34,380,747.16, the net working capital, \$26,050,559.14, the net income, \$2,136,770.49, the total surplus, \$3,466,833.31.

The aggregate net income for the five years from 1935-1939, inclusive, was \$10,674,906.53 making an annual average, for that five year period of the sum of \$2,134,981.30.

The headquarters of the company are in the city of New York (W. W. H.)

DIAMOND NECKLACE, THE AFFAIR OF THE, a mysterious incident at the court of Louis XVI of France, which involved the queen, Marie Antoinette. The Parisian jewellers Boehmer and Bassenge had spent some years collecting stones for a necklace which they hoped to sell to Mme Du Barry, the favourite of Louis XV, and after his death to Marie Antoinette. They were considerably embarrassed by their failure to do so.

Since his recall in disgrace from Vienna in 1774, Louis, cardinal de Rohan, had been anxious to be reconciled to the queen. In March 1784 he took as mistress a certain Jeanne de St. Reny de Valois, who had married a *sous-secrétaire* comte de Lamotte. She persuaded him that she had been received by the queen and enjoyed her favour, and carried on for him a pretended correspondence with the queen, the adventures duly producing replies to Rohan's notes in the queen's name. The tone of the letters became very warm, and the cardinal, convinced that Marie Antoinette was in love with him, became ardently enamoured of her. A secret meeting took place in Aug. 1784, in a grove in the garden at Versailles, between Rohan and a lady whom the cardinal believed to be the queen herself. Rohan offered her a rose, and she promised him that she would forget the past. The jewellers also believed in the relations of the countess with the queen, and they resolved to use her to sell their necklace. She agreed, and shortly after Rohan purchased it for 1,600,000 livres, payable in instalments. He said that he was authorized by the queen, and showed the jewellers the conditions of the bargain approved in the handwriting of Marie Antoinette. The necklace was given up. Rohan took it to the countess's house, where a man, in whom Rohan believed he recognized a valet of the queen, came to fetch it. Boehmer and Bassenge, before the sale, in order to be doubly sure, had sent word to the queen of the negotiations in her name. Marie Antoinette allowed the bargain to be concluded, and after she had received a letter of thanks from Boehmer, she burned it.

When the time came to pay, the comtesse de Lamotte presented the cardinal's notes, but these were insufficient, and Boehmer complained to the queen, who told him that she had received no necklace and never ordered it. Then followed a *coup de théâtre*. On Aug. 15, 1785, Assumption Day, when the whole court was awaiting the king and queen in order to go to the chapel, the cardinal de Rohan, who was preparing to officiate, was arrested and taken to the Bastille. The police also arrested Mme de Lamotte, and some minor accomplices. A sensational trial before the *parlement* of Paris resulted (May 31, 1786) in the acquittal of the cardinal. The comtesse de Lamotte was condemned to be whipped, branded and shut up in the Salpêtrière. Her husband, who is believed to have escaped with the necklace to London, was condemned, in his absence, to the galley for life. Various circumstances fortified the popular belief that Marie Antoinette, in her hatred of the cardinal, had deliberately trapped Rohan—her disavowal of the necklace, the fact that he was deprived of his charges and exiled to the abbey of la Chaise Dieu, and finally the condescension of the comtesse de Lamotte from the Salpêtrière, with the condescension, as people believed, of the court. Mme de Lamotte, having taken refuge abroad, published *Mémoires*, in which she accused the queen.

See Emile Campardon, *Marie Antoinette et le procès du collier* (1863); F. d'Albion, *Marie Antoinette and the Diamond Necklace from another Point of View* (1900); M. Tournoux, *Marie Antoinette devant l'histoire. Essai bibliographique* (2nd ed., 1901); P. Audebert, *L'Affaire du collier de la reine, d'après la correspondance inédite du chancelier de Puyol* (Rouen, 1902); Funck-Brentano, *L'Affaire du collier* (1903); A. Lang, *Historical Mysteries* (1904).

DIAN, a patrilineal people closely related to the Lohi and the Gan but more advanced, living near Diebougou, Gaour district, Upper Volta, Africa.

See Labouret, "La Terre, la chasse et la guerre parmi les populations du Lohi," *Annales et Mémoires, Comité Études Hist. et Scient.* (Dakar, 1916-17).

DIANA, in Roman mythology, an Italian goddess in later times identified with the Greek Artemis (*q.v.*). That she was originally an independent Italian deity is shown by the presence of her cult at Nemi, which shows no foreign influence. This was in a grove beside the lake of (Nemus) Nemi, near Aricia (whence

her title of Nemorensis). Here she was worshipped side by side with an obscure male deity, Virbius (*q.v.*). Her priest, called *rex Nemorensis*, who was a runaway slave, was obliged to qualify for office by slaying his predecessor in single combat (Strabo v. 239; Suetonius, *Caligula*, 35). This led to the identification of Diana with the Tauric Artemis, whose image was said to have been removed by Orestes to the grove of Aricia (see AUGUST).

After the destruction of Alba Longa, this grove was for a long time the united sanctuary of the Latin League, until Rome became supreme. The festival of the goddess was on the ides (13th) of August, the full moon of the hot season. She was worshipped with torches, but also was sought by women seeking a happy deliverance in childbirth, and many votive offerings have been found on the site. The worship of Diana was brought to Rome, and her temple on the Aventine was founded, according to tradition, by Servius Tullius, originally as a sanctuary of the Latin League (Dion. Halic. iv. 26.3). On the day of its dedication (Aug. 13) the slaves kept holiday (Plutarch, *Quaest. Rom.*, 100), which was explained as a reference to the founder's servile origin. Another celebrated sanctuary of Diana was that on the slopes of Mount Tifata, near Capri, where she was worshipped under the name of Tifata.

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DIANA MONKEY, a West African guenon (*q.v.*) taking its name *Cercopithecus diana*, from the white crescentic band on the forehead. The general colour is iron gray, a broad chestnut band runs down the lower back and the thigh is crossed with a white band. A beard, white except for the front hairs which are black, decorates the chin. *C. d. roloway*, of the Gold Coast has a longer, pure white beard, *C. d. dryas* of the Congo is similar, but more greenish. (J. H. C.)

DIANE DE FRANCE (1538-1619), duchess of Montmorency and Angoulême, was the natural daughter of Henry II of France and a young Piedmontese, Filippa Duc. She was a beautiful and accomplished girl. She married in 1553 Horace Farnese, son of the duke of Parma, who was killed at the siege of Hesdin shortly after the marriage. In 1559 she married François de Montmorency, one of the leaders of the *politiques*. After her husband's death she exercised a wise and moderating influence at the courts of Henry III and Henry IV successively.

See Brantôme, ed. by Lalanne in *Coll. de la société d'histoire de France*, Vol. vii (1875); J. de Thou, *Historia sui temporis* (1733); M. de Morgues, *Oraison funèbre de Diane de France* (Paris, 1610).

DIANE DE POITIERS (1499-1566), duchess of Valentinois, mistress of Henry II of France, was the daughter of Jean de Poitiers, seigneur de St. Valher, who came of an old family of Dauphiné. In 1515 she married Louis de Brézé, grand sénéchal of Normandy, by whom she had two daughters. After her husband's death in 1533, she became the mistress of Prince Henry, who became dauphin in 1530. She inspired in the young prince who was twenty years her junior, a passion which lasted until his death. The accession of Henry II in 1547 was also the accession of Diane. She was virtuous queen, while Henry's lawful wife, Catherine de Medici, lived in comparative obscurity. Diane devoted her energies chiefly to augmenting her income, and providing for her family and friends. Henry gave her the duchy of Valentinois. Catherine drove her from the court after Henry's death, and forced her to restore the crown jewels and to accept Chaumont in exchange for Châteaufort. Diane retired to her château at Anet, where she died in 1566.

The story that she had been the mistress of Francis I, in order to obtain the pardon of her father, who had been condemned to death as an accomplice of the constable de Bourbon, has no serious foundation. Diane was a patroness of the arts. She entrusted to Philibert de l'Orme the building of her château at Anet, and it was for her that Jean Goujon executed his masterpiece, the statue of Diane, now in the Louvre.

See G. Guiffrey, *Lettres inédites de Diane de Poitiers* (1866) and *Procès criminel de Jehan de Poitiers* (1867); Capefigue, *Diane de Poitiers* (1860); Hay, *Madame Diane de Poitiers* (1900).

DIANTHUS *see* CARNATION

DIAPASON (Gr *δια πασών*, through all), a term in music originally denoting the interval of an octave. The Greek is an abbreviation of *ἡ δια πασῶν χορῶν συμφωνία*, a consonance through all the tones of the scale. In this sense it is only used now, loosely, for the compass of an instrument or voice, or for a harmonious melody. The name is given to the two foundation stops of an organ, the open and the stopped diapason (*see* ORGAN) and to a standard of musical pitch, as in the French *diapason normal* (*see* PITCH, MUSICIAN).

DIAPER, the name given to a textile fabric, formerly of a rich and costly nature with embroidered ornament, but now of linen or cotton with a simple woven pattern, and particularly restricted to small napkins.

In architecture, the term "diaper" is given to any small pattern of a conventional nature repeated continuously and uniformly over a surface, the designs may be purely geometrical or based on floral forms, and in early examples were regulated by the process of their textile origin. Subsequently similar patterns were employed in the middle ages for the surface decoration of stone, as in Westminster Abbey and Bayeux cathedral in the spandrels of the arcades of the choir and nave, also in mural painting, stained glass, incised brasses, encaustic tiles, etc. Probably in most cases the pattern was copied, so far as the general design is concerned, from the tissues and stuffs of Byzantine manufacture, which came over to Europe and were highly prized as ecclesiastical vestments.

In its textile use, the term diaper was originally applied to silk patterns of a geometrical pattern, it is now almost exclusively used for diamond patterns made from linen or cotton yarns. An illustration of two patterns of this nature is shown in the figure. The floats of the warp and the weft are mostly in three, indeed the patterns are made from a base weave which is composed entirely of floats of this number. It will be seen that both designs are formed of what may be termed concentric figures—alternately black and white. Pattern B differs from pattern A only in that more of these concentric figures are used for the complete figure. If pattern B, which shows only one unit, were extended, the effect would be similar to A, except for the size of the unit. In A there are four complete units, and hence the pattern appears more striking. Again, the repeating of B would cause the four corner pieces to join and to form a diamond similar to the one in the centre. The two diamonds in B would then alternate diagonally to left and right. Special names are given to certain kinds of diapers, e.g., "bird's eye," "pheasant's eye," these indicate, to a certain extent, the size of the complete diamond in the cloth—the smaller kind taking the name "bird's-eye." The size of the pattern on paper has little connection with the size of the pattern in the cloth, for it is clearly the number of threads and picks per inch which determine the size of the pattern in the cloth from any given design. Although A is larger than what is usually termed the "bird's-eye" pattern, it is evident that it may be made to appear as such, provided that the cloth is fine enough. These designs, although adapted mostly for cloths such as nursery-draps, for pinafores, etc., are sometimes used in the production of towels and table cloths. In the figure the first pick in A is identical with the first pick in B, and the part C shows how each interweaves with the 24 threads.

DIAPHONIA, in Greek musical terminology, dissonance, as opposed to consonance. Later, that is, in the early middle ages, the term signified one of the earliest kinds of descent (*see* 1), it is known as organum, in which the parts moved by unvaried parallel motion in fourths and fifths.

DIAPHORETICS, the name given to those remedies which promote perspiration. Among the best known are vapour or hot water baths, or that part of the process of the Turkish bath

which consists in exposing the body to a dry and hot atmosphere. Such measures, particularly if followed by the drinking of hot liquids and the wrapping of the body in warm clothing, seldom fail to excite copious perspiration. Numerous medicinal substances have the same effect.

DIAPHRAGM (di'á-frám) (or midriff). In human anatomy a large fibro-muscular partition between cavities of the thorax and abdomen, it is convex toward the thorax, concave toward the abdomen, and consists of a central tendon and a muscular margin. The central tendon (*see* fig.) is triangular in shape. The fleshy fibres rise, in front, from the back of the xiphoid cartilage, laterally by six serrations, from the inner surfaces of the lower six ribs, posteriorly from the five arcuate ligaments, two external, two internal and one median. There are three large openings in the diaphragm, the aortic is behind the middle arcuate ligament and transmits the aorta, the vena azygos major, and the thoracic duct. In the right kiellet is an opening for the inferior vena cava and a branch of the right phrenic nerve, while in front and a little to the left of the aortic opening is one for the oesophagus and the two pneumogastric nerves.

Through the crura pass the splanchnic nerves. The sympathetic nerves usually enter the abdomen behind the internal arcuate ligaments. The phrenic nerves, which are the main supply of the diaphragm, divide before reaching the muscle and pierce it in a number of places to enter its abdominal surface, but some of the lower intercostal nerves assist in the supply.

For the action of the diaphragm *see* RESPIRATORY SYSTEM, ANATOMY OF.

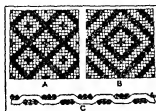
Embryology.—The diaphragm is at first developed in the neck region of the embryo, and this accounts for the phrenic nerves, which supply it, rising from the fourth and fifth cervical. With growth of the body and development of the lungs the diaphragm shifts its position downward. (*See* A. Keith, "On the Development of the Diaphragm," *Journal of Anat. and Phys.* vol. 39.)

A Paterson has recorded cases in which the left half of the diaphragm is wanting (*Proceedings of the Anatomical Society of Great Britain*, June 1900, *Journal of Anat. and Phys.* vol. 34), and occasionally deficiencies are found elsewhere, especially in the sternal portion.

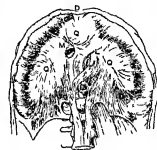
Comparative Anatomy.—A complete diaphragm is characteristic of the Mammalia, it usually has the human structure and relations except that below the Anthroponchus it is separated from the pericardium by the azygos lobe of the lung. In some mammals, e.g., Echidna and Phocaena, it is entirely muscular. In the Cetacea it is remarkable for its obliquity, this allows a larger lung space in the dorsal than in the ventral part of the thorax and may be concerned with the equipping of the animal. Below the mammals incomplete partitions are found in chelonians, crocodiles and birds, and in amphibians (*Xenopus* and *Pipa*).

DIAPHRAGM: *see* GRAMOPHONE, MICROPHONE, TELEPHONE.

DIARBEKR or DIYARBEKR, chief town of a vilayet of Turkey, situated on a basaltic plateau on the right bank of the Tigris, which there flows in a deep open valley. The town is still surrounded by the masonry walls of black basalt which give it the name of Kara or Black Armid, they are well built and imposing on the west facing the open country, but almost in ruins where they overlook the river. A mass of gardens and orchards covers the slope down to the river on the southwest. Pop. (1904) 41,555. The streets are narrow, badly paved and dirty, the houses and shops are low, mostly of stone and some of stone and mud. The bazaar is a good one, and gold and silver filigree work is made. From Diar, land, and Bekr (*see*, Abu Bekr, the caliph).



DIAPER A AND B SHOW TWO VARIETIES OF DIAMOND PATTERN. DIAPERS AND C SHOWS THE WARP AND WEFT.



THE DIAPHRAGM THE CHIEF MUSCLES OF RESPIRATION. Abdominal surface showing origin of central tendons (O) from xiphoid cartilage (D) and openings for aorta (K) inferior vena cava (M) pneumogastric nerves (L) and oesophagus.

peculiar in character and design. Trut is good and abundant as the rich volcanic soil is well watered from the town springs. The size of the melons is specially famous. To the south, the walls are some 40 ft. high, faced with large cut stone blocks of very solid construction, with towers and square bastions rising to 50 ft. There are four gates, on the north the Kharput gate, on the west the Rum, on the south the Mardin and on the east the Veni Kapu or new gate. A citadel enclosure stands at the northeast corner and is now partly in ruins, but the interior space is occupied by the government konak. The summer climate in the confined space within the town is excessively hot and unhealthy. Winters are frequently severe but do not last long. The town is supplied with water both by springs inside the town and by aqueducts from fountains at Ali Pinar and Hürmerit. The principal exports are wool, mohair and copper ore, and imports are cotton and woollen goods, indigo, coffee, sugar, petroleum, etc. Cereals, cotton, tobacco, rice and silk are produced, and a school has been opened to give villagers instruction in silkworm culture. An exceptionally rich copper mine exists at Arghana Maden, galena, mineral oil and silicious sand are also found. Scorpions noted for their virulence abound.

The Great Mosque, Ulu Jami, formerly a Christian church, occupies the site of a Sassanian palace and was built with materials from an older palace, probably that of Tigranes II. The churches of greatest interest are those of SS Cosmas and Damian (Jacobite) and the church of St James (Greek). In the 19th century Diarbekr was one of the largest and most flourishing cities of Asia. It is at the head of the navigation of the Tigris, which is traversed downstream by keleks or rafts supported by inflated skins. There is a good road to Aleppo and Alexandretta on the Mediterranean, and to Samarra on the Black sea by Kharput, Malatia and Sinas. There are also routes to Mosul and Bilis. Railroad service to Diarbekr from Ankara was inaugurated on Nov. 22, 1935.

Diarbekr became a Roman colony in A.D. 230 under the name of Amida. It was enlarged and strengthened by Constantius II, in whose reign it was taken after a long siege by Shapur (Sapor) II, king of Persia. The historian Ammianus Marcellinus, who took part in the defense, gives a detailed account of it. In the later wars between the Persians and Romans it more than once changed hands. Though ceded by Jovian to the Persians it again became annexed to the Roman empire, and in the reign of Anastasius (A.D. 491) it was once more taken by the Persians. It was taken c. 638 by the Arabs, and afterward passed into the hands of the Seljuks and Persians, from whom it was finally captured by Selim I. in 1515, and from that date it has remained under Ottoman rule. About 2 mi. below the town is a masonry bridge over the Tigris, the older portion being probably Roman, and the western part, which bears a Kufic inscription, being Arab.

(C W W, F R M)

DIARRHOEA, a looseness of the bowels with frequent soft or watery stools which may contain mucus and blood, usually accompanied by griping pain or colic, may be due to many causes, which differ somewhat in adults and in children.

In adults primary diarrhoea may be due to diet, constipation, changes of climate or weather, to irritants taken with food, food poisoning, to alterations of intestinal secretion or absorption

other worm infections, to general infections, endocarditis, septicaemia and pulmonary tuberculosis, to diseases of the intestines carcinoma, tuberculosis, syphilis, actinomycosis, diverticulitis,

Crohn's disease (regional ileitis), peritonitis, appendicitis and haemorrhoids, to blood diseases. Hæmochs and other forms of purpura, to chronic circulatory disturbances, portal congestion, cirrhosis of the liver, chronic heart and lung diseases, to toxic causes, hyperthyroidism (hyperthyroidism), chronic alcoholism, uræmia and lardaceous diseases, to avitaminosis pellagra and other vitamin B₂ deficiencies. There are also a few special types of diarrhoea, various forms of colitis and polyposis, stercoral ulceration of the bowel and foreign bodies in the rectum.

Diarrhoea in children may be classified as follows: diarrhoea and vomiting (summer diarrhoea), diarrhoea from chills and errors in diet, acute gastroenteritis, the bacillary dysenteries, amoebic dysentery (rare), coeliac disease (fatty diarrhoea), intussusception and polyposis. (See DYSENTERY.) (P H M-B)

DIARY, the book in which are preserved the daily memoranda regarding events and actions which come under the writer's personal observation or are related to him by others. The person who keeps this record is called a diarist.

It is not until the close of the Renaissance (but see COMMON SENSE) that we find diaries beginning to have literary value. In the 17th century they began to be largely written in England although in most cases without any idea of even eventual publication. Sir William Dugdale (1605-86) had certainly no expectation that his slight diary would ever see the light. Bulstrode Whitelocke (1605-75), whose *Memorials of the English Affairs* covers the ground from 1625-60, was a genuine diarist. So was the elder George Fox (1624-91), who kept not merely "a great journal," but "the little journal books," and whose work was published in 1694.

The famous diary of John Evelyn (1620-1706) professes to be the record of 70 years and, although large tracts of it are covered in a very perfunctory manner, while in others many of the entries have the air of having been written in haste after the event, this is a very interesting and amusing work; it was not published until 1818. It would hold a still higher position in the history of literature than it does if it were not overshadowed by what is unquestionably the most illustrious of the diaries of the world, that of Samuel Pepys (1633-1703) (q.v.). This was begun on Jan. 1, 1660, and was carried on until May 29, 1669. The extraordinary value of Pepys's diary consists in its fidelity to the portraiture of its author's character. In the age which succeeded that of Pepys, a diary of extraordinary emotional interest was kept by Jonathan Swift from 1710 to 1713, and was sent to Ireland in the form of a *Journal to Stella*, it is a surprising amalgam of ambition, affection, wit and freakishness. John Byrom (1692-1763), the Manchester poet, kept a journal, which was published in 1854.

The diary of the celebrated dissenting divine, Philip Doddridge (1702-51), was printed in 1839. Of far greater interest are the admirably composed and vigorously written journals of John Wesley (1703-91). But the most celebrated work of this kind produced in the latter half of the 18th century was the diary of Fanny Burney (Madame d'Arblay), published in 1842-46. It will be perceived that, without exception, these works were posthumously published. James Boswell's *Journal of a Tour to the Hebrides* (1785), a genuine diary though somewhat expanded, was published during the author's lifetime.

Many of the diaries described above were first published in the opening years of the 19th century, and the interest which they awakened led to their imitation. Diaries ceased to be rare, but as a rule those which appeared did not present much literary interest. Sir Walter Scott's *Journal* (published 1890) and the diastrophic portions of R. B. Haydon's *Autobiography and Journal* are eminent exceptions. Exception must also be made in favour of the journals of two minor politicians, Charles Greville (1794-1865) and Thomas Creevey (1768-1838), whose indiscretions added much to the gaiety of nations, the papers of the former appeared in 1874-87, those of the latter in 1903. The diary of Henry Crabb Robinson (1775-1867), printed in 1869, contains excellent biographical material. Tom Moore's journal, published in 1856 by Lord John Russell, disappointed its readers. Charles Darwin's historic *Voyage Round the World* is written in diary form. R. W. Emerson's *Journals* are the notebook of an author rather than a

book of intimate confessions. In the 20th century many men and women published their diaries during their lifetimes. Col. Charles Repington's diary of World War I was a monument of indecision. "W N P Rebellion" was still alive when his tragic *Diary of a Disappointed Man* was published. Of recent diaries none has possessed more literary grace than the *Journal of Katherine Mansfield*.

It was natural that the form of the diary should appeal to a people so sensitive to social peculiarities as the French. A medieval document of immense value is the diary kept by an anonymous curé during the reigns of Charles VI and Charles VII. This *Journal d'un bourgeois de Paris* was kept from 1409 to 1431, and was continued by another hand until 1449. The marquis de Dangeau (1618-1700) kept a diary from 1684 till the year of his death; this is an inexhaustible storehouse of facts about the reign of Louis XIV. Saint Simon's own brilliant memoirs, written from 1691 to 1723, may be considered as a sort of diary. The lawyer, Edmond Barbier (1689-1771), wrote a journal of anecdotes from 1718-62.

The song writer, Charles Collé (1709-83), kept a *journal historique* from 1758 to 1782; it is full of vivacity, but very scandalous. Pétit de Bachaumont (1690-1771) had access to remarkable sources of information, and his *Mémoires secrets* contains a valuable mass of documents. The posthumous publication of the diaries of the Russian artist, Marc Bashkirtseff (1860-84), produced a great sensation in 1887. The brothers Jules and Edmond de Goncourt kept a very minute diary of artistic and literary Paris, after the death of Jules, in 1870; this was continued by Edmond, who published the first three volumes in 1888.

DIASPORE, an aluminum oxide, Al_2O_3 , isomorphous with goethite. It occurs as platy orthorhombic crystals and as lamellar or scaly masses, the flattened surfaces being the direction of a perfect cleavage and having a markedly pearly lustre. It may be colourless, grayish, greenish, brownish, yellowish or pink and sometimes violet with marked pleochroism. It is readily distinguished from other common platy minerals, such as mica, talc, gypsum and brucite, by its greater hardness, 6.5 to 7. The specific gravity is 3.4.

When heated in the blowpipe it decrepitates violently, forming white scales, hence the name from the Greek *diaspora*, a scatter. It is associated with corundum and at times is a major constituent of bauxite and aluminous clays. (L. S. RL.)

DIASTYLE, an intercolumniation (*q.v.*) of three or four diameters.

DIATHERMY, a term first applied by C. F. Nagelschmidt in 1898 to the use of alternating currents of high frequency for heating locally the tissues of the body. The frequencies employed are 300,000 cycles or higher, which are too rapid to affect the nerve endings. Hence currents of an ampere or more can be used the patient feeling only a sensation of warmth. The currents are generated in a coil of appreciable inductance and very low resistance by the oscillatory discharge of a condenser. The condenser is charged to a high voltage by a step-up transformer on an A.C. supply, and the discharge is produced by the passage of a spark through a multiple tungsten-faced spark gap. The oscillations are of the necessary high frequency and are maintained continuously by the spark discharge. The currents are led to the patient by pads of flexible metal sheets. (See ELECTROTHERAPY AND ELECTRODIAGNOSIS.) (F. L. A.)

DIATOMACEAE, see BACILLARIOPHYCEAE or DIATOMS.

DIATOMACEOUS EARTH (DIATOMITE) is a hydrous form of silica or opal composed of the siliceous shells of diatoms, which are uncelled aquatic plants of microscopic size. It is light coloured and occurs in sedimentary beds that somewhat resemble chalk, but it is much lighter and will not effervesce in acid. Under a high powered microscope the form of the diatoms can be distinguished. These are so small and abundant that several million are contained in one cubic inch of diatomite. Many thousands of different varieties are known and diatoms are living today in some bodies of fresh and salt water where the shell sink to the bottom when the organism dies. The largest deposit worked in the United States is in northern Santa Barbara County

near Lompoc, Calif. Miocene beds more than 1,000 ft. thick are known to extend over several square miles and vary from soft earth to hard compact rock that can be stewed into blocks. The principal production in the United States has come from these deposits in California and those of Oregon, but some also has been produced in Idaho, Nevada, New York and Washington. The main uses are for pressure filtration of oil, sugar, syrups and cereal beverages, for heat and sound insulation, for fillers, and for fine abrasives such as silver polish. In Europe it has been used as the inert ingredient of nitroglycerin. (V. T. A.)

DIATONIC, a musical term signifying literally "through the tones," otherwise music in which the notes employed are confined to those of the key, major or minor as the case may be, in which it is written. Hence diatonic music gives a general impression of strength, simplicity and solidity as distinguished from the more restless and poignant character of chromatic (*q.v.*) music in which notes from foreign keys are introduced by accidentals (*q.v.*). The diatonic was one of the three Greek genera of scale. (See Music: Non-Harmonic and Greek Music.)

DIATRYMA, a group of extinct birds known from the Eocene fossil deposits of New Jersey, Wyoming and New Mexico. These were huge flightless species as large as the larger of the extinct moas of New Zealand or the fossil *Phororhacos* of South America, developed for an active, aggressive terrestrial life. *Diatryma stem*, described by W. D. Matthew and Walter Granger from a nearly complete skeleton, stood almost seven feet high.

The neck was short and strong and the head huge, the skull being 17 in. long with a compressed beak which, as preserved with out the horny rhamphotheca, measures 9 in. long and 6½ in. high. The postorbital and squamosal are joined distally to form a temporal fenestra. The mandible is massive, though having a slender tip, with strong muscular attachments.

The coracoid and scapula are fused, and the humerus much reduced, the wing being completely nonfunctional for flight. The pelvis and leg are large and strong, the femur being 15 in. long and the tibia nearly 2 ft. The metatarsus is incompletely preserved, but is a heavy bone with two perforations of the shaft at the upper end. The three anterior toes are strong while the hallux is small and elevated.

Three other species, *Diatryma ajax*, *D. giganteum* and *Onychomphus storchii* have been described and another, *Boromis regis* from the Eocene of New Jersey, is placed with these somewhat uncertainly. *Diatryma sarasini* was named from Montheleon near Epemay, Fr. These form the family Diatrymidae, which is placed in the order Diatrymiformes near the Cranes with which, however, it does not show close affinity.

The fossil family of the Gastornithidae, represented by six species from the Eocene of western Europe, is placed tentatively in this order.

DIATRYMA—W. D. Matthew, and Walter Granger, "The Skeleton of *Diatryma*, a Gigantic Bird from the Lower Eocene of Wyoming," *Bull. Amer. Mus. Nat. Hist.*, vol. xxvii, pp. 107-136 (1917); Kálmán Lambrecht, *Handbuch der Palaeornithologie*, pp. 566-579 (1933). (A. Wt.)

DIADLOS, originally, in Greece, a race of twice the usual length, or two stadia, also, in architecture, the colonnade surrounding the great court of the Greek palaestra, so called because its total circuit was about two stadia, or about 1,200 ft.

DIAYOLO, FRA (1771-1806), the popular name given to a famous Italian brigand. His real name was Michele Pezza, and he was born of low parentage at Itri, he had committed many murders and robberies in the Terra di Lavoro, but escaped capture, whence his name, popular superstition having invested him with the characters of a monk and a demon, and it seems that at one time he actually was a monk.

Fra Diavolo was made leader of one of the bands raised by the Bourbon king Frederick IV against the French occupation, and succeeded in interrupting the enemy's communications between Rome and Naples. But although he wore a military uniform and held military rank, and was even created duke of Cassano, his atrocities were worthy of a bandit chief. On one occasion he threw some of his prisoners, men, women and children, over a precipice, and on another he had a party of 70 shot. He was for a short time

imprisoned in the castle of St. Angelo, but was soon liberated. Joseph Bonaparte put a price on Fra Duvello's head. For some time he evaded his pursuers but at length, hungry and ill, he went in disguise to the village of Baronissi, where he was arrested, tried by an extraordinary tribunal, condemned to death and shot. His name has gained a world-wide celebrity as the title of a famous opera by D. Auber.

See A. Luzio, *Profilo e bozzetti storici* (Milan, 1906).
DÍAZ, ARMANDO (1861-1928), Italian marshal, was born in Naples on Dec. 6, 1861. He served in the Italo-Turkish War, and in 1914 was promoted to major general. On Italy's entry into World War I he was director of military operations, and in 1916 became lieutenant general in command of the 49th division. In 1917 he was put in command of the 13th corps and saw much hard fighting on the Carso.

In Nov. 1917 after Caporetto, Díaz succeeded Luigi Cadorna as chief of the general staff. Under him the battle front was successfully reconstituted and the Austrian armies were destroyed at Vittorio Veneto (Oct.-Nov. 1918). After the signature of the Armistice he became inspector general of the army. He received many honours, Italian and foreign, and in 1921 was created duca della Vittoria.

On the advent of the fascist government he was appointed minister of war, and held that appointment until ill health obliged him to resign in April 1924. On Nov. 4, 1924, the newly created rank of marshal was conferred on him. He died on Feb. 29, 1928, at Milan.

DÍAZ, JOSÉ DE LA CRUZ PORFIRIO (1830-1915), Mexican soldier and statesman, born in the city of Oaxaca, state of Oaxaca, Sept. 15, 1830. His family was poor, and his mother was part Indian. He was educated for the church, then the only career open to a youth without wealth. At the age of 15 he entered the Seminario Pontifical in Oaxaca, but in 1849, falling under the influence of Benito Juárez, rector of the university, he relinquished his clerical ambitions to undertake the study of law with Juárez in the Institute of Arts and Sciences, where he passed his examinations in civil and canon law in 1853. But he was pre-eminently a man of action. During the war with the United States (1847-48) he left home to serve in the army. In the plebiscite of 1855 he repudiated the dictatorship of Antonio de Santa Anna. When the anticlerical measures of the constitution of 1857 resulted in the War of Reform (1858-61), Díaz supported Juárez then president of the country, and aided materially in the overthrow of the clerical revolution and the final establishment of the Reform laws.

He was one of the first to oppose the French invasion of 1862 and, after the establishment of Maximilian in Mexico in 1864, he was the most prominent figure in the struggle against the empire. He defeated a French attack upon Puebla in 1862 and in 1865, when the republican fortunes seemed at their nadir, he formed the "army of the east," recaptured Puebla in the spring of 1867 and on June 21, 1867, two days after the execution of Maximilian at Querétaro, re-entered the capital. Placing the city under martial law he maintained order until he was able to hand over his command to Juárez. Then he resigned his position in the army and retired to Oaxaca. He took no part in the government until 1871. Dissatisfied with Juárez' policy, he appeared as a candidate for the presidency against Juárez and Sebastián Lerdo de Tejada, and when congress proclaimed the re-election of Juárez, led an unsuccessful revolt in protest. In 1872 Lerdo succeeded as president in an administration which brought disorder and, when he attempted to be re-elected in 1876, Díaz took the leadership of a revolution, proclaimed the principle of non-re-election and defeated the government forces in the battle of Teocac, on Nov. 16, 1876. He was elected president in May 1877, and at once forged ahead with financial and political reform, the centralization of the government, the re-establishment of public security, the scrupulous settlement of all national debts and the building of railroads and telegraphs. His rule was stern, his methods sometimes brutal, but he achieved amazing results.

In 1880 he was succeeded by Manuel González the former minister of war, in whose cabinet he sat for some time as minister

of *fomento*, but in 1884 was unanimously re-elected to the presidency. Continuing his program of political reorganization and economic reform, he opened the nation's natural resources to the world, succeeded in attracting great quantities of foreign capital and won for Mexico, for the first time in its history, a position of respect among the nations. Political crises which arose with Guatemala, Austria and the United States he handled to the advantage of Mexico. In 1887 and 1892 the constitution was amended to permit his re-election and from 1884 until 1911 he was continuously in office. But material prosperity was achieved at the cost of repression and increasing discontent. The land problem became acute, education was inadequate, and agitators fomented widespread dissatisfaction at the alleged control of the country by foreign capitalists. An incipient revolt headed by Gen. Bernardo Reyes in 1903 was quickly crushed, but in 1910 the standard of agrarian revolt was raised. The movement spread swiftly over the country, the government was unable to control the army and on May 4, 1911, Díaz resigned his post and left for Europe. He died in Paris on July 2, 1915, having seen destroyed most of the stability which he had brought to his country.

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DÍAZ, NARCISSE VIRGILE (1809-1876), French painter of the Barbizon school, was born in Bordeaux of Spanish parents on Aug. 25, 1809. At first a figure painter who indulged in strong colour, in his later life Díaz became a painter of the forest and a tone artist of the first order.

He had an unhappy childhood. He lost a leg through a badly dressed insect bite, and worked for some time as a porcelain painter at Sévres. About 1831 at Díaz encountered Théodore Rousseau for whom he entertained a great veneration although Rousseau was four years his junior. Ten years later Díaz found Rousseau painting his wonderful forest pictures, and determined to paint in the same way if possible. Rousseau was touched with the pious words of admiration, and finally taught Díaz all he knew. Díaz exhibited many pictures at the Paris Salon, and was decorated in 1851.

After 1871 he became fashionable and he worked constantly and successfully. In 1876 he caught cold at his son's grave, and on Nov. 18 of that year he died at Mentone. Díaz' finest pictures are his forest scenes and storms. There are several fairly good examples of his work in the Louvre. Perhaps the most notable of Díaz' works are "La Fée aux Perles" (1857), in the Louvre, "Sun 'et in the Forest" (1868), "The Storm" and "The Forest of Fontainebleau" (1870) at Leeds. Díaz had no well-known pupils, but Léon Richet followed markedly his methods of tree painting, and J. F. Millet at one period painted small figures in avowed imitation of Díaz' then popular subjects.

See A. Husen, *Les Artistes célèbres*. Díaz, J. Claret, *Peintres et sculpteurs contemporains*. Díaz (1893). J. H. Thomsen, *The Barbizon School of Painters* (1890). J. W. Mallet, *Díaz* (1890).

DÍAZ DEL CASTILLO, BERNAL (1492?-c. 1581), Spanish soldier and author, was born at Medina del Campo. In 1514 he visited Cuba and five years later accompanied Cortez to Mexico where he died.

He is known chiefly by his *True Account of the Discovery of*

New Spain (3 vol., 1532, critical edition by Garcia, Mexico, 1904, Eng. trans. by Mudsley, 3 vol., 1908)

DIAZ DE NOVAES, BARTHOLOMEU (# 1481-1500), Portuguese explorer, discoverer of the Cape of Good Hope, was probably a kinsman of Joao Diaz, one of the first Portuguese to round Cape Bojador (1434), and of Diniz Diaz, the discoverer of Cape Verde (1445). In 1478 Bartholomeu Diaz, probably identical with the discoverer, was exempted from certain customary payments on ivory brought from the Guinea coast. In 1481 he commanded one of the vessels sent by King John II under Diogo Cao to the Gold Coast. On Oct. 10, 1486, he received an annuity of 6,000 reis from King John for "services to come", and some time after receiving the money he left Lisbon with three ships fully manned and equipped to carry on the work of African exploration which had been so greatly advanced by Diogo Cao (1482-86).

Passing Cao's farthest point near Cape Cross (in modern South-West Africa and in 21° 50' S), he erected a pillar on what is now known as Diaz point, south of Angra Pequena or Luderitz bay, in 26° 35' S, of this fragments still exist. From this point (according to De Barros) Diaz ran 13 days southward, in a comparatively high southern latitude, considerably south of the Cape.

Failing, after several days' search, to find land, the Portuguese turned north, and so struck the south coast of Cape Colony at Mossel bay (Diaz' Bahia dos Vaqueiros), half way between the Cape of Good Hope and Port Elizabeth (Feb. 3, 1488). Thence they coasted eastward, passing Algoa bay (Diaz' Bahin da Roca).

The officers and men began to insist on return, and Diaz could only persuade them to go as far as the estuary of the Great Fish river. There, however, half way between Port Elizabeth and East London, the northeasterly trend of the coast became unmistakable, the way round Africa had been definitely laid open by the Portuguese explorer.

On this return Diaz perhaps named Cape Agulhas after St. Brendan, while on the southernmost projection of the modern Cape peninsula, whose remarkable highlands doubtless impressed him as the practical termination of the continent, he bestowed, says De Barros, the name of Cape of Storms (*Cabo Tormentoso*), this name was changed by King John to that of Good Hope (*Cabo da Boa Esperança*). Some authorities, however, make Diaz himself give the Cape its present name.

After touching at the Ilha do Principe (Prince's Island, south-west of the Cameroons) as well as at the Gold Coast, he returned to Lisbon in Dec. 1488. He had discovered 1,260 mi. of hitherto unknown coast, and his voyage, taken with the letters soon afterward received from Pero de Covilhao (who by way of Ceuta and Aden had reached Malabar on one side and the "Zanzibar coast" on the other as far south as Sofala in 1487-88) was rightly considered to have solved the question of an ocean route round Africa to the Indies and other lands of south and east Asia.

No record has yet been found of any adequate reward tendered to Diaz for his great achievement, on Cabril's voyage of 1500 it has been recorded he was indeed permitted to take part in the discovery of Brazil (Apr. 22), and thence should have helped to guide the fleet to India, but he perished in a storm off his own Cabo Tormentoso now known as the Cape of Good Hope, which he discovered in 1488. As Galvano says he was allowed to see the Promised Land but not to enter it.

BIOGRAPHY—Joao de Barros, *Asia*, Dec. 1, bk. vi, ch. 4, ed. by A. A. Grillo and G. A. Grillo (1866 et seq.), Duarte Pacheco Pereira, *Esmeraldo de situ orbis* (see Raphael Basto, *Introduction to his edition*, 1899, also ed. by A. da Silva Dias, 1905). A marginal note, probably by Christopher Columbus himself, on fol. 13 of a copy of Pierre d'Ailly's *1490 mundi*, now in the Biblioteca at Seville gives Diaz's return to Lisbon in Dec. 1488. The writer says he was present at Diaz's interview with the king of Portugal when the explorer described his voyage and showed his route upon the chart he had kept. See also the *Journal of the First Voyage of Vasco da Gama* Hakluyt Society, ed. by E. G. Ravenstein (1893), F. Lopez de Castanheira, *Historia*, bk. 1 (Columb. 1551), A. Galvão, *Descobrimentos (Discoveries of the World)*, Hakluyt Society (1862), F. G. Ravenstein, *Voyages of Vasco da Gama*, *Geographical Journal*, vol. xvi (1906).

DIAZO COMPOUNDS. Diaz compound is a term used

in organic chemistry to describe two groups of compounds which have little in common except that they contain two nitrogen atoms in the molecule and can be obtained by the action of nitrous acid on certain primary amines. One group is that of the aromatic diazo compounds which are of both industrial and theoretical importance and can be obtained from practically all primary aromatic amines, and the second, much smaller, group is that of the aliphatic diazo compounds which are of no industrial importance but raise several points of theoretical interest.

AROMATIC DIAZO COMPOUNDS

The first known compound of this group was prepared by P. Griess at Marburg, Ger., in 1858. As Griess continued his work, first in London at the Royal College of Chemistry and later in the laboratories of Allsopp's brewery at Burton on Trent, the technical importance of the compounds became rapidly apparent, and by 1863 azo dyestuffs derived from them were being manufactured and sold. Their multifarious reactions, which lead to aromatic compounds of a large number of types, soon made aniline and the simple aromatic amines in general the most important intermediates known and gave great impetus to technical organic chemistry and especially to the utilization of coal tar as raw material for manufacture. Later the protracted controversy about the structure of the compounds, with which the names of A. Hantzsch and E. Bamberger are associated, was of importance in the development of theoretical chemistry, it is noteworthy as being the first time that physicochemical methods were applied to the elucidation of organic structures and as leading to a clearer understanding and more precise formulation of the ideas of stereoisomerism and tautomerism.

Aromatic diazo compounds exist in three distinct isomeric forms, the reasons for the structures given are summarized at the end of the article. As usually prepared they are diazonium salts which contain the cation of a strong base, $[Ar.N_2]^+OH^-$, where Ar is an aromatic radical. The free bases are hardly known since in alkaline solution they change into the normal diazoates which contain the anion of a weak acid, $Ar.N=N.OH^-$, this is usually quite unstable. The normal diazoate ion can be converted by simple means into a more stable isomeric form, the isodiazotate ion. Lastly, the weak acid liberated from an isodiazotate by acetic acid is known to change in certain cases into a neutral form to which the structure of a primary nitrosamine, $Ar.NH.NO$, must be allotted. All these three last forms are reconverted into a diazonium salt by a mineral acid. In general, all forms of a diazo compound are unstable, the diazoate usually the most, though certain isodiazotes are sufficiently stable to be manufactured and sold as intermediates in dye manufacture. This instability has been a constant handicap in elucidating the structures of the isomeric forms.

The most important method of preparation is by the action of nitrous acid on a primary aromatic amine in presence of a mineral acid $Ar.NH_2 + ONOH + HCl \rightarrow [Ar.N_2]Cl + 2H_2O$. If the solid diazonium salt is required, the reaction can be carried out by passing nitrous fumes into a paste of the amine hydrochloride and water, addition of alcohol and ether to the resulting solution precipitates the diazonium chloride. The solid salts are explosive and are seldom prepared. In the vast majority of cases an aqueous solution suffices and is obtained by adding sodium nitrite to a solution of the amine in excess (two to three equivalents) of the mineral acid. The temperature must usually be kept below 10° C during and after the reaction because of the decomposition of the diazonium salt at room temperatures and above. Other methods

and are evolved as gaseous nitrogen and those in which they are retained in the molecule of the product. In the first class the diazo group is replaced by some other group. Examples are:

1. Replacement by hydroxyl, leading to a phenol, usually takes place easily by warming the aqueous solution of the diazonium salt



Side reactions may interfere, especially the coupling of the phenol with an undecomposed diazo compound, and this can be avoided by working in strongly acid solution or by passing steam into the solution to remove the phenol as formed

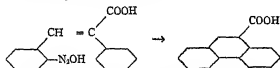
2. Replacement by hydrogen is brought about by reducing agents such as formic acid, hypophosphorous acid and sodium stannite. Addition of alcohol often gives the same result but sometimes the ethoxy compound, ArOC_2H_5 , is formed together with, or instead of, ArH . This reaction is of value where an amino group has been introduced to act as a powerful directing group for some desired substitution. The amino group can later be eliminated by diazotization and replacement by hydrogen

3. Replacement by halogen takes place readily with iodine since diazonium iodides decompose spontaneously into nitrogen and the iodo compound. With chlorine the usual methods are to treat the diazonium chloride with cuprous chloride (Sandmeyer's reaction) or with finely divided copper (Gattermann's reaction). Similar methods are used for bromine. Fluorine is best introduced by precipitating the sparingly soluble borofluoride, $[\text{Ar N}_2]\text{BF}_4$, by adding borofluoric acid to the solution. The dry borofluoride decomposes smoothly on heating into boron trifluoride, nitrogen and the fluoro compound

4. Replacement by cyanogen can be achieved by Sandmeyer's method, by use of a solution of cuprous cyanide in potassium cyanide. Since the product is a nitrile, it can be hydrolyzed to a carboxylic acid and the reaction is valuable for effecting the change $\text{ArNH}_2 \rightarrow \text{ArCOOH}$

Groups containing sulphur can be linked to the aromatic ring in a variety of ways and the processes are of technical importance since they give intermediates for the preparation of dyestuffs containing sulphur. An example is to treat the diazo compound with potassium ethyl dithiocarbonate (xanthogenate). The product, $\text{ArSCSC}_2\text{H}_5$, can be hydrolyzed to the thiophenol, ArSH , or heated alone to give the thioether, ArSC_2H_5

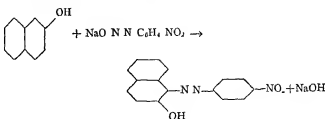
Linkage between carbon atoms sometimes occurs in the decomposition of diazonium compounds, especially when a new aromatic structure is formed. An example is R Pschorr's synthesis of phenanthrene-carboxylic acid by the decomposition of diazotized α -amino- α -phenylcinnamic acid



There is good evidence to show that the reactions mentioned so far are those of the positively charged aromatic radical formed by loss of nitrogen from the diazonium cation

Of the second class of reactions, in which nitrogen is not lost, an example is reduction to a hydrazine, ArNHNH_2 , this is carried out with stannous chloride or sulphites and is the general method for preparing the valuable reagents, phenylhydrazine and its substitution products. An important example of this class is the coupling reaction which leads to the formation of azo compounds ($q.v.$) While the older view was that the diazonium ion does not couple, recent work shows that the most probable mechanism with phenols is coupling between the diazonium ion and the phenoxide ion, and with amines, coupling between the diazonium ion and the undissociated amine molecule (cf. Richard Wistlar and Paul D. Bartlett, "Kinetics and Mechanism of the Coupling of Diazonium Salts With Aromatic Amines in Buffer Solutions," *J. Am. Chem. Soc.*, vol. 63, pp. 413-417 [1941], Louis P. Hammett, *Physical Organic Chemistry* [1949]). Coupling with aromatic amines and phenols is of technical importance since many of the aminoazo and hydroxyazo compounds formed are useful dyes. Thus, diazotized para-

aminiline couples in alkaline solution with β -naphthol to give a red dye (para red) much used for cotton



Coupling also takes place with aliphatic amines, phenolic ethers, aliphatic β -ketonic esters and β -diketones and with reactive unsaturated hydrocarbons such as isoprene. In some cases the product first formed is not the azo compound, thus primary amines, both aliphatic and aromatic, often give diazoamine compounds ArN=NHR , such a product can, however, usually be transformed into the azo compound. Because of the technical importance of the reaction there is an enormous mass of empirical knowledge on the rates of coupling and conditions and factors which affect the reaction. Nevertheless, the actual mechanism remains to a large extent obscure

Constitution of the Aromatic Diazo Compounds.—The reasons for the structures of the various forms of a diazo compound which have been given above can be summarized as follows: a diazonium salt behaves as the salt of a strong base and resembles a salt of an alkali metal. The carbonate is soluble in water with an alkaline reaction. The salt must contain a cation similar to that of a quaternary ammonium salt and hence one nitrogen atom must be tetravalent. Christian Blomstrand's view that this cation is $[\text{ArN}=\text{N}]^+$ is clearly correct. In the normal diazotate, formed when the salt is treated with alkali in excess, the diazo group is an anion. A change must have occurred in which the hydroxyl group becomes covalently linked in such a position that it has weak acidic properties. F. A. Kekule's formula, ArNOH , satisfies this condition, the acidic properties finding a close parallel in those of the oximes ($q.v.$) which contain the group NOH . Heated with excess alkali, the diazotate is converted into the isodiazotate which, though more stable, resembles the normal diazotate in all its properties. The two anions must be geometrical isomers which can be represented by the formulas,



A parallel case is that of the geometrically isomeric oximes ($q.v.$) The main reason for this view is that a similar isomerism occurs in the diazo sulphonates, $\text{ArN=NOSO}_3\text{K}$, and the diazo cyanides, ArN=NCN , and all these cases must almost certainly arise from a common cause which can only be geometrical isomerism. In the diazo cyanides careful study of the physical properties shows that any other type of isomerism is excluded. It also shows that the more stable isomer has the trans configuration so that on the presumption that all the more stable forms have the same configuration the isodiazotate is I and the diazotate II. Finally, treatment of an isodiazotate with a weak acid gives first the isodiazohydrate, ArN=N.OH , itself a weak acid, and this in chloroform solution changes into a yellow isomer which has no acidic properties. The behaviour recalls that of the aliphatic nitro compounds, where a pseudo acid form exists, and suggests that the yellow solid is the primary nitrosamine, ArNHNO . A point where there was still uncertainty at mid-20th century was the constitution of diazonium salts in the solid state. The sulphates and chlorides are colourless solids which behave as true salts, but some salts, notably the iodides, are so unstable that they hardly exist and the bromides are often yellow and less stable than the

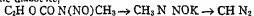
chlorides Hantzsch's view that an equilibrium of the type $\text{Ar}(\text{N}=\text{N})\text{Br} \rightleftharpoons \text{Ar} \cdot \text{N} \cdot \text{N} \cdot \text{Br}$ exists would seem to have little to recommend it.

Diazo compounds of the aromatic type occur not only in the benzene and naphthalene series but also in most heterocyclic aromatic systems, such as pyrazoles, thiazoles and triazoles. With pyridine and quinoline only the β amino compounds can be diazotized. The reason why diazo compounds of this kind are formed in the aromatic but not in the aliphatic series has something to do with conjugation of the unsaturated diazo group with the aromatic system.

ALIPHATIC DIAZO COMPOUNDS

These compounds contain the grouping $>\text{C}=\text{N}_2$ and are sharply differentiated from the aromatic diazo compounds in that they show neither basic nor acidic properties. With the exception of diazomethane, which is used in the laboratory as a methylating agent, they have little practical interest, but the problem of the structure of the group was a subject of dispute for many years and was solved only when quantum mechanics gave a clearer picture of chemical valency.

There are three chief methods for obtaining these compounds: 1. Diazomethane, CH_2N_2 , and diazoethane, CH_3CHN_2 are formed when nitroso N methyl (or ethyl) urethane is hydrolyzed with methanolic potassium methoxide. There is evidence that in intermediate in the reaction is an unstable salt analogous to the aromatic diazotate.



This method of H. von Pechmann was modified by A. Arndt, methylurea can be prepared from technical methylamine hydrochloride and potassium cyanate and forms an N -nitroso derivative which is hydrolyzed to diazomethane. The method was generalized by J. Kenner who showed that many primary aliphatic amines form addition compounds with methyl oxide of formula $\text{RCH}_2\text{-NH}(\text{CH}_3)_2\text{COCH}_3\text{COCH}_3$. These are secondary amines and their nitroso derivatives give diazo compounds on hydrolysis.

2. A limited number can be prepared by Theodor Curtius' method. The vast majority of aliphatic primary amines react with nitrous acid to give the corresponding alcohol, aliphatic diazo compounds are, however, given by a few, such as esters of α -aminoacids (but not the acids themselves), α -aminonitriles and α -amino ketones, such as ω -aminoacetophenone, $\text{C}_6\text{H}_5\text{COCH}_2\text{-NH}_2$. Diazo acetic ester is obtained thus way.

3. Oxidation of the hydrazones of aldehydes and ketones is often a useful method. Thus, diphenyldiazomethane, $(\text{C}_6\text{H}_5)_2\text{CN}_2$, is obtained by shaking benzophenone hydrazone with yellow mercuric oxide in cold petroleum ether for six hours.

The aliphatic diazo compounds vary in stability over a wide range. Those with hydrocarbon residues attached to the diazo group are coloured and unstable, those with a carbonyl or carboxyl group on the next carbon atom such as diazoacetic ester, are pale yellow and more stable, while those with two such groups, as $\text{C}_6\text{H}_5\text{COCH}_2\text{COCH}_3$, are colourless and comparatively unreactive, so much so that at one time they were allotted a different constitution. Diazomethane is a deep yellow gas boiling at -23°C , higher members are liquids or low melting solids. Nearly all explode on rapid heating but are reasonably stable in solution. In some of their reactions there is a superficial resemblance to the aromatic diazo compounds in that nitrogen is lost from the molecule with dilute aqueous acids the elements of water are added on to give a hydroxy compound, $>\text{CN}_2 \rightarrow >\text{CHOH}$. A similar reaction takes place with many classes of compounds containing the $-\text{OH}$, $-\text{NH}_2$ and $-\text{NH}$ groups and it is for this reason that diazomethane is a valuable methylating agent. When the diazo compounds decompose spontaneously, a variety of products is formed which arise from the reactions of the methylene radical formed by a simple loss of nitrogen from the molecule. Thus, the ethylenic compound $\text{R}^1\text{C}=\text{C}=\text{R}^2$ is a frequent product. Another characteristic set of reactions is addition to unsaturated compounds. These often take place without loss of nitrogen to give heterocyclic compounds of the pyrazole and pyrazoline series.

Sometimes nitrogen is lost in a subsequent stage and a cyclopropane derivative formed, a striking example is the addition of diazoacetic ester to benzene, one of the few reactions in which the latter shows simple ethylenic behaviour.

The structure of the characteristic group $>\text{CN}_2$ was a matter of controversy for many years. Curtius in 1883 proposed the formula



which was accepted until A. Engel in 1907 pointed out that the relationship to hydrazones both in oxidation and reduction, was evidence for a straight chain formula which he wrote as $>\text{C}=\text{N}=\text{N}$. Electron diffraction by diazomethane vapour (H. Boersch, 1935) shows beyond doubt that the straight chain is correct. Engel's formula is, however, inconsistent with modern views on the valency of nitrogen and the actual structure must be that of a resonance hybrid between $>\text{C}=\text{N}=\text{N}$ and $>\text{C}-\text{N}=\text{N}$. This view is supported by the known distances between the atoms of the group. This is one of the few cases where no one formula based on the older ideas of valency can be satisfactorily given.

(T. W. J. T.)

DIBDIN, CHARLES (1745-1814), British composer and entertainer, was born in Southampton c. March 4. From 1756 to 1759 he was a chorister at Winchester cathedral, in 1760 he was engaged as singer-actor at Covent Garden where his first operetta was produced in 1764. Of a restless and irascible disposition, he lived an unsettled life and several of his theatrical ventures were ended by quarrels. During an engagement as actor and composer at Drury Lane theatre (1768-76) he produced two successful works—*The Waterman* (1774) and *The Quaker* (1775). Later (1785) his ballad opera, *Liberty Hall*, containing the song "The Bells of Aberdovey," was also produced there. His fame as a song writer rests mainly on the stirring sea songs he introduced into his one-man "table entertainments" which were popular from 1789 to 1806, the best known is "Tom Bowling."

In 1791 he opened his own theatre, the Sans Souci, and also became his own publisher. In addition to about 100 dramatic pieces and 1,400 songs, he wrote his autobiography, *Professional Life* (1803), a *History of the Stage* (1795) and *The Musical Tour of Mr. Dibdin*, an account of his tour through England in 1787-88 to raise money for a projected, but abortive, visit to India. He also wrote several novels. He died in London on July 25, 1814. His sons, Charles and Thomas John Dibdin, were popular dramatists, and his grandson, Henry Edward Dibdin, was compiler of the *Standard Psalm Tune Book* (1857).

DIBDIN, THOMAS FROGNALL (1776-1847), English bibliographer born at Calcutta, was the son of Thomas Dibdin, the sailor brother of Charles Dibdin. He was educated at St. John's college, Oxford, and was entered at Lincoln's Inn. After an unsuccessful attempt to obtain practice as a provincial counsel at Worcester, he was ordained at the close of 1804, being appointed to a curacy at Kensington. In 1823 he received the living at Exning in Sussex. Soon afterward he was appointed by Lord Liverpool to the rectory of St. Mary's, Bryanston square, which he held until his death.

The first of his numerous bibliographical works was his *Introduction to the Knowledge of Editions of the Classics* (1802), which brought him under the notice of the third Earl Spencer, who threw open to him the rich library at Althorp, he spent much of his time in it, and in 1814-15 published his *Bibliotheca Spenceriana*. In 1818 he was commissioned by Earl Spencer to purchase books for him on the continent of Europe, an expedition described in his sumptuous *Bibliographical, Antiquarian and Picturesque Tour in France and Germany* (1821). Dibdin was the originator and vice president of the Roxburghe club, founded in 1812.

Other works of his are *Bibliomana* (1809), *Reminiscences of a Literary Life* (1866), and *Bibliographical, Antiquarian and Picturesque Tour in the Northern Counties of England and Scotland* (1838).

DIBDIN, THOMAS JOHN (1771-1841), English dramatist and song writer, son of Charles Dibdin, the song writer, the composer of "Tom Bowling," was born on March 21, 1771.

He was apprenticed to his maternal uncle, a London upholsterer, and later to William Rawlins, afterwards sheriff of London, from whose service he ran away to join a company of country players. He returned to London in 1705, having married two years before, and in the winter of 1708-9 his *Ivan and the Doctor* was produced at Covent Garden. His 70 comedies, operas and farces brought immense popularity to the writer and immense profits to the theatres. It is stated that the pantomime of *Mother Goose* (1807) produced over £20,000 for the management at Covent Garden theatre, and *The High mettled Racer*, adapted to a pantomime from his father's play, £18,000 at Astley's. Dibdin was prompter and pantomime writer at Drury Lane until 1816, when he took the Surrey theatre. This venture proved disastrous. After this he was manager of the Haymarket, but without his old success, and his last years were passed in comparative poverty. In 1827 he published two volumes of *Reminiscences*. Of his songs "The Oak Table" and "The Snug Little Island" are well known. He died in London on Sept. 16, 1841.

See *Reminiscences of Thomas Dibdin* (1827), and *T. R. Dibdin The Dibdins* (1888).

DIBRA (Serbian *Debar*), a fortified city in S. Serbia, Yugoslavia, and the key to the upper valley of the Black Drin. Pop. (1931) 6,913, of Albanians, Bulgars and Serbs. There are two Serbian schools. Cattle breeding is the chief occupation but some maize and tobacco are grown. There are sulphurous springs in the neighbourhood. It was captured by the Serbs in the Balkan Wars (1912-13) and assigned to them by the Treaty of Bucharest (1913). It was occupied by Bulgaria in 1941.

DIBRUGARH, a town of British India, headquarters of the Lalumpur district of Assam, on the Dibru river about 4 m. above its confluence with the Brahmaputra. Pop. (1941) 13,191. It is the terminus of steamer navigation on the Brahmaputra, and also of a railway line, which connects with the Assam Bengal system. The town contains a cantonment, the headquarters of the Assam Valley Light Horse and various educational institutions. In 1900 a medical school was established from a bequest by J. Berry White, to train hospital assistants for the tea gardens.

DICAEARCHUS, of Messene in Sicily, Peripatetic philosopher and pupil of Anaxagoras, historian, and geographer, flourished about 320 B.C. He was a friend of Theophrastus, to whom he dedicated many of his works. Of his writings only the titles and a few fragments survive. The most important of them was his *βίος τῆς Ελλάδος* (*Life in Greece*), in which the moral, political, and social condition of the people was fully discussed. In his *Τριπολιτικός* he described the best form of government as a mixture of monarchy, aristocracy, and democracy, and illustrated it by the example of Sparta. Among the philosophical works of Dicaearchus may be mentioned the *Lesbiaikos*, a dialogue in three books, showing that the soul is mortal, to which he added a supplement called *Korinthiakos*. He also wrote a *Description of the World*, illustrated by maps, in which was probably included his *Measurements of Mountains*. A description of Greece (150 iambics, in C. Muller *Frags. Hist. Graec.* i 238-243) was formerly attributed to him, but was really the work of Dionysius, son of Calliphon. The *De republica* is supposed to be founded on one of Dicaearchus's works.

The best edition of the fragments is by M. Fuhr (1841), a work of great learning; see also a dissertation by F. G. Osmund, *Antiquae narrationis et græcæ literaturæ*, II pp. 2-117 (1839), Pauli-Wissowa, *Realencyclopædie der class. Altertumswiss.*, v pt. 1 (1905).

DICE, small cubes of ivory, bone, wood or metal used in gaming (O Fr. *de*, derived from Lat. *dare*, to give). The six sides of a die are each marked with a different number of incised dots in such a manner that the sum of the dots on any two opposite sides shall total seven. Dice seem always to have been employed, as they still are, for gambling, and in games like backgammon. There are many methods of playing, from one to five dice being used, the dice being thrown on to a smooth surface either from the hand or dice-box.

It is a remarkable fact that, wherever dice have been found, whether in the tombs of ancient Egypt, of classic Greece, or of the far East, they differ in no material respect from those in use

to-day, the elongated ones with rounded ends found in Roman graves having been not dice but *tal*, or knuckle bones. Eight-sided dice have comparatively lately been introduced in France as aids to children in learning the multiplication table. The tetrahedron, or spinning die, used in many modern games, was known in ancient times in China and Japan.

The increased popularity of the more elaborate forms of gaming has resulted in the decline of dicing. One method is to throw three

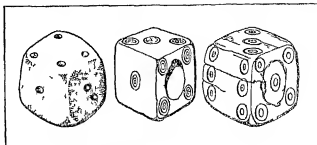


FIG. 1. COURTESY OF THE BRITISH MUSEUM.

SIX-SIDED EARLY EGYPTIAN DICE AND TWO ROMAN DICE.

One similar to those used to-day have been used from the earliest times being found among ancient relics in Egypt, the Mediterranean and the Far East.

times with three dice. If one or more sixes or fives are thrown the first time, they may be reserved, the other throws being made with the dice that are left. The object is to throw three sixes=18 or as near that number as possible.

The most popular form of pure gambling with dice at the present day is *craps*, or *crap shooting*, a simple form of *hasard*, of French origin. Two dice are used. Each player puts up a stake and the first player may cover any or all of the bets. He then "*shoots*," i.e., throws the dice from his open hand upon the table. If the sum of the dice is 7 or 11 the throw is a *nich*, or *natural*, and the player wins all stakes. If the throw is either 2, 3 or 12 it is a *crap*, and the player loses all. If any other number is thrown it is a *point*, and he continues until he throws the same number again, in which case he wins, or a 7, in which case he loses. *Poker dice* are marked with ace, king, queen, jack, ten and nine spot. Five are used and the object is, in three throws, to make pairs, triplets, full hands or fours and fives of a kind, five aces being the highest hand. Straights do not count.

History—Dice were probably evolved from knucklebones. The antiquary Thomas Hyde, in his *Synagoga*, records his opinion that the game of "odd or even" played with pebbles, is nearly coeval with the creation of man. It is almost impossible to trace clearly the development of dice as distinguished from knucklebones, on account of the confusing of the two games by the ancient writers. It is certain, however, that both were played in times antecedent to those of which we possess any written records. Sophocles, in a fragment, ascribed their invention to Palamedes, a Greek, who taught them to his countrymen during the siege of Troy, and who, according to Pausanias (on Corinth, xx), made an offering of them on the altar of the temple of Fortune. Herodotus (*Clio*) relates that the Lydians, during a period of famine in the days of King Atys, invented dice, knucklebones and indeed all other games except chess. The fact that dice have been used throughout the Orient from time immemorial, as has been proved by excavations from ancient tombs, seems to point clearly to an Asiatic origin. Dicing is mentioned as an Indian game in the *Rig veda*. In its primitive form knucklebones was essentially a game of skill, played by women and children, while dice were used for gambling, and it was doubtless the gambling spirit of the age which was responsible for the derivative form of knucklebones, in which four sides of the bones received different values, which were then counted, like dice.

Gambling with three, sometimes two, dice (*κίβητοι*) was a very popular form of amusement in Greece, especially with the upper classes, and was an almost invariable accompaniment to the symposium, or drinking banquet. The dice were cast from conical beakers, and the highest throw was three sixes, called *Aphrodite*, while the lowest, three aces, was called the *dog*. Both in Greece

and Rome different modes of counting were in vogue. Roman dice were called *teserae* from the Greek word for four, indicative of the four sides. The Romans were passionate gamblers, especially in the luxurious days of the empire, and dicing was a favourite form though it was forbidden except during the Saturnalia. The emperor Augustus wrote in a letter to Suetonius concerning a game that he had played with his friends: "Whoever threw a *dog* or a six paid a *denarius* to the bank for every die, and whoever threw a *Venus* (the highest) won every thing." In the houses of the rich the dice-bearers were of carved ivory and the dice of crystal inlaid with gold. Mark Antony wasted his time at Alexandria with dicing, while, according to Suetonius, the emperors Augustus, Nero and Claudius were passionately fond of it, the last named having written a book on the game. Caligula notoriously cheated at the game, Domitian played it, and Commodus set apart special rooms in his palace for it. The emperor Verus, adopted son of Antoninus, is known to have thrown dice whole nights together.

Fashionable society followed the lead of its emperors, and, in spite of the severity of the laws, fortunes were squandered at the dicing table. Horace derided the youth of the period, who wasted his time amid the dangers of dicing instead of taming his charger and giving himself up to the hardships of the chase. Throwing dice for money was the cause of many special laws in Rome, according to one of which no suit could be brought by a person who allowed gambling in his house, even if he had been cheated or assaulted. Professional gamblers were common, and some of their loaded dice are preserved in museums. The common public-houses were the resorts of gamblers, and an old fresco is extant showing two quarrelling dicers being ejected by the indignant host. That the barbarians were also given to gaming, whether or not they learned it from their Roman conquerors, is proved by Tacitus, who states that the Germans were passionately fond of dicing, so much so, indeed, that, having lost everything, they would even stake their personal liberty. Centuries later, during the middle ages, dicing became the favourite pastime of the knights, and both dicing schools (*scholae decarum*) and guilds of dicers existed. In France both knights and ladies were given to dicing, which repeated legislation did not abolish. In India and

more or less cultivated. Other noteworthy American species are the Dutchman's breeches (*D. cucullaria*), one of the most attractive wild flowers of eastern North America, the squirrel corn (*D. canadensis*), of similar range, the small tubers of which resemble grains of Indian corn (maize), and the golden ear drops (*D. chrysantha*), a smooth, stiff stemmed plant, 2 ft to 5 ft high, with large pinnated clusters of yellow flowers, widely distributed in California. (See DUTCHMAN'S BREECHES.)

DICETO, RALPH DE (d. c. 1202), dean of St. Paul's, London, and chronicler, is first mentioned in 1152, when he received the archdeaconry of Middlesex. He was probably born between 1120 and 1130, of his parentage and nationality nothing is known. Diceto was selected, in 1166, as the envoy of the English bishops when they protested against the excommunications launched by Becket. About 1180 he became dean of St. Paul's. In this office he distinguished himself by careful management of the estates, by restoring the discipline of the chapter, and by building at his own expense a deanery house. Diceto's most important historical works, the *Abbreviationes Chroniconum* and the *Ymagines Historiarum*, cover the history of the world from the birth of Christ to the year 1202. The former, which ends in 1147, is a work of learning and industry, but almost entirely based upon extant sources. The latter, beginning in a compilation from Robert de Monte and the letters of Foliot, becomes an original authority about 1173, and a contemporary record about 1181. The *Ymagines* is a valuable authority for the last years of the reign of Henry II and for the reign of Richard I.

See the introduction to W. Stubbs's edition of the *Historical Works* of Diceto (Rolls ed. 1896, 2 vols.). Diceto's fragmentary *Domesday* of the capital estates has been edited by Archdeacon Hale in *The Domesday of St. Paul's*, pp. 109 ff. (Camden Society, 1888).

DICEY, EDWARD (1832-1911), English writer, son of T. E. Dicey of Claybrook Hall, Leicestershire, was born on May 15, 1832, and educated at Trinity college, Cambridge, where he took mathematical and classical honours. He visited the United States in 1862, and in 1863 wrote *Six months in the Federal States*, in which he took the part of the North. He was called to the bar in 1875, became a bencher of Gray's Inn in 1896, and was treasurer 1893-04. He was connected with the *Daily Telegraph* from 1862 onwards as leader writer and then as special correspondent, and after a short spell in 1870 as editor of the *Daily News*, he became editor of the *Observer*, a position which he held for 19 years. Of his many books on foreign affairs perhaps the most important are his *England and Egypt* (1884), *Bulgaria, the Peasant State* (1895), *The Egypt of the Future* (1907). He died in London on July 7, 1911.

His brother **ALBERT VENN DICEY** (1835-1922), English jurist, was educated at Balliol college, Oxford, and was called to the bar at the Inner Temple in 1863. He held fellowships successively at Balliol, Trinity and All Souls', and from 1882 to 1900 was Vinerian professor of law. He became QC in 1890. His chief works are the *Introduction to the Study of the Law of the Constitution* (1885, 6th ed. 1902), a standard work on the subject, *England's Case against Home Rule* (1886), *A Digest of the Law of England with Reference to the Conflict of Laws* (1896), and *Lectures on the Relation between Law and Public Opinion in England during the 19th century* (1905). He died on April 7, 1922.

DICHOTOMY, literally a cutting asunder, the technical term for a form of logical division, consisting in the separation of a class into two sub-classes, one of which has and the other has not a certain quality or attribute (Gr. *di* = apart, *chōreō*, to cut). Men may be thus divided into white men and men who are not white, each of these may be subdivided similarly. On the principle of contradiction this division is both exhaustive and exclusive, there can be no overlapping, and no members of the original genus or the lower groups are omitted. This method of classification, though formally accurate, has slight value in the exact sciences, partly because at every step one of the two groups is merely negatively characterized and may be unreal, it is useful, however, in setting forth clearly the gradual descent from the most inclusive genus (*summu genus*) through species to the lowest class (*infima species*), which is divisible only into indivi-

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North American Indians are said to have played dice as far back as 1636. In his revelations of the time, Father Brebeuf gives long accounts of the game, the causes for its being played and the excesses in gambling to which it led. Even up to about 1860, the Indians were known to stake all they had, frequently losing all their earthly possessions. Dice or *Crope* was a popular game among the American soldiers in France during World War I, the Afro Americans possessing a marked fondness for the "bones."

DICENTRA, a genus of perennial herbs of the fumitory family (Fumariaceae), containing 15 species, natives of Asia and North America, 8 of which occur in the United States and Canada. They are mostly low or stemless plants, a few of which are cultivated for their attractive deeply cut or dissected foliage and handsome irregular flowers. The familiar bleeding-heart (*D. spectabilis*) of the gardens, with showy rose-red, heart-shaped flowers, an inch or more long, is a native of Japan. The eastern bleeding-heart (*D. eximia*), with pink, narrow, heart-shaped flowers, about 2 in. long, of the Allegheny Mountain region, and the western bleeding-heart (*D. formosa*), with similar rose-purple flowers, of mountain woods from California to British Columbia, are both

ual persons or things (*See* DIVISION) In astronomy the term is used for the aspect of the moon or of a planet when apparently half illuminated, so that its disc has the form of a semicircle

DICK, ROBERT (1811-1866), Scottish geologist and botanist, was born in Tullibody, Clackmannanshire, the son of an officer of excise. He became a baker and worked at his trade until his death in Thurso on Dec. 24, 1866. He never published any thing, but from 1835 onwards, when he first discovered fossils in the Caithness flags, he sent his specimens to Hugh Miller and others. His herbarium, which consisted of about 200 folios of mosses, ferns and flowering plants, is now stored, with many of his fossils, in the museum at Thurso

DICKCISSEL (*Spiza americana*), a common North American bird between the Rockies and the Alleghenies from Minnesota and western Ontario southward. It is recognized by its yellow breast, wing-band, sides of throat and eye streak, and is slightly over 6 in. long. It is brownish in colour, with chestnut shoulders, and the black crescent at the bottom of its white throat gives it the name of black-throated bunting

DICKENS, CHARLES JOHN HUFFAM (1817-1870) the most popular and perhaps the greatest of English novelists, was born on Feb. 7, 1812 in Landport, a division of Portsea, in a house in Mile End terrace, Commercial road. The house can be identified and is in some sense a popular shrine or memorial, enabling the sightseer to link up in one journey two of the most romantic national names, associating Dickens with Portsea and Nelson with Portsmouth. But beyond this symbolic and almost legendary local interest, the actual address indicates little more than the drifting and often decaying fortunes of the class and family from which he came. It would be an exaggeration to compare it to Lant street, in the Borough, of which, it will be remembered, "the inhabitants were migratory, disappearing usually towards the verge of quarter day." But there is the note of something nomadic about the social world to which he belonged. We talk of the solid middle class, he belonged, one might almost say, to the liquid middle class, certainly to the insecure middle class. His father, John Dickens, was a clerk in the Navy Pay Office, and all through life a man of wavering and unstable status, partly by his misfortunes and partly by his fault. It is said that Dickens sketched him in a lighter spirit as Micawber and in a sadder and more realistic aspect as Dorrit. The contrast between the two men, as well as the two moods, should be a warning against the weakness of taking too literally the idea of Dickensian "originals." The habit has done grave injustice to many people, such as Leigh Hunt, and it may involve a grave injustice to John Dickens, and perhaps an even graver injustice to Mrs. John Dickens, nee Elizabeth Barrow, whom a similar rumour reports as the real Mrs. Nickleby. Some may question, not without grief, whether there really could be a real Mrs. Nickleby. But in any case there certainly could not be a man who was both Dorrit and Micawber. The truth is that we shall misunderstand from the beginning the nature of the Dickensian imagination, if we suppose these things to be mechanical portraits in black and white, taken by "the proffer machine," as Mr. Weller said. It is the whole point of Dickens that he took hints from human beings, and turned them, one may say, into superhuman beings. But it is true that John Dickens was of the type that is often shifted from place to place, and this is the chief significance of Charles Dickens's connection with Portsea, or rather of his lack of connection with it. He can only have been two years old when the household moved for a short time to London and then for a longer time to Chatham. It was perhaps lucky that the formative period of his first childhood was also the most fortunate period of his not very fortunate family. The dockyard of Chatham, the towers of Rochester, the

greater profit, from a random heap of old novels that included much of the greatest English literature and even more of the type of literature from which he could learn most, *Roderick Random* and *Robinson Crusoe* and *Tom Jones* and *The Vicar of Wakefield*

He can hardly have been ten years old when the household was once more upon the march. John Dickens had fallen heavily into debt, he continued the tendency to change his private address, and his next private address was the Debtors' Prison of the Marshalsea. His wife, the mother of eight children of whom Charles was the second, had to encamp desolately in Camden Town and open a dingy sort of "educational establishment." Meanwhile the unfortunate Charles was learning his lessons at a very different sort of educational establishment. After helping his mother in every sort of menial occupation, he was thrown forth to earn his own living by tying and labelling pots of blacking in a blacking warehouse at Old Hungerford Stairs. The blacking was symbolic enough, Dickens never doubted that this piece of his childhood was the darkest period of his life, and he seems indeed to have been in a mood to black himself all over, like the Othello of the Crummles Company. Of his pessimistic period, of the heartrending monotony and ignominy, he has given little more than a bitter abbreviation in *David Copperfield*. But he was storing up much more than bitterness, it is obvious that he had already developed an almost uncanny vigilance and alertness of attention. By the time his servitude came to an end, by his father filling into a legacy as he had fallen into a jail (there was really a touch of Micawber in the way in which things turned up and turned down for him) the boy was no longer a normal boy, let alone a child. He called his wandering parent "the Frogdial Father", and there was something of the same fantastic family invasion in the very existence of so watchful and critical a son. We are struck at once with an almost malicious maturity of satire, some of the best passages of the prison life of the Pickwick and the Dorrits occur in private letters about his own early life. He had shared, of course, the improvement in the family condition, which was represented in his case by a period of service as a clerk to a Mr. Blackmore, a Grays Inn solicitor, and afterwards in the equally successful, and much more congenial, occupation of a newspaper reporter and ultimately a Parliamentary reporter. His father had taken up the trade, but his son was already making a mark in it, as reporter to *The True Sun*, *The Mirror of Parliament* and *The Morning Chronicle*. In all these aspects and attitudes, at this time, he appears as alert, sharp-witted and detached, recalling that sort of metallic brightness which an observer at this period so often saw flash upon his face. It is worthy of note, because certain healthy social emotions which he always championed have somewhat falsified his personality in the eyes of the pangs whom he loved to rap over the head. He was a genuine champion of generosity, but he was not always genial, certainly not only genial. One of his earliest sketches, published not long after this time, was a defence of the Christian festivity of Christmas against the Puritans and the Unitarians, it was called "Sunday Under Three Heads." All his life he defended valiantly the pleasures of the poor, and insisted that God had given ale and rum, as well as wine, to make glad the heart of man. But all this has clouded his character with fumes of mere conviviality and irresponsibility which were very far from being really characteristic. Even in youth, which is the period of irresponsibility, Dickens appears in some ways as highly responsible. He was in sharp reaction against the futurity of his family, he was both ambitious and indolent, and there were some who even found him hard. In many moods he had as angry a dislike of the Skimpoles as of the Gradgrinds.

Indeed he had come in more ways than one to the high turning-point of his fortunes. His marriage and his first real literary work can be dated at about the same time. He had already begun to write sketches, chiefly in *The Old Monthly Magazine*, which were in the broadest sense caricatures, of the common objects of the street or the market place. They were illustrated by Cruikshank, and in these early stages of the story the illustrator is often more important than the author. This was notoriously true of his next

and perhaps his greatest experiment, but it is typical in any case of his time and his time of life. The prose sketches were signed "Boz" and the signature had become a recognized pseudonym when Messrs Chapman and Hall, the publishers, approached him with the suggestion of a larger scheme. A well known humorous artist of that epoch, Seymour, was to produce a series of plates illustrating the adventures, or misadventures, of the Nimrod Club, a group of amateur sportsmen, destined to dwindle and yet to grow infinitely greater in the single figure of Mr Nathaniel Winkle. Dickens consented to write the letter press, which was little more than a running accompaniment like an ornamental border around the drawings, and in that strange fashion, secondary, subordinate and even trivial, first formed itself in the human fancy the epic and pantomime of *Pickwick* (1837). Dickens persuaded the publishers to let the *Pickwick* Club represent more varied interests or eccentricities retained Mr Winkle to represent or misrepresent the original notion of sport, and by that one stroke of independence cut himself free from a stale fashion and started a new artistic adventure and revolution. He gave as one of his reasons the fact that he had no special knowledge of sports or games, and proceeded to drive his argument home triumphantly by his description of the cricket-match at Dingley Dell. And yet that cricket-match alone might illustrate exactly the game which Dickens so gloriously won, and why that wild and ill-instructed batsman has had so many thousand runs and is not out. What did a few mistakes in the description of cricket, or even in the description of real life, matter in a man who could invent that orator at the cricket dinner, who complimented the defeated eleven by saying, with the gesture of Alexander, "If I were not Dumkins, I would be Luffey, if I were not Podder, I would be Struggles"? Men do not read that sort of thing to learn about cricket, or even about life, but to find something more living than either. There had broken through the entanglements of that trumpery bargain a force of comic genius which swallowed up its own origin and excuses, a wild animal big enough to eat all its direction labels. People forgot about Seymour, forgot about sport, forgot about the Nimrod Club, soon forgot about the *Pickwick* Club. They forgot all that he forgot and followed whatever he followed, much bigger and wilder game than any aimed at by the mere gun of Mr Winkle. The track of the story wandered, the tone of the story changed, a servant whom *Pickwick* found cleaning boots in an inn-yard took the centre of the stage and towered even over *Pickwick*, *Pickwick* from being a pompous buffoon became a generous and venerable old English gentleman, and the world still followed that incredible transformation scene and wishes there were more of it to this day. This was the emergence of Dickens into literature. It had, of course, many secondary effects in life. One was the first and almost the most bitter of his quarrels, Seymour may be excused for having been annoyed at the relations of artist and author being thus turned upside down in a whirlwind, but Seymour was not therefore necessarily justified in saying, as he did say and his widow long continued to say, that Dickens had gained glory from another man's ideas. Nobody, we may well imagine, believes that the oration of Sergeant Buzfuz or the poem of Mrs Leo Hunter, were Mr Seymour's ideas. Dickens had an inexhaustible torrent of such ideas, and no man on earth could pretend to have provided them. But it is true that in this quarrel, as in others, some found a touch of sharpness and acid self defence in Dickens, and he was never without his enemies. His ideal was certainly the leisure and geniality of *Pickwick*, but he was fighting rather too hard for his own hand and had too much at stake and too pressing a knowledge of poverty to be anything but practical.

As *Pickwick* was the foundation of his public life, his marriage was naturally the foundation of his private life, and in this also he has been an object of criticism as he was certainly an object of sympathy. Very little good is done by making guesses about a story of which the spiritual balance and proportion were probably never known to more than three or four people. It is sufficiently significant that those who were nearest to it, and who survive to speak or rather to be silent, agree in laying no very heavy blame upon anyone involved. One of the principals of the

Morning Chronicle, George Hogarth, had been so much struck by the "Boz" sketches as to insist on an improvement in the payment of the writer, he introduced Dickens to his family and especially (we may say) to his daughters, with all of whom the young journalist seems to have been on very friendly and even affectionate terms. One of them, Catherine, he married, and certainly married for love, but not perhaps with the sort of love which gives a man a full and serious realization of what he is doing. It is the pithos of the story that in a sense the friendship outlasted the love, for another sister, who understood him better, remained his friend long after his marriage had become a prolonged misunderstanding. All this, however, happened long afterwards, for the moment his marriage may be taken as marking his step into security and success, especially as he was probably stimulated and, it were, intoxicated, by a romance that brought him into more refined social surroundings than his own. From that moment he was launched as a popular writer and a power in the world, and he never went back, until he died of popularity thirty years afterwards.

It is notable that his next work was *Oliver Twist* (1838), which might be meant for a contrast to *Pickwick*. If the first trick had succeeded, nobody could accuse the conjurer of trying the same trick twice. He was probably proud of proving his range, but he was certainly courageous in testing his popularity. It is true that *Oliver Twist* consists of a queer mixture of melodrama and realism, but both the realism and the melodrama are deliberately dark and grim. Nevertheless it is fortunate that with his second book he thus brought into play what may be called his second talent. It is too common to compare his humour with his pathos, for indeed there is no comparison. But there really is a comparison between his humour and his horror, and he really had a talent for a certain sort of horror, which is exactly rendered by the popular phrase of supping on horrors. For there is a sort of lurid conviviality that accompanies the panic, as if the nightmare could accompany and not follow the heavy meal. This suppressed vitality is due to his never for an instant losing the love of life, the love of death, which is despair and pessimism, was meaningless to him till he died. The sort of horror which afterwards concerned the death of Krook is already found in *Oliver Twist*, as in that intolerable repetition throbbing in the murderer's ears, "will wash out mud-stains, blood stains" and so on. For the rest, the plot is preposterous and the flashes of fun excellent but few, yet there is another aspect of the book which makes it important in the story of Dickens. It is not only the first of his nightmare novels, but also the first of his social tracts. Something of social protest could be read between the lines of *Pickwick* in prison, but the prison of *Pickwick* was very mild compared with the charitable almshouse of *Oliver*. Dickens is witness, with Hood and Cobbett and many others, that the workhouse was felt by all generous people as something quite unnaturally new and hard and inhuman. It is sometimes said that he killed Bumble, it would be truer to say that, by making Bumble live, he created something by which it will always be possible to kill bureaucracies.

Whether he call the transition from *Pickwick* to *Oliver Twist* a change from comedy to tragedy, or merely a change from farce to melodrama, it is notable that the next act of Dickens is to mix the two in about equal proportions. Having shown how much he can vary, he tries to show how well he can combine. It is worth noting because it explains much of the failure as well as the success of his art as a whole. We may even say that, to the last, this sort of exhibition of power remained his principal weakness. When the critics, like those of *The Quarterly*, called him vulgar, it meant nothing except that the critics themselves were snobbish. There is nothing vulgar about drinking beer or describing the drinking of beer, or enjoying the humours of really humorous people who happen to black boots, like Sam Weller. But there is something just a little vulgar about professing to be a Universal Provider, a man who writes not only something that he wants to write, but anything that anybody wants to read. Anything in his work that can really be called failure is very largely due to this appetite for universal success. There is nothing

wrong about the jester laughing at his own jokes, indeed they must be very poor jokes if even he cannot laugh at them. Dickens, in one of those endless private letters which are almost more entertaining than his published novels, describes himself as "a gentleman with rather long hair and no neckcloth, who writes and grins, as if he thought he was very funny indeed", and so he was. But when he set out to prove that he was not only very funny, but very pathetic, very tragic, very powerful, he was not always enjoying the sense of power over his work, he was enjoying the sense of power over his audience. He was an admirable actor in private theatricals, and sometimes, unfortunately, they were public theatricals. And on this side of his character he had the proverbial itch of Toole to act Hamlet. When he was rendering the humours of the crowd, he was that rather rare thing, a real democrat. But when he was trying to command the tears and thrills of the crowd, he was something of a demagogue, that is, not one mingling with the crowd but one trying to dazzle and to drive it. One of the ways in which he displayed this attribute, if not of vulgarity at least of vanity, was in his habit, from this time onwards, of running side by side in the same book about five different stories in about five different styles. It pleased the actor in him to show his versatility and his ease in turning from one to the other. He did not realize clearly enough that in some of the parts he was a first-rate actor and in some a second rate, and in some a fifth-rate actor. He did not remind himself that though he turned to each topic with equal ease, he did not turn to each with equal effect. But, whatever the disadvantages of the universal ambition, it definitely dates from the period of his next book. *Pickwick* has a prevailing tint of gaiety and *Oliver Twist* of gravity, not to say grimness, but with *Nicholas Nickleby* (1839) we have the new method, which is like a pattern of bright and dark stripes. The melodrama is if possible even more melodramatic than in *Oliver Twist*, but what there is of it is equally black and scowling. But the comedy or farce has already displayed the rapid opening of his real genius in letters. There is no better company in all literature than the strolling company of Mr. Vincent Crummles, though it is to be hoped that in any convivial meeting of it, Miss Snevlicci will remember to invite her incomparable papa. Mr. Mantalini also is one of the great gifts of Dickens to the enduring happiness of humanity. For the rest, it is very difficult to take the serious part of the story seriously. There is precious little difference between the rant and claptrap of the Crummles plays, which Dickens makes fun of, and the rant and claptrap of Ralph Nickleby and Mulberry Hawke which Dickens gravely narrates to us. All that, however, was of little consequence either immediate or permanent. Dickens was not proving that he could write smooth and probable narratives, which many people could do. He was proving that he could create Mantalini and Snevlicci, which nobody could do.

Nevertheless, this pretence of providing for all tastes, which produced the serio-comic novel, is also the explanation of the next stage of his career. There runs or recurs throughout his whole life a certain ambition to preside over a more or less complex or many-sided publication, a large framework for many pictures, a system of tales within tales like the Arabian Nights or the tales of the Tabard. It is the ambition that he afterwards gratified by becoming the editor of two magazines, *Household Words* and *All the Year Round*. But there is here something of a shadow of the original meaning of the word magazine, in the sense of a shop, and another hint of that excessive desire to keep a shop that sells everything. He had been for a time editor of something of the sort in *Bentley's Miscellany*, but the final form taken by this mild and genial megalomania (if we may so describe it) was the plan which Dickens formed immediately after the success of *Nicholas Nickleby*. The serial scheme was to be called "Master Humphrey's Clock," and was to consist of different stories told by a group of friends. With the idea of making them the more friendly he turned some of them into old friends, reintroducing Mr. Pickwick and the two Wellers, though these characters were hardly at their best, the author's mind being already on other things. One of these things was a historical novel, perhaps conceived more in the romantic manner of Scott than the prosaic

manner of Smollett, which Dickens generally followed. It was called *Barnaby Rudge* (1840) and the most interesting part of it perhaps is the business of the Gordon Riots, and the mob that has a madman for its mascot and a penny dreadful pretence for its comic relief. But there is also a plot as complicated as, though rather clearer than, that of *Oliver Twist*, a plot that intensely interested the detective mind of Poe. *Barnaby Rudge*, however, is not so directly Dickensian as the romance that preceded or the romance that followed it. The second story, somewhat insecurely wedged into the framework of *Master Humphrey's Clock*, was *The Old Curiosity Shop* (1841), as the opening and some of the references in the story still vaguely attest. The public reception of this story very sharply illustrates what has been said about the double character of his success. On the one side was his true success as a craftsman carving figures of a certain type, generally gargoyles and grotesques. On the other side was his inferior success as a jack-of-all-trades tending only too much to be a cheap jack. As a matter of fact, *The Old Curiosity Shop* contains some of the most attractive and imaginative humour in all his humorous work, there is nothing better anywhere than Mr. Swiveller's imitation of the brigand or Mr. Brass's funeral oration over the dwarf. But in general gossip and association, everything else in the story is swallowed up in the lachrymose subject of Little Nell. There can be no doubt that this unfortunate female had a most unfortunate effect on Dickens's whole conception of his literary function. He was flattered because silly people wrote him letters imploring him not to let Little Nell die, and forgot how many sensible people there were, only hoping that the Marchioness would live for ever. Little Nell was better dead, but she was an unconscious long time dying, and we cannot altogether acquit Dickens of keeping her lingering in agony as an exhibition of his power. It tended to fix him in that unfortunate attitude, of something between a showman and a magician, which explains almost all the real mistakes of his life.

About this time a very determining event interrupted his purely literary development, his first visit to America. It was destined to have, apart from any other results, a direct effect upon his next book, which was *Martin Chuzzlewit* (1844). There were, of course, many purely practical and personal elements in the criticism which he directed against the western democracy. An unjust copyright law, or one which he at any rate thought very unjust, had enabled Americans to pirate his most popular works, and it would seem that the people he met were, in their breezy way, but little inclined to apologize for the anomaly. But it would be very unjust to Dickens to deny that his sense and sensibility were alike irritated by some real divisions in the international relation. There were things in the American culture, or lack of culture, which he could not be expected to understand but which he might reasonably be expected to dislike. His English law-abiding liberalism would in any case have been startled by a certain streak of ferocity and persecution that there really is in the Americans, just as he might have recoiled from the same fierceness in the Irish or the Italians. But in the Americans it was also connected with something crude and incomplete in the society, and was not softened by tradition or romance. He was also both annoyed and amused at the American habit of uttering solemn idealistic soliloquies and of using rhetoric very rhetorically. But all these impressions are important chiefly as they changed the course of his next important narrative, and illustrated a certain condition or defect of his whole narrative method.

All these early books of Dickens, from *Pickwick* onward, appeared, it must always be remembered, serially and in separate parts. They were anticipated eagerly like bulletins, and they were often written up to time almost as hastily as newspaper reports. One effect of this method was that it encouraged the novelist in a sort of opportunism and something of a hand-to-mouth habit of work. And a character that always belonged, in varying degrees, to his novels is first and most sharply illustrated in *Martin Chuzzlewit*. The earlier numbers, though they contained the two superb caricatures called Pecksniff and Mrs. Gamp, had not for some reason been so popular as the caricatures called Pickwick and Miss Squeers. Dickens was already beginning

to show something of that feverish fatigue which was the natural reaction of his fervid industry. He feared that the public was bored with the book, he became perhaps subconsciously a little bored with it himself. He conceived the bold idea of breaching the story in the middle and putting in a purple patch woven from his wild memories of the Yankees. It was completely successful, in the comedy sense, but it is worth noting that Dickens did something cynically Dickensian in thus suddenly sending Martin Chuzzlewit across the sea to America. It is not easy to imagine Thackeray suddenly hurling Penninus from Mayfair into the middle of Australia, or George Eliot dislodging Felix Holt and flinging him as far as the North Pole. The difference was partly the result of the Dickensian temper and partly of the method of publication. But it will be well to remember it for there is more than one example of what looks like a positive change of plan in the Dickens stories, made more possible by this early habit of not producing the work of art as a whole. Some have suggested that the degeneration of Boffin was originally meant to be real, and his rather clumsy plot an afterthought, and the same idea has figured in the reconstructions of *Edwin Drood*.

At this point there is a break in the life of Dickens, in more ways than one. It is represented by his decision to live abroad for a time, chiefly on grounds of economy, the last lingering results of the relative failure of *Martin Chuzzlewit*. He took a villa in the neighbourhood of Genoa in 1844, and he and his family, already a fairly large one, settled down there with a certain air of finality that deserved for a time the name of exile. But it is curious to note that the literary work done there has something of the character of an interlude, and indeed of a rather incongruous interlude. For it was in that Italian landscape that he concentrated on a study so very domestic, insular and even cockney as *The Chimes* (1845), and industriously continued the series of short Christmas stories which had recently begun in the very London fog of *A Christmas Carol* (1843). Whatever be the merits or demerits of the *Christmas Carol*, it really is a carol, in the sense of being short and direct and having the same chorus throughout. The same is true in another way of *The Chimes*, and of most things that occupied him in his Italian home. He had not settled down to another long and important book, and it soon became apparent that he had not settled down at all. He returned to London, the landscape which for him was really the most romantic and even historic, and did something so ominously typical of the place and time as almost to seem like tempting Providence. He became the first editor of the *Daily News*, a paper started to maintain those Liberal, if not Radical opinions of which he always shared the confident outlook and the humane simplicity. He did not long remain attached to the editorial chair or even to the metropolis, for this was the most restless period in all his restless life. He immediately went back to Lausanne and immediately wanted to go back to London. It seems probable that this break in his social life corresponded to a break in his artistic life which was in a sense just about to begin all over again and begin at the other end. He did indeed write one more full size novel of the earlier type, *Dombey and Son* (1846-48); but it has very much the character of the winding up of an old business, like the winding up of the Dombey firm at the end of it. It is comic as the earlier books were comic, and no praise can be higher, it is conventional as the earlier plots were conventional, and never really pretended to be anything else, it contains a dying child upon the pattern of Little Nell, it contains a very amusing major much improved from the pattern of Mr Dowler. But underneath all this easy repetition of the old dexterity and the old clumsiness the mind of the conjurer is already elsewhere. *Dombey and Son* was more successful in a business sense than *Martin Chuzzlewit*, though really less successful in many others. Dickens settled again in England in a more prosperous style, sent his son to Eton and, what was more sensational, took a rest. It was after a long holiday at Broadstairs, in easier circumstances more favourable to imaginative growth and a general change of view, that there appeared in 1850 an entirely new novel in an entirely new style.

There is all the difference between the life and adventures of

David Copperfield and the life and adventures of Nicholas Nickleby, that there is between the life of Charles Dickens and the life of Amadis of Gaul. The latter is a good or bad romance, the former is a romantic biography, only the more realistic for being romantic. For romance is a very real part of life and perhaps the most real part of youth. Dickens had turned the telescope round or was looking through the other end of it, looking perhaps into a mirror, looking in any case out of a new window. It was life as he saw it, which was somewhat fantastically, but it was his own life as he knew it, and even as he had lived it. In other words, it is fanciful but it is not fictitious, because not merely invented in the manner of fiction. In Pickwick or Nickleby he had in a sense breathed fresh imaginative life into stock characters, but they were still stage characters, in the new style he may be extravagant, but he is not stagey. That vague glow of exaggeration and glamour which lies over all the opening chapters of *David Copperfield*, which dilates some figures and distorts others, is the genuine sentimentalism and suppressed passion of youth, it is no longer a convention or tradition of caricature. There are men like Steerforth and girls like Dora, they are not as boys see them, but boys do see them so. This passionate autobiography, though it stiffens into greater conventionality at the real period of passion, is really, in the dimly battered phrase, a human document. But something of the new spirit, more subtle and sympathetic but perhaps less purely creative, belongs to all the books written after this date. The next of the novels in point of time was *Bleak House* (1853), a satire chiefly directed against Chancery and the law's delay, but containing some brilliant satire on other things, as on the philanthropic fool whose eyes are in the ends of the earth. But the description of the feverish idleness of Rick has the new note of one for whom a well meaning young man is no longer merely a "first walking gentleman." After a still more severe phase in *Hard Times* (1854) (historically important as the revolt of a Radical against the economic individualism which was originally identified with Radicalism) he continued the same tendency in *Little Dorrit* (1857), the tone of which is perhaps as sad as anything illustrated by Dickensian humours can be, broke off into an equally serious and more sensational experiment in historical romance in *A Tale of Two Cities* (1859), largely an effect of the influence of Carlyle, and finally reached what was perhaps the height of his new artistic method in a purely artistic sense. He never wrote anything better, considered as literature, than the first chapters of *Great Expectations* (1861). But there is, after all, something about Dickens that prevents the critic from being ever quite content with criticizing his work as literature. Something larger seems involved, which is not literature, but life, and yet the very opposite of a mere recorded way of living. And he who remembers Pickwick and Pecksniff, creatures like Puck or Pan, may sometimes wonder whether the work had not most life when it was least lifelike.

The stretch of stories following on *David Copperfield*, from 1850 onwards, fall into the framework of another of Dickens's editorial schemes, and this time a much more successful one. He began to edit *Household Words*, in which some, though not all of his later tales appeared, and continued to do so until he exchanged it in 1859 for another and similar periodical called *All the Year Round*. Just as we find him about this time induced at last to settle down finally in a comparatively comfortable editorial chair, so we find him at last settled more comfortably in a domicile that could really be called a home, when, returning at last to his beloved Rochester district on the great road of Kent, he set up his house at Gads hill. It is sad to realize that this material domestic settlement had followed on a moral unsettlement, and the separation of Dickens and his wife, by agreement (of which the little that needs saying has already been said) had already taken place in 1856. But indeed, even apart from that tragedy, it is typical of Dickens that his repose could never be taken as final. His life was destined to end in a whirlwind of an entirely new type of activity, which none the less never interrupted that creative work which was the indwelling excitement of all his days. He wrote one more complete novel, *Our Mutual*

Friend (1864-65), and it is more complete than most. Indeed it is one of the best though not one of the most Dickensian of the Dickens novels. He then turned his restless talent to something in the nature of a detective story, more in the manner of his friend Wilkie Collins, the sort of story which begins by asking a question, in this case a question about the secret and the sequel of the fate of the hero, Edwin Drood. The question will never be answered, for it was cut short by the only thing that could be more dramatic than the death of the hero, the death of the author. Charles Dickens was dead.

He died very suddenly, dropping from his chair at the dinner table, in the year 1870 at the comparatively early age of fifty-eight. A death so abrupt, and essentially so premature, could not but raise doubts about the wisdom of his untempered industry and debates almost as varied as those round the secret of Edwin Drood. But without exaggerating any one of the elements that contributed to it, we may note that the very last phase of his life was a new phase, and was almost entirely filled with his new activity in giving public readings from his works. He had gone to America once more in the November of 1867, with this particular purpose, and his campaign of public speaking in this style was truly American in its scope and scale. If he had indeed been unjust to America as a writer, it is curious that he should have reached his final popularity and perhaps his final collapse, in a character so supremely American. Differences exist about how far he exaggerated the function or how far his biographer exaggerated the danger, but his own letters, ragged with insomnia and impatience, full of desperate fatigue and more desperate courage, are alone enough to show that he was playing a very dangerous game for a man approaching sixty. But it is certainly true, as is alleged on the other side, that this was nothing new in the general conduct of Dickens, that he had long ago begun burning the candle at both ends, and there have been few men, in the matter of natural endowments, with so great and glorious a candle to burn.

He was buried in the Poet's Corner of Westminster Abbey, and new and vulgar as many critics had called his work, he was far more of a poet than many who were buried there as poets. He left a will commending his soul to God, and to the mercy of Jesus Christ, and leaving his works to the judgment of posterity, and in both respects the action was symbolic and will remain significant in history. Intellectually limited as he was by the rather cheap and chery negations of an age of commercial rationalism, he had never been a bitter secularist or anti-clerical, he was at heart traditional and was drawn much more towards Anglican than Puritan Christianity, and his greatest work may yet prove to be the perpetuation of the joyful mystery of Christmas. On the other side, he has suffered and may suffer again the changes in the mere fashions of criticism, but his work was creative, it added something to life, and it is hard to believe that something so added will ever be entirely taken away. The defects of his work are glaring, they hardly need to be detected, they need the less to be emphasized because, unfortunately, he always emphasized them himself. It may be a fault, it is certainly a fact, that he enjoyed writing his worst work as much as his best.

The charge of exaggeration is itself exaggerated. It is also, which is much more important, merely repeated mechanically, without any consideration of its true meaning. Dickens did exaggerate, but his exaggeration was purely Dickensian. In this sense his very vulgarity had the quality of distinction. Mere overstatement, to say that a tall man is ten feet high, to say that a frosty morning froze Niagara, this is something relatively easy to do, though sometimes very cleverly done, especially by Americans. But the distinction of Dickens can be stated even in the common charge against him. He is said to have turned men into monsters of humour or horror, whereas the men were really commonplace and conventional persons in shops and offices. If any critic depreciates the Dickensian method as mere overstatement, the answer is obvious, let him take some of these commonplace people and overstate them. He will soon discover that he has not the vaguest notion of what to overstate. He will soon realize that it is not a simple matter of mere exaggeration, in the sense of

mere extension. It is not a matter of making a man a little taller or a morning a little colder, the challenge to imagination is not whether he can exaggerate, but whether he can find anything worth exaggerating. Now the genius of Dickens consisted in seeing in somebody, whom others might call merely prosaic, the germ of a sort of prose poem. There was in this or that man's attitude, or affection, or habit of thought, something which only needed a touch of exaggeration to be a charming fantasy or a dramatic contradiction. The books of Dickens are in fact full of bones, of bones who do not bore us, merely because they did not bore him. We have all of us heard a hundred times the tiresome trick of public speakers of asking themselves rhetorical questions which they do not want answered. Any of us might have heard a fit Dissenting minister doing it at a tea-party and thankfully for gotten all about him. But Dickens seized on the fallacy and turned it into a fantasy into Mr. Childbride's demands to know why he could not fly, or his wild and beautiful apologue about the elephant and the cat. We tell of the power of drawing people out, and that is the nearest parallel to the power of Dickens. He drew reeds and reeds of highly coloured caricature out of an ordinary person, as dazzlingly as a conjurer draws reeds and reeds of highly coloured puppets out of an ordinary hat. But if anybody thinks the conjuring trick is easy to perform, let him try it with the next ordinary person he sees. The exaggeration is always the logical extension of something that really exists, but genius appears, first in seeing that it exists, and second in seeing that it will bear to be thus exaggerated. That is something totally different from giving a man a long nose, it is the delicate surgical separation or extension of a living nerve. It is carrying a ludicrous train of thought further than the actual thinker carries it, but it requires a little thinking. It is making fools more gloriously foolish than they can be in this vale of tears, and it is not every fool who can do it.

There were other reasons for the injustice in the particular case of Dickens. Though his characters often were caricatures, they were not such wild caricatures as was supposed by those who had never met such characters. And the critics had never met his characters, because the critics did not live in the common life of the English people, and Dickens did. England was a much more amusing and horrible place than that it appeared to the sort of man who wrote reviews in *The Quarterly*, and, in spite of all scientific progress or social reform, it is still. The poverty and anarchy of Dickens's early life had stuffed his memory with strange things and people never to be discovered in Tennyson's country houses or even Thackeray's drawing-rooms. Poverty makes strange bed fellows, the same sort of bedfellows whom Mr. Pickwick fought for the recovery of his nightcap. In the vivid phrase, he did indeed live in Queer street and was acquainted with very queer folk. And it is something of an irony that his tragedy was the justification of his farce. He not only learnt in suffering what he taught in song, but what he rendered, so to speak, in a comic song.

It is also true, however, that he caught many of these queer fish because he liked fishing in such troubled waters. A good example of this combination of opportunity and eccentricity is to be found in his affection for travelling showmen and vagabond entertainments of all sorts, especially those that exhibited giants and dwarfs and such monstrosities. Some might see in this truth a sort of travesty of all his travesties. It would be easy to suggest a psychological theory, by which all his art tended to the antics of the abnormal, it would also be entirely false. It would be much truer to say that Dickens created so many wild and fantastic caricatures because he was himself commonplace. He never identifies himself with anything abnormal, in the more modern manner. In his travelling show, the Giant always falls far short of being a Superman. And though he was tempted only too easily to an obvious pathos, there was never anything particularly pathetic about his dwarfs. His fun is more robust, and even, in that sense, more callous. The truth is that Dickens's attitude to the abnormal has been misunderstood owing to the modern misunderstanding of the idea of the normal. He was in many ways a wild satirist, but still a satirist, and satire is founded on sanity. He had his teal

Cockney limitations. But his moderation was not a limitation but a liberty, for it allowed him to hit out in all directions. It was precisely because he had an ordinary and sensible view of life that he could measure the full madness both of Gradgrind's greed or Micawber's improvidence. It was because he was what we call commonplace that Dombey appeared to him so stiff or Jellyby so slovenly. In a later generation a real person often assumed such an unreal pose and lost the power of merely laughing at it, as, for example, when Oscar Wilde said seriously all that Skimpole had said absurdly. The Victorian commonsense was not a complete commonsense, and Dickens did suffer from having a narrower culture than Swift or Rabelais. But he did not suffer from being sensible, it was even more from his sense than his sensibility, it was from a sort of inspired irritation and impatience of good sense, that he was able to give us so radiant a fairytale of fools.

His literary work produced of course much more than a literary effect. He was the last great poet, in the true sense of maker, who made something for the people and was in the highest sense popular. He still gives his name, not to a literary clique, but to a league or fellowship numbering thousands all over the world. In this connection it is often noted that he achieved many things even considered as a practical political and social reformer. He led light into dark corners, like the dens of dirt and brutality often called schools, especially in Yorkshire, he probably had much to do with making the professional nurse a duller but more reliable person than Mrs. Gamp, it is likely enough that his vivid descriptions, assisted by the whole trend of the time, hastened the extinction of ordinary imprisonment for debt and clarified much of the original chaos of Chancery. But precisely because this has often been said, it will be well not to say it too often. It has the effect of making his satire appear much more superficial and utilitarian than it really was, for the great satirist is concerned with things not so easily destroyed. We do more honour to Dickens in noting the evils he did not destroy than those he did. The eager worship of a man merely wealthy, however dull and trivial, which appears in the affair of Merdle, has by no means disappeared from our own more recent affairs. The pompous old Barnacle and the agreeable young Barnacle are still almost as much alive as in Dickens's day. The sweeping away of a genuine gentry, in the person of Mr. Twemlow, on the tide of a new plutocracy, represented by Mr. Venetianer, has gone much further than in Dickens's day. But this makes Dickens's satire the more rather than the less valuable to posterity. The other mood, which pictures all such abuses as things of the past, tends not to reform but only too much to repose, and to the perpetuation of a rather snobbish and paltry version of the Dickensian tradition. In that spirit we may hear to this day a Stiltsalker telling the House of Commons that Stiltsalkers have pershed before the march of progress, or in the law courts a Buzfuz quoting Buzfuz and jeering at himself as an extinct monster.

The future of the work of Dickens is no part of the Dickens record and a ridiculous part of the Dickens criticism. Some have suggested that his glory will be in new editions succeeded those he created, others have said, it is equally reasonably, that the influence of his ideas will be in all the things he got old, and that his opinions and characters have outlived their descendants as well as their contemporaries. But there can be no question of the importance of Dickens as a man or a writer in history, a sort of conflagration and illumination in the very heart of what is called the conventional Victorian era, a naked flame of mere natural genius, breaking out in a man without culture, without tradition, without help from historic religious or philosophies or from the great foreign schools, and revealing a light that it never was so cold and land only in the long fantastic shadows that it threw from common things.

(G. H. C.)

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DICKINSON, EMILY (1830-1886), American poet, was born on Dec. 10, 1830, at Amherst, Mass., where her grandfather, Samuel Fowler Dickinson, had been one of the founders of the town, church and college. Her father, Edward Dickinson, was a lawyer and treasurer of the college, her mother, Emily Norcross Dickinson, a model New England housewife who "did not care for thought." In all her heredity, according to her biographer, traced back nine generations in America and 13 in England, there is nothing to explain her genius—not to confute it. As a child she went to public school, went berrying and chestnutting, learned the household arts and crafts. As a girl she made a herbarium, embroidered the usual book marks, and wrote sentimental letters in the verbose style of the time. In the fall of 1847 she entered South Hadley seminary, where she studied chemistry, physiology and English composition, and where she was "cramped, curbed and repressed in every natural desire or impulse." She left the seminary in 1848, re-entered Amherst academy for a while, and then, except for the lectures of the resident and visiting professors and her own reading, her education was finished. The winter of 1853 she spent in Washington, where her father was serving two terms in Congress, and on a visit to Philadelphia in the spring experienced an unhappy love affair—she firmly renouncing the man because she would not "wreck another woman's life." This possibly influenced the change from an apparently normal, witty young woman, to an increasingly mystical poet. By 1862 she had practically withdrawn from the world, venturing out of her father's house only at dusk to attend to her plants, but remaining always the "ecstatic darddevil, shy paradox," to her brother's family and to a very few intellectual friends. She died at Amherst on May 16, 1886. During her lifetime she had allowed only three or four of her poems to be published. In 1892 her friend, Col. Thomas Wentworth Higginson, published a small collection with a success almost unparalleled in American literature, but it was not until 1924 that her complete poems and her *Letters* were published, making her work generally accessible. Her poetry has been described as suggestive of William Blake in its "flashes of wholly original and profound insight into nature and life." She herself has been described as the epigrammatic Walt Whitman, and she remains a strange and entirely original genius, "defiant of outward form, sometimes obscure, at times inscrutable," but more often with a perfection in the mating of word and idea that has rarely been achieved.

See *The Complete Poems of Emily Dickinson*, edited by Martha Dickinson Bianchi (Boston, 1925), *Martha Dickinson Bianchi, Life and Letters of Emily Dickinson*, T. W. Higginson, Carlyle's Laugh (Boston, 1909).

DICKINSON, JOHN (1732-1808), American statesman and pamphleteer, was born in Talbot county, (Md.) Nov. 8, 1732. He removed with his father to Kent county (Del.), in 1740, studied under private tutors, read law, and, in 1753, entered the Middle Temple, London. Returning to America in 1757, he practised law in Philadelphia and started, in 1760, his long public career. Since Pennsylvania and Delaware were under the same proprietor and the same governor, he acted in the same capacity at various times for both colonies—member of the assembly, president of the executive council, and representative in the Continental Congress. He was sent from Pennsylvania to the Stamp Act Congress (1765), served for a time as private, and later as brigadier general, in the Delaware militia, and represented Delaware at the Annapolis Convention of 1786 and the Federal Constitutional Convention of 1787. He was most important, however, as the "Penman of the Revolution." Scarcely any other writer of the day presented arguments so numerous, so timely and so popular. He drafted the "Declaration of Rights" of the Stamp Act Congress, the "Petition to the King" and the "Address to the Inhabitants of Quebec" of the Congress of 1774, the second "Petition to the King" and "Articles of Confederation" of the Second Congress. Most influential of all, however,

were *Letters From a Farmer in Pennsylvania* written in 1767-68 in condemnation of the Townshend acts of 1767, in which he rejected speculative natural rights theories and appealed to the common sense of the people through simple legal arguments. By opposing the Declaration of Independence he lost his popularity and never entirely regained it. As the representative of a small state, he championed the principle of state equality in the Constitutional Convention, but he was one of the first to advocate the compromise, which was finally adopted providing for equal representation in one house and proportional representation in the other.

After the adjournment of the convention he defended its work in a series of forceful letters signed "Tribus". Largely through his influence Delaware and Pennsylvania were the first two states to ratify the constitution. Dickinson's interests were not exclusively political. He helped to found Dickinson college (named in his honour) at Carlisle Pa. in 1783 and was the first president of its board of trustees and was for many years its benefactor.

He died Feb. 14, 1808, and was buried in the Friends' burial ground in Wilmington, Del.

See C. J. Stille, "Life and Times of John Dickinson" *Memoirs of the Historical Society of Pennsylvania* vol. xiii (Philadelphia, 1901), P. L. Ford (ed.), "The Writings of John Dickinson," *Ibid.*, vol. xiv (1895), R. R. Richards, "The Life and Character of John Dickinson" *Delaware Historical Society Papers* no. 10.

DICKINSON, WILLOUGHBY HYETT DICKINSON, 1st BARON (1859-1945), British politician, was born April 9, 1859, the son of a British parliamentarian.

He attended Eton and Trinity college, Cambridge university, studied law and was called to the bar in 1884. He served on the London county council from 1889 to 1907 and served as its chairman in 1899.

He was chairman of the London Liberal federation, 1896-1918, and was made a privy councillor in 1914. He was created 1st Baron Dickinson of Painswick in 1930 and joined the Labour party in the same year.

Lord Dickinson, who was chairman of the League of Nations society, 1915-18, was one of the originators of the League of Nations. In 1923 he was substitute delegate to the Geneva assembly. He was also life president of the World Alliance for Promoting International Friendship Through the Churches.

He died at Painswick, Eng. on June 1, 1943.

DICKINSON, a city in the southwestern part of North Dakota, U.S., on the Heart river and federal highway 10, at an altitude of 2,430 ft., the county seat of Stark county. It is a division point on the Northern Pacific railway, which has repair shops there.

The population by the 1950 federal census was 7,469. Dickinson is the shipping point for a farming and grazing region, and has large livestock sales rings, lignite coal mines, a plant for the manufacture of briquets and a concrete block plant. One of the state teachers' colleges is located there, and the state agricultural college established a branch of the agricultural experiment station in Dickinson.

A bureau of reclamation dam, a portion of the Missouri basin project, spans the Heart river 1 mi. W. of the city. The city was settled about 1885 and incorporated in 1900.

DICKSEE, SIR FRANCIS BERNARD (1853-1928), English painter, born in London on Nov. 27, 1853, son of Thomas Dicksee, artist, was president of the Royal academy in 1924. He belongs to the older academic school, whose aim was to express poetic sentiments in a realistic pictorial form. His pictures are painted with extreme sensibility and his execution is always skilful and competent.

Two of his principal works were bought under the Chantrey bequest for the Tate gallery "Harmony" (1877) and "The Two Crowns" (1900).

He died Oct. 17, 1928.

DICKSON, SIR ALEXANDER (1777-1840), British artilleryman, attended the Royal Military academy. He entered the royal artillery in 1794.

Dickson served in Minorca (1798), at Malta (1800), in the Montevideo expedition (1806-07) and in 1809 accompanied Ho-

worth to the peninsula as brigade major of the artillery. In the end he became commander of the whole of the artillery of the allied army and though still only a substantive captain in the British service he had under his orders about 8,000 men. At Vittoria, the battle of the Pyrenees and Toulouse he directed the movements of the artillery. He served on the artillery staff at Quatre Bras and Waterloo, and subsequently commanded the British battering train at the sieges of the French fortresses left behind the advancing allies.

He died a major general and G.C.B. in 1840. He was an early fellow of the Royal Geographical society.

His diaries kept in the peninsula were the main source of information used in Duncan's *History of the Royal Artillery*.

DICKSON, SIR JAMES ROBERT (1832-1901), Austral. iron statesman, was born in Plymouth Eng. on Nov. 30, 1832. In 1854 he emigrated to Victoria but after several years spent in that colony and in New South Wales, he settled in 1862 in Queensland where he was connected with the Royal Bank of Queensland. He entered the Queensland house of assembly in 1871, and became minister of works (1876), treasurer (1876-79 and 1883-87), acting premier (1884), but resigned in 1887 on the question of taxing land.

In 1889 he retired from business and spent three years in Europe before resuming political life. He fought for the introduction of Polytechnic labour on the Queensland sugar plantations at the general election of 1892 and was elected to the house of assembly in that year and again at the elections of 1893 and 1896. He became secretary for railways in 1897, minister for home affairs in 1898, represented Queensland in the federal council of Australia in 1898 and at the postal conference at Hobart in 1898, and in 1898 became premier. His energies were now devoted to the formation of an Australian commonwealth. He secured the reference of the question to a plebiscite, the result of which justified his anticipations.

He resigned the premiership in Nov. 1899, but in the ministry of Robert Philp, formed in the next month, he was reappointed to the offices of chief secretary and vice president of the executive council which he had combined with the office of premier. He represented Queensland in 1900 at the conference held in London to consider the question of Australian unity, and on his return was appointed minister of defense in the first government of the Australian commonwealth.

He died at Sydney on Jan. 10, 1901, in the midst of the festivities attending the inauguration of the new state.

DICKSON CITY, a borough of Lackawanna county, Pa., U.S.A., in the anthracite region. It is on the Lackawanna river, 5 mi. N.E. of Scranton, and is served by the Delaware and Hudson, the Erie, and the New York, Ontario and Western railways. The population in 1950 was 9,948 and in 1940, 11,548.

DICOTYLEDONS, in botany, the larger of the two great classes of angiosperms (*qv*), embracing most of the common flower bearing plants. The name expresses the most universal character of the class, the importance of which was first noticed by John Ray, namely, the presence of a pair of seed leaves or cotyledons in the plantlet or embryo contained in the seed. The embryo is generally surrounded by a larger or smaller amount of foodstuff (known as the endosperm) which serves to nourish it in its development to form a seedling when the seed germinates, frequently, however, the whole of the nourishment for future use is stored in the cotyledons themselves, which in that case become thick and fleshy.

In germination of the seed the rudimentary root at the distal end of the hypocotyl develops the primary root, this is usually followed by growth of the hypocotyl which carries the cotyledons above ground, where they become the first green leaves of the plant. Lying between the bases of the cotyledons and terminating the axis of the plant is the first stem bud (epicotyl of the embryo).

Size and manner of growth of the adult plant show variety, from the small herb lasting for one season only to the forest tree living for centuries. The arrangement of the conducting tissue in the stem is characteristic, a transverse section of the very young stem shows a number of distinct conducting strands—vascular

bundles—arranged in a ring round the pith, these soon become united to form a closed ring of phloem and wood separated by a layer of cambium. In perennials the stem shows a regular increase in thickness each year by the addition of a new ring of wood outside the old one—for details of structure see PLANTS and PLANT SCIENCE. *Anatomy of Plants*

A similar growth occurs in the root. This increase in the diameter of stem and root is correlated with the increase in leaf area each season, caused by the continued production of new leaf-bearing branches. A characteristic of the class is afforded by the complicated network formed by the leaf veins—well seen in a skeleton leaf from which the soft parts have been removed by maceration. The parts of the flower are most frequently arranged in fives or multiples of fives, for instance, a corolla arrangement is as follows—five sepals, succeeded by five petals, ten stamens in two sets of five and five or fewer carpels. An arrangement in fours is less frequent, while the arrangement in threes so common in monocotyledons is rare in dicotyledons. In some families the parts are numerous, chiefly in the case of the stamens and the carpels as in the buttercup and other members of the Ranunculaceae and in the Rosaceae.

The characters of the flower and fruit are described in the articles FLOWER, FRUIT, and SEED.

DICTATING MACHINES see OFFICE MACHINES AND APPLIANCES

DICTATOR, in modern usage, a ruler enjoying extraconstitutional power, in ancient times, an extraordinary magistrate in the Roman commonwealth (from the Lat. *dictare*, frequentative of *dicere*). The earlier official title was *magister populi*, which may mean "head of the host" as opposed to his subordinate, the *magister equitum*, who was "head of the cavalry." Emphasis was thus laid on the military aspect of the dictatorship and in fact, the office seems to have been instituted for the purpose of meeting a military crisis too serious for the annual consuls with their divided command. The repression of civil discord was one of the motives for the institution of a dictatorship. This function of the office is attested by the internal history of Rome. In the crisis of the agitation at the time of the Licinian laws (367 B.C.) a dictator was appointed, and in 314 B.C. a dictator was created for purposes of criminal jurisdiction (*quaestioibus exercendis*). The dictator appointed to meet the dangers of war sedition or crime was described as the "administrative dictator" (*rei gerendae causa*). He held office for six months.

The powers of a dictator were a temporary revival of those of the kings, with some limitations. The dictator was never concerned with civil jurisdiction. His military authority was confined to Italy, and his power of life and death was limited. By the *lex Valeria* of 300 B.C. he was made subject to the right of criminal appeal (*provocatio*) within the limits of the city. But all the magistrates of the people were regarded as his subordinates. The dictator was nominated by one of the consuls. But the senate claimed authority over the magistrates, and suggested not only the nomination but also the name of the nominee. After nomination, the *lex curata* confirmed the dictator's imperium (see COMITIA).

The first dictator is said to have been created in 501 B.C., the last of the "administrative" dictators belongs to the year 216 B.C. The epoch of the Second Punic War was marked by experiments with the office, such as the election of Q. Fabius Maximus by the people, and the co-dictatorship of M. Minucius. The emergency office of the early and middle republic has little in common with the dictatorship as revised by Sulla and by Caesar. Ostensibly to prevent its further abuse, M. Antonius in 44 B.C. carried a law abolishing the dictatorship.

Modern dictators, like the ancient ones, have taken over the reins of government in times of emergency, but they have used the powers thus gained to establish a permanent, autocratic and sometimes despotic rule. In this they resemble the ancient tyrants rather than the ancient dictators. Both Benito Mussolini and Adolf Hitler falsely posed as the defenders of popular rights, used democratic institutions and exploited the techniques of mass communication to cement their power; they became heads of the governments in their respective countries formally in accordance with

the existing constitutions, and even enjoyed some popular support in spite of their suppression of freedom. The Communist dictatorship in Russia was proclaimed originally as the temporary dictatorship of a political élite to preserve the Revolution, it became permanent and, under Joseph Stalin, was a personal one.

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DICTIONARY, a book listing words of a language, with their meanings in the same or another language, usually in alphabetical order, often with data regarding pronunciation, origin and usage.

The term "dictionary" in one of its Latin forms (*dictionarius*, a collection of words) was used c. 1225 by an English scholar, John Garland, as title for a manuscript of Latin words to be learned by heart. The words were arranged not in alphabetical order, but in groups according to subject. This *Dictionarius*, used only for the teacher's classroom work in teaching Latin, contained no English except for a few interlined glosses (translations of single words).

15th and 16th Centuries—In the 15th century English words did appear in dictionaries, but even then they were used only as an aid to the study of Latin, as in the famous *Promptorium Parvulorum* ("Storehouse for the Little Ones"), a pioneer English-Latin wordbook. This important manuscript, completed in Norfolk c. 1440, was the work of a Dominican friar known as Galfridus Grammaticus (Geoffrey the Grammarian). He listed about 12,000 English words mostly nouns and verbs, with their Latin equivalents, and for some time his dictionary held a place of leadership. The *Promptorium* was written several years before the invention of printing, but in 1499 it was published, at the London press of Richard Pynson, an early servant and associate of William Caxton.

The custom of giving colourful titles to dictionaries was followed for many years. In the *Promptorium* we had a "storehouse," and later, in 1500, came a "garden of words," for that is the meaning of *Ortus Vocabulorum*, printed by another of Caxton's assistants, Wynkyn de Worde. *Ortus*, a Low-Latin form of *hortus* (garden), shows that even scholars sometimes omitted the aspirate. In the *Ortus*, Latin words come first, translated by English. The book, like earlier ones, was designed for students of Latin.

What has been called the first real English dictionary, printed in 1552, was the *Abecedarium Anglicano-Latinum pro Tyrnuculis*, compiled by Richard Huloet. Huloet, sometimes addressed as "Maister Howlet," was a native of Wisbeach in Cambridgeshire. *Pro tyrnuculis* means "for young beginners," but Huloet seems to have intended his book for beginners of all ages, including adults whose main interest was to learn to read English. Latin study, as usual, was probably the goal of this work, but the Latin translation was not given until the English word had been defined in English, hence the *Abecedarium* can be regarded as an English dictionary. Huloet's style was informal and sometimes humorous, as may be judged from some of his definitions:

Bachelor, or one unmarried, or having no wife, *Agamus, mi Black* (or blew) spots in the face or body, made with a stroke, as when a wife hath a blewie eye, she sayth she hath stumbled on her good man his cyste. *Sugillato omis; Lyvor, uoris*. Trymme wenche gorgeously decked, *Phalerata femina*.

Huloet doubtless felt that the resplendent young lady needed no further definition in English, and it should be noted that *wench*, in 1552, was a very proper word, it meant simply a girl or young woman.

The *Abecedarium*, which contained 26,000 words, was popular, but it was expensive. This fact was recognized by a Yorkshire schoolmaster and physician named Peter Levinus, who decided to write a smaller work, then, he said, "the price being little, the poorer sorte may be able to buy it." Comparing Huloet's big book with his own little one, Levinus wrote, "This is for greater students, and them that are richable to have it, this is for beginners and them that are poorable to have no better." From that day to this, rich

able and poorish have needed dictionaries, and generations of publishers have tried to serve them all. Following the custom of using a picturesque title, Levins named his book, published in 1570, *Manipulus Vocabulorum* "a handful of words" the handiul compusing about 9,000 entries. He also called it, "A dictionary of English and Latine wordes, set forth in suche order as none heretofore hath ben necessary not only for scholars that want variety of words, but also for such as use to write in English metre." To help the poets, he arranged his words not according to their initial letters, but by the spelling of their final syllables, which resulted in a sort of rhyming dictionary, the first of its kind in English. The final syllables, however, brought together some strange bedfellows such as casket, suet, bell, chudl, midime, surname, and—most confusing—bough cough, though tough, which even in 1570 were probably not more than "eve rhymus".

In 1573 John Baret published a dictionary which he called *In Alvearie*, or 'beehive'. In this work an English word is given in English definition, and the equivalent in Latin, followed usually by French. Baret, an ingenious and doubtless popular educator, tells us how the book was compiled: "About eighty-one years ago, having pupils at Camlridge studious of the Latin tongue" they "perceiving what great trouble it was to come running to mee for every word they missed. I appointed them every day to write English before we Latin and likewise to gather a number of fine phrases out of Cicero, Terence, Caesar, Livie etc. and to set them under severall titles, for the more ready finding them againe at their needs." Baret encouraged his pupil assistants by calling them his busy bees, and "within a yere or two they had gathered together a great volume," like "diligent Bees in gathering their wax and honny into their Hive." Here is a sample entry from the *Alvearie*:

A GOAST, an image in man's imagination, *Spectrum*, *tri*, *Cic*. Phantasma, visio. La semblence des choses que nostre pensee h't conceue

17th Century—The compilers of early dictionaries made no attempt to include all words. They were satisfied to explain or define the hard words of the language, and often so stated. This custom was illustrated in 1604 when Robert Cawdrey issued his dictionary, *A Table Alphabetical, containing and teaching the true writing and understanding of hard usuall English words with the interpretation thereof by plaine English words, gathered for the benefit & helpe of Ladies, Gentlewomen, or any other unskilfull persons*. Cawdrey was another schoolmaster, and his explanations of about 2,500 words may have been based in part on his classroom experience. Much of his work, however, was taken without acknowledgment from earlier writers. It was an era of borrowing, adapting and downright plagiarism, often on a scale that by modern standards would seem outrageous. But almost every writer added something of value, and as dictionaries increased in number they tended to increase also in usefulness. Cawdrey, perhaps recalling the informal or complicated groupings of words in some earlier dictionaries, stressed the importance of the word "alphabetical" in his title. Apparently some "unskilfull persons" in his day (as in ours) had not taken the trouble to learn their ABC's. So, he said, "Thou must learne the Alphabet, to wit, the order of the Letters as they stand."

At long last, in 1623, a work was issued entitled simply *The English Dictionary*. The author, or compiler, was "H. C. Gent.," who turned out to be Henry Cockeram. Much of his material was borrowed from Cawdrey and others, but for the use of the intelligentsia he added some weird Latinesque words, such as "*Com-motrix*, A maid that makes ready and unready her Mistis, *Glaucitate*, To cry like a whelp, *Torvisse*, Sownesness of countenance." An amusing definition of a more familiar word was "*Oval*, a long round circle like an Egge, wherein pictures are sometimes drawne in." Always dramatic, Cockeram calls his preface a "Premontion" or forewarning, perhaps having in mind the third section of his book, a fearsome "recitall" of "Gods and Goddesses, Giants and Devils, Birds and Beasts" and signs and wonders miscellaneous. Here we are told that the "*Huem*" is "a subtil Beast, counterfeiting the voice of a man. He is sometimes male and sometimes fe-

In 1656 a London lawyer named Thomas Blount published a dictionary entitled *Glossographia*, loosely translated as 'in expounding of strange words'. The author addresses himself to readers of all classes, including "the more knowing Women and less knowing Men". Blount did the best he could to provide etymologies, which was commendable, but some of his derivations were more amusing than accurate, as when he says: "Tomboy, a girl or weuch that leaps up and down like a boy, comes from the Saxon *tumbe*, to dince."

The *Glossographia* was followed in 1658 by *The New World of English Words*, collected and published by E. P. "E. P." was Edward Phillips, a writer of only moderate ability. His *New World* was a pretentious work largely copied from his predecessors, notably from Blount. The word "collected" on his title page was hardly frank enough; the truth would have been better expressed by "appropriated."

In 1656 Elihu Coles, teacher of shorthand Latin and English, issued *An English Dictionary* with brief and generally adequate definitions and a small but interesting selection of cant and slang expressions. Coles was ingenious, in his address "To the Reader" he wrote:

I am no friend to vain and tedious Repetitions, therefore you will often meet with words, explain'd in their Dependence and Relation to one another, and the Sense completed by taking them together. As for example,

Lupa a She wolf that nourished *Romulus* in the *Lupercal* a place near *Rome*, where they celebrated the *Lupercalia*, feasts in honour of *Pan*, performed by the *Luperci*, Priests of *Pan*.

Coles died in 1680, but his dictionary was often reprinted and survived him by many years.

18th Century—John Kersey, an open minded and progressive lexicographer, is credited with a good small workbook, *New English Dictionary*, issued in 1702 "by J. K. Philobibol." He also edited and revised Phillips' *New World of Words*, enlarging it in 1706 and somewhat abridging the enlarged version in 1708. Kersey was a pioneer in introducing and defining words of everyday use, which his predecessors had not troubled to do.

In 1721 was issued the *Universal Etymological English Dictionary*, a comprehensive work "compiled and Methodically digested" by "N. Bailey, Philologos." This was Nathaniel Bailey, an ingenious and enterprising London schoolteacher. His book contained more words "than any English Dictionary before extant." In 1730 Bailey followed with his great *Dictionaryum Britannicum*, a folio volume "containing not only the Words, and their Explications, but the Etymologies," and "Illustrated with near Five Hundred Cuts." This was enlarged in 1736. Bailey was more than a lexicographer, he was a philosopher, an entertainer and a humorist. When he came to an important word, he was seldom satisfied merely to define it, he used it as an excuse for a little lecture, for example "*Woman* the female of the human race. Women have two Qualities, a good and a bad. This is, they are either a blessing or a curse, according to the use we make of them", then about 30 more lines of amusing commentary. Bailey was one of the pioneers in indicating pronunciation, or at least marking the stressed syllables. Bailey's work was revised and reprinted for many years, and when Samuel Johnson was preparing his own dictionary, he kept by his side an interleaved copy of Bailey's *Dictionaryum*.

Johnson, a sort of lexicographical giant, undertook, with very little aid, a work which in modern times would be entrusted to a corps of editors, subeditors and departmental experts numbered in the hundreds. In France and in Italy learned academies had been established, to preserve the purity of the national languages. Academic concepts of purity involved a tendency to oppose change, in spite of the fact that change is essential to the life and growth of language. Johnson, with the approval of many of his contemporaries, was expected to be a one-man academy, to set forth the English tongue in all its glory and, if possible, to crystallize it in a classic form. He hoped to do it all within three years, it took him nearly eight—little enough for such a mighty task. That the task was mighty could be realized by anyone who saw the two folio

usage by Samuel Johnson A M And when it was all done, Johnson admitted in his preface that no scholar "can embalm his language and secure it from corruption," and that "no dictionary of a living tongue can ever be perfect, since while it is hastening to publication, some words are budding and some falling away"

Johnson was a skilled definer He had a way of perceiving the essential character and use of a word and of explaining it cleverly He pioneered in the illustration of definitions "by examples from the best writers," a work involving long and painstaking research A few of Johnson's definitions became famous for reasons that had nothing to do with scholarship, as when he wrote "Lexicographer, a writer of dictionaries, a harmless drudge," and "Excuse, a hateful title levied upon commodities, and adjudged not by the common judges of property, but writhes lured by those to whom excuse is paid" Johnson's services to the science and art of lexicography were substantial and of lasting value They set a high standard for later workers to keep in mind

In 1791 came the *Critical Pronouncing Dictionary and Expositor of the English Language*, by John Walker, a 59 year old actor with a trained and perceptive ear and a lively interest in all types of English pronunciation Walker's dictionary is of value even now because of the author's thorough treatment of pronunciation problems Its influence was felt throughout Britain and America More than 40 editions were published Walker, who died in 1807, was regarded as an authority as late as 1837, when Isaac Pitman, himself a famed phonetician, published a system of shorthand "founded on Walker's Principles of English Pronunciation"

In 1794, three years after Walker's first edition, another enterprising Londoner, James Hindmarsh, carried lexicography into a hitherto unexplored field with *A New Dictionary of Correspondences or the Spiritual significations of words in the Sacred Scriptures* This work, based on the researches of Emanuel Swedenborg, gave meanings not of words but of scriptural persons, places and things, as *Peter*, faith, *Egypt*, science, *Water*, truth

Signs of US Initiative—As the 18th century drew to its close more than 20% of the world's English speaking people were inhabitants of the United States Pledged to a policy of universal education they felt the need of an English dictionary designed specifically for use in their primary schools In 1798 this need was recognized by a Connecticut schoolmaster, Samuel Johnson, Jr, who issued in New Haven, Conn, a little book entitled *A School Dictionary* Although this work was admittedly a "collection from previous authors," it was well received, it was the first English dictionary compiled by an American In 1800 it was followed by another small book, *A selected, pronouncing and accented Dictionary*, of about 10,000 words, published at Suffield, Conn Samuel Johnson, Jr, shared its authorship with John Elliott, pastor of the church in East Guilford This Elliott-Johnson work showed signs of Americanization, it included a few words peculiar to America (tomahawk, wampum, Cincinnati), or considered to have American meanings (Capitol, federal, freshest) It quoted endorsements from 19 educators, clergymen and others, including Noah Webster, then famed as author of a spelling book The Connecticut pioneers indicated pronunciation, somewhat crudely, by diacritical marks and an occasional footnote

Now, also in 1800, came *The Columbian Dictionary*, by another New Englander, Caleb Alexander of Massachusetts In this work, containing about 32,000 entries, American usage was recognized by a few words (cent, dime, dollar, elector, Congress, Congressional, lengthy, minute-man, Presidential, Yanky), and honor, favor, color, Savor, troop, wo, were so spelled Some alternatives were listed calendar-kalendar, checker-checker, screen-skreen, sponge spunge Pronunciation was shown by respelling Whereas the Connecticut pioneers had given much of their space to "choice" or fairly hard terms, Caleb Alexander included also the simple words, providing a vocabulary that could reasonably be called complete

A few weeks before Alexander's work was published, Noah Webster of New Haven Conn, announced that he was planning a series of dictionaries The first was published in 1806 as *A Compendious Dictionary of the English Language* It contained about

40,000 words, with brief definitions Webster spent years in language study and research to prepare for his masterpiece, *An American Dictionary of the English Language*, published in 1828 in two quarto volumes and thereafter in many revised and improved editions The 1828 edition, which contained about 70,000 entries, earned general acceptance as an authority, even in England Some of Webster's definitions were faulty, but many of them were confirmed, years later, when language study had become a science

Still another New Englander, Joseph Emerson Worcester, issued three reputable dictionaries (1830, 1846, 1860), designed to record and not to reform American usage Worcester's works were in some quarters preferred to Webster's but Webster, although he died 22 years earlier than his rival, "had the last word," for he is remembered as America's foremost pioneer lexicographer

Compilers of British dictionaries in the 19th century availed themselves generously of American aid Sometimes they acknowledged their indebtedness, notably so in the case of the monumental *New English Dictionary on Historical Principles*, later known as the *Oxford English Dictionary* This great work, conceived 70 years before its completion in 1928, listed and defined all recorded English words from the 7th century to the 20th It showed each word in all its traceable forms, with dated quotations and with etymologies determined in the light of modern scholarship Every possible use of a word was considered, with the result that the little word set, for instance, was allotted more than 22 large pages of three columns each Pronunciation was indicated by scientific respelling

The project involved years of research by hundreds of volunteers on both sides of the Atlantic Editor in Chief James A H Murray stated that most of the co operation from "men of Academic standing" came from "Professors in American Universities" and their students In 1860 supervision of the American workers was in the hands of the Hon G P Marsh of Vermont, in 1870 it was taken over by Prof Francis A March of Massachusetts, famed for his 50 years at Lafayette college in Pennsylvania Both gentlemen were noted philologists, both in the pioneer tradition New Englanders and both were eager to help their British confreres in building a monument to their common tongue

Historically important is *The Century Dictionary* an *Encyclopedic Lexicon of the English Language*, first issued in 1889-91 in six volumes and edited by William Dwight Whitney of Yale This work, which started as an authorized expansion and Americanization of the English *Imperial Dictionary*, was rich in words, etymologies and literary examples

Much used in the 20th century are large one- or two-volume editions of Webster's and the *New Standard Dictionary* (the latter first published 1893-95), also graduated abridgments of such works for college, school and home use The *Britannica World Language Dictionary*, published first in 1954 with the *New Practical Standard Dictionary*, has a master list of English words with their equivalents in French, German, Italian, Spanish, Swedish and Yiddish In addition to the word list proper, this work includes letters of the alphabet, cardinal numbers, days of the week, months of the year and common first names, also data on grammar and pronunciation, there is a separate index for each language Presenting modern British usage is *Wyld's Universal Dictionary of the English Language* (1933 or later editions)

America's contributions to the vocabulary are found in *Dictionary of American English* (Chicago, Oxford, 1936-44, out of print, but available in some public libraries), also, notably, in *Dictionary of Americanisms* (Chicago, 1951), the latter includes about 50,000 words and expressions, a large percentage of which have earned acceptance as normal English

Lexicography as a science owes much to the researches of Jakob Grimm, one of the world's master philologists, discoverer of Grimm's law, and his hardly less famous brother, Wilhelm Grimm These eminent scholars, who did not think it beneath them to write the stories known as "Grimm's Fairy Tales," collaborated in launching a German dictionary on scientific principles, the great *Deutsches Wörterbuch*, started in 1852 and completed years later by their followers In many ways the *Wörterbuch* served as an aid to workers in other languages

Also of international repute and service in this field was Émile Littré, French dictionnaireur, philosopher and physician, whose *Dictionnaire de la langue française* (1863-72, supplements later) is one of the monuments of lexicography. Littré's work, a one-man task for more than 30 years, is a fascinating blend of science and genius. It served as a treasury, on which many later compilers have drawn freely.

Pierre Larousse (1817-75), a distinguished French educator, published the *Grand dictionnaire universel* in 15 volumes, virtually an encyclopaedia, completed in 1876 just after his death. His successors have issued a series of dictionaries to meet varied popular needs, such as the *Nouveau Larousse illustré*, the *Larousse universel* and the *Petit Larousse*, all of them revised from time to time.

BIBLIOGRAPHY—Some of the best essays on the making of dictionaries are found in prefaces of the important modern works of the 19th and 20th centuries mentioned above. Significant works of value are *A Survey of English Dictionaries* by Milford M. Matthews (1923) and *The English Dictionary From Caedmon to Johnson* by De Witt Staines and G. E. Noyes (Chapel Hill, N.C., 1946, Oxford, 1947). Because of their special interest and importance, two foreign language works one of them quite old, may be mentioned. They are *Comment j'ai fait mon dictionnaire* by Émile Littré (new ed., Paris, 1897) and *Introducción a la Lexicografía Moderna* by Julio Casares (Madrid, 1950).

See also CONCORDANCE, ENCYCLOPEDIA, AMERICANISM, SI AND (A. M. Q.)

DICTION DE OMNI ET NULLO This is the name of the alleged Aristotelian principle of deductive inference. There are various formulations of it. That given by Cracanthorpe is perhaps as near to Aristotle's meaning as any: *Quodcumque affirmatur (sive negatur) universali de aliquo, idem affirmatur (sive negatur) etiam de omni de quo illud praedicatur*. The more usual and concise form is, *Quod de aliquo omni praedicatur, praedicatur etiam de quolibet eius parte*—"What is predicated of any whole is predicated of any part of it." If "whole" be taken to mean "a kind" (or "class" in the sense of a "kind" or "type," see CLASS), then the *dictum* may be said to express the principle, that is, the form or spirit, of *deductive* inference. It is invariably treated as formulating the principle of *sylogistic* inference, but (this is not quite correct, as it does not apply to syllogisms composed of singular terms, and, on the other hand, it applies to the immediate inference of a particular or singular proposition from a general proposition as much as to deductive syllogisms).

See H. W. B. Spence, *Introduction to Logic* (1916), A. Wolf, *Essentials of Logic* (1926).

DICTYONEMA A genus of important fossils composed of numerous branches radiating from a centre, found from Cambrian to Devonian times in Europe and North America and belonging to the group known as Graptolites (*q.v.*)

Dictyonema is also the name of a genus of lichens (*q.v.*)

DICTYS CRETENSIS, of Chossus in Crete, the supposed companion of Idomeneus during the Trojan War, and author of a diary of its events.

The ms of this work, written in Phoenician characters, was translated into Greek by the order of Nero. In the 4th century A.D. a certain Lucius Septimius brought out *Dictys Cretensis Ephemeris belli Troiani*, which professed to be a Latin translation of the Greek version. Possibly the Latin Ephemeris was the work of Septimius himself. Its chief interest lies in the fact that (with Dares Phrygius's *De excidio Troiae*) it was the source from which the Homeric legends were introduced into the romantic literature of the middle ages.

BIBLIOGRAPHY—Best edition by F. Meister (1873), with short but useful introduction and index of Latinity, see also G. Korting, *Dictys und Dares* (1874), with concise bibliography, E. Collin, *Étude sur Dictys de Crète et Dares de Phrygie* (1887), with bibliography, F. Colagrosso, "Ditté Cretese" in *Atti della Accademia di Archeologia* (Naples, 1897, vol. 18, pt. 2), N. E. Griffin, *Dares and Dictys Introduction to the Study of the Medieval Versions of the Story of Troy* (1907).

DICUL (# 825), Irish monk, grammarian and geographer. His *De mensura orbis terrae*, finished in 825, contains the earliest notice of a European discovery of and settlement in Iceland and the most definite Western reference to the old fresh-water canal between the Nile and the Red sea, blocked up in 767. In 795

Irish hermits had visited Iceland, where they marvelled at the perpetual day of midsummer. Relics of their settlements were found by the permanent Scandinavian colonists of Iceland in the 9th century. Of the old Egyptian fresh water canal Dicul learnt from one "brother Fideles," probably another Irish monk, who, on his way to Jerusalem, sailed along the "Nile" into the Red sea—passing on his way the "Barns of Joseph" or Pyramids of Giza, which are well described. Dicul's reading was wide, he quotes from, or refers to, 30 Greek and Latin writers, the patristic St. Isidore and Orosius, and his contemporary the Irish poet Sedulius, he professes to utilize the alleged surveys of the Roman world executed by order of Julius Caesar, Augustus and Theodosius (whether Theodosius the Great or Theodosius II is uncertain).

A short astronomical treatise written between A.D. 814 and 816 and dedicated to Louis le Debonnaire, the Frankish king in whose kingdom Dicul was living, has been edited by Mario Eposito in the *Proceedings of the Royal Irish Academy*, vol. xxvi, s. C (1907). Editions of the *De Mensura* were made by C. A. Wilkenier (Paris, 1907), A. Letronne (Paris, 1814) and G. Parthey (Berlin, 1870, best as to text). See also C. R. Beazley, *Dawn of Modern Geography*, vol. 1 (1897).

DIDA, a bush population of the French Ivory Coast between the Boudouma river and the Rio Fricco. Their language is related to Bile.

See Duhalosse, *Vocabulaires comparatifs* (1904).

DIDACHE, THE, or *Teaching of the (twelve) Apostles*. This early Christian document is one of the most important discoveries of the second half of the 19th century. There are several references to it in Eusebius and elsewhere, and by applying to these the methods of comparative criticism a rough reconstruction of its contents had been obtained. But in 1875 Bryennios discovered it in the Patriarchal Library at Constantinople, in the ms which also contains I and II Clement.

The *Didaché*, as we now have it in the Greek, falls into two marked divisions: (a) a book of moral precepts, opening with the words, "There are two ways," (b) a manual of church ordinances, linked on to the foregoing by the words, "Having first said all these things, baptize," etc. Each of these must be considered separately before we approach the question of the locality and date of the whole book, in its present form.

The author of the complete work, as we now have it, has modified an earlier document entitled *The Two Ways*, which may have been a Jewish manual carried over into the use of the Christian Church. Near the beginning he has inserted a considerable section containing, among other matters, passages from the Sermon on the Mount, in which the language of St. Matthew's Gospel is blended with that of St. Luke's. He has also added at the close a few sentences, beginning, "If thou canst not bear (the whole yoke of the Lord), bear what thou canst" (vi. 2), a d among minor changes he has introduced, in dealing with confession, reference to "the church" (iv. 14).

The second part of the *Teaching* might be called a church directory. It consists of precepts relating to church life, which are couched in the second person plural, whereas *The Two Ways* uses throughout the second person singular. It appears to be a composite work: (1) First (vv. 1-11) is a short sacramental manual intended for the use of local elders or presbyters, though such are not named, for they were not yet a distinctive order or clergy. This section was probably added to *The Two Ways* before the addition of the remainder. It orders baptism in the three fold name, and adds directions as to the manner of baptism and preparation for it. Then follows the Lord's Prayer, almost exactly as in St. Matthew, with a brief doxology—"For Time is the power and the glory for ever." This is to be said three times a day. Next come three eucharistic prayers, the language of which is clearly marked off from that of the rest of the book, and shows parallels with the dictum of St. John's Gospel. As in Ignatius and other early writers, the eucharist, a real meal (x. 1) of a family character, is regarded as producing immortality (cf. "spiritual food and drink and eternal life"). None are to partake of it save those who have been "baptized in the name of the Lord" (an expression which is of interest in a document which prescribes the threefold

formula) The "prophets" are not to be confined to these forms, but may "give thanks as much as they will." This appears to show that a "prophet," if present, would naturally preside over the eucharist. (2) The next section (vi 3-xii) deals with the ministry of spiritual gifts as exercised by "apostles," "prophets" and "teachers." An apostle is to be "received as the Lord," but he must follow the Gospel precepts, stay but one or two days, and take no money, but only bread enough for a day's journey. Here we have that wider use of the term "apostle" to which Lightfoot had already drawn attention. A prophet, on the contrary, may settle if he chooses and in that case he is to receive tithes and first-fruits, "for they are your high priests." If he be once approved as a true prophet, his words and acts are not to be criticized, for this is the sin that shall not be forgiven. (3) Next comes a section (xiii, xv) reflecting a somewhat later development concerning fixed services and ministry, the desire for a stated service, and the need of regular provision for it, is leading to a new order of things. The eucharist is to be celebrated every Lord's Day, and preceded by confession of sins "appoint there fore unto yourselves bishops and deacons, worthy of the Lord, men meek and uncovetous, and true and approved, for they also minister unto you the ministration of the prophets and teachers." This is an arrangement recommended by one who has tried it, and he reassures the old fashioned believer who clings to the less formal régime (and whose protest was voiced in the Montanist movement), that there will be no spiritual loss under the new system. The book closes (chap. xvi) with exhortations to steadfastness in the last days, at the coming of the "world deceiver" or Antichrist, which will precede the coming of the Lord. This section is perhaps the actual utterance of a Christian prophet, and may be of earlier origin than the two preceding sections.

It will now be clear that indications of the locality and date of the present *Teaching* must be sought for only in the second part, and in the Christian interpolations in the first part. We have no ground for thinking that the second part ever existed independently as a separate book. The whole work was in the hands of the writer of the seventh book of the *Apostolic Constitutions* (qv), who embodies almost every sentence of it, interspersing it with passages of Scripture, and modifying the precepts of the second part to suit a later (4th century) stage of church development, this writer was also the interpolator of the Epistles of Ignatius, and belonged to the Syrian Church. The *Apostolic Church Order* has several passages closely parallel to *The Two Ways*, but the only parallel to the second part of the *Teaching* is in a quotation from one of the eucharistic prayers. The anti-Jewish tone of the second part suggests the neighbourhood of Jews, from whom the Christians were, to be sharply distinguished. Either Egypt or Syria would satisfy this condition, and in favour of Syria is the fact that the presbyterate there was to a late date regarded as a rank rather than an office. But all that we can safely say as to locality is that the community here represented seems to have been out of touch with the larger centres of Christian life.

This last consideration helps us in discussing the question of date. For such an isolated community may have preserved primitive customs for some time after they had generally disappeared. Certainly the stage of development is an early one, as is shown, e.g., by the prominence of prophets, and the need that was felt for the vindication of the position of the bishops and deacons (there is no mention at all of presbyters), moreover, there is no reference to a canon of Scripture (though the written Gospel is expressly mentioned) or to a creed. On the other hand the "apostles" of the second part are obviously not "the twelve apostles" of the title, and the prophets seem in some instances to have proved unworthy of their high position. The ministry of enthusiasm which they represent is about to give way to the ministry of office, a transition which is reflected in the New Testament in the 3rd Epistle of John. Three of the Gospels have clearly been for some time in circulation, St. Matthew's is used several times, and there are phrases which occur only in St. Luke's, while St. John's Gospel lies behind the eucharistic prayers which the writer has embodied in his work. There are no indications of any form of doctrinal heresy as needing rebuke, the warnings against false teaching are quite general. While the first part must be dated before the Epistle

of Barnabas, i.e., before A.D. 90, it seems wisest not to place the complete work much earlier than A.D. 120, and there are passages which may well be later.

BIBLIOGRAPHY.—A large literature has sprung up round *The Didache* since 1884. Harnack's edition in *Texte und Untersuchungen* vol. vi (1884) is indispensable to the student, and his discussions in *Geschichte der altchristlichen Literatur* give clear summaries of his work. Other editions of the text are those of F. X. Funk, *Patres Apostolici*, vol. i (Tübingen, 1901), H. Lietzmann (Bonn, 1923), with Latin version. Dr. C. Taylor in 1886 drew attention to some important parallels in Jewish literature, his edition contains an English translation. Dr. Rendel Harris published in 1887 a complete facsimile, and gathered a great store of patristic illustration. Text and translation will also be found in Lightfoot's *Apostolic Fathers* (shorter edition). The fullest critical treatment in English is by Dr. Vernon Bartlett in the extra volume of Hastings's *Dictionary of the Bible*, the most complete commentary on the text is by P. Drews in Hennecke's *Handbuch zu den N.T. Apocryphen* (1924). The most convenient edition with text and translation is that of Kirsopp Lake, *The Apostolic Fathers* vol. i (The Loeb Classical Library).

DIDACTIC POETRY, that form of verse the aim of which is less to excite the hearer by passion or move him by pathos than to instruct his mind and improve his morals. The Greek word *didaktikós* signifies apt for teaching, and poetry of the class under discussion approaches us with the arts and graces of a schoolmaster. Modern criticism is inclined to exclude the term 'didactic poetry' from our nomenclature, as a phrase absurd in itself and indeed obsolete. But in earlier times, in the absence of all written books, this was the easiest way in which information could be made attractive to the ear and be retained by the memory.

In the prehistoric dawn of Greek civilization there was a great body of verse occupied entirely with increasing the knowledge of citizens in useful branches of art and observation, these were the beginnings of didactic poetry, and we class them together under the dim name of Hesiod. *The Works and Days*, which passes as the direct masterpiece of Hesiod (qv), may be taken as the type of all the poetry which has had education as its aim. In somewhat later times, as the Greek nation became better supplied with intellectual appliances, the stream of didactic poetry flowed more and more closely in one, and that a theological channel. The great poem of Parmenides, *On Nature* and those of Empedocles exist only in fragments, but enough remains to show that these poets turned on the didactic method in mythology. Cleostratus of Tenedos wrote an astronomical poem in the 6th century, and Pindar in a medical one in the 4th, but didactic poetry did not flourish again in Greece until the 3rd century, when Aratus, in the Alexandrian age, wrote his famous *Phenomena*, a poem about things seen in the heavens.

By far the greatest didactic Latin poet known to us is Lucretius, who composed, in the 1st century before Christ, his magnificent *De rerum natura*. By universal consent, this is the noblest didactic poem in the literature of the world. It was intended to instruct mankind in the interpretation and in the working of the system of philosophy revealed by Epicurus. What gave the poem of Lucretius its extraordinary interest, and what has prolonged and even increased its vitality, was the imaginative and illustrative insight of the author, piercing and lighting up the recesses of human experience. On a lower intellectual level, but of a still greater technical excellence, was the *Georgics* of Virgil, a poem on the processes of agriculture published about 30 B.C. The brilliant execution of this famous work has justly made it the type and unapproachable standard of all poetry which desires to impart useful information in the guise of exquisite literature. In the rest of surviving Latin didactic poetry the influence and the imitation of Virgil and Lucretius are manifest. Manilius produced a fine *Astronomica* towards the close of the reign of Augustus. Columella, regretting that Virgil had omitted to sing of gardens, composed a smooth poem on horticulture. Natural philosophy inspired Lucilius Junor, of whom a didactic poem on Etna survives. Long afterwards, under Diocletian, a poet of Carthage, Nemesianus, wrote in the manner of Virgil the *Cynegética*, a poem on hunting with dogs, which has had numerous imitations in later European literatures.

In Anglo Saxon and early English poetic literature, and espe-

cially in the religious part of it, an element of didacticism is not to be overlooked. The first English poem, however, which we can in any reasonable way compare with the classic works of which we have been speaking is the *Hundred Good Points of Husbandry* published in 1557 by Thomas Tusser, these humble Georgics aimed at a practical description of the whole art of English farming. In the early part of the 17th century one or two writers appeared who were as didactic as the age would permit them to be, Samuel Daniel with his philosophy, Iulke Greville (Lord Brooke) with his "treatises" of war and monarchy. After the Restoration, as the lyrical element rapidly died out of English poetry, there was more and more room left for educational rhetoric in verse. The poems about prosody, founded upon Horace and signed by John Sheffield, 3rd earl of Mulgrave (1648-1721), and Lord Roscommon, were among the earliest purely didactic verse studies in English. John Philips deserves a certain pre-eminence, as his poem called *Cyder*, in 1706, set the fashion, which lasted all down the 18th century, of writing precisely in verse about definite branches of industry or employment. None of the greater poets of the age of Anne quite succumbed to the practice, but there is a very distinct flavour of the purely didactic about a great deal of the verse of Pope and Gray. In such productions as Gilbert West's (1703-56) *Education*, Dryden's *Fleece*, and Somerville's *Chase*, technical information is put forward as the central aim of the poet. In 1748 Gray began, though he failed to finish, a didactic poem on *The Alliance of Education and Government*. Didactic poems were discredited by the publication of *The Sugar Cane* (1704), a long verse-treatise about the cultivation of sugar by negroes in the West Indies, by James Grainger (1721-60). Whether so great a writer as Cowper is to be counted among the didactic poets is a question on which readers of *The Task* may be divided, this poem belongs rather to the class of descriptive poetry, but a strong didactic tendency is visible in parts of it. Perhaps the latest frankly educational poem which enjoyed a great popularity was *The Course of Time* by Robert Pollok (1798-1827), in which a system of Calvinistic divinity is laid down in the pomp of blank verse. This kind of literature had already been exposed, and discouraged, by the teaching of Wordsworth, who had insisted on the imperative necessity of charging all poetry with imagination and passion. Oddly enough, *The Excursion* of Wordsworth himself is perhaps the most didactic poem of the 19th century, but it must be acknowledged that his influence, in this direction, was saner than his practice.

The history of didactic poetry in France repeats, in great measure, but in a drearier language, that of England. Boileau, like Pope, but with a more definite purpose as a teacher, offered instruction in his *Art poétique* and in his *Epistles*. But his doctrine was always literary, not purely educational. At the beginning of the 18th century the younger Racine (1692-1763) wrote sermons in verse, and at the close of it the Abbé Delille (1738-1813) tried to imitate Virgil in poems about horticulture.

During the century which preceded the Romantic revival of poetry in Germany didactic verse was cultivated in that country on the lines of imitation of the French, but with a greater dryness and on a lower level of utility. Modern German literature began with Martin Opitz (1597-1639) and the Silesian School, who were in their essence rhetorical and educational, and who gave their tone to German verse. Albrecht von Haller (1708-77) brought a very considerable intellectual force to bear on his huge poems, *The Origin of Evil*, which was theological, and *The Alps* (1729), botanical and topographical. Johann Peter Uz (1720-96) wrote a *Theodæce*, which was very popular, and not without dignity. Johann Jacob Dusch (1725-87) undertook to put *The Sciences* into the eight books of a great didactic poem. Tieck (1752-1840) was the last of the school, in a once famous *Urania* he sang of God and Immortality and Liberty. These German pieces were the most unservingly didactic that any modern European literature has produced. There was hardly the pretence of introducing into them descriptions of natural beauty, as the English poets did, or of grace and wit like the French.

DIDEROT, DENIS (1713-1784), French man of letters and encyclopaedist, was born at Langres on Oct. 5, 1713. He was

educated by the Jesuits, and then threw himself into the vagabond life of a bookseller's hack in Paris. An imprudent marriage (1741) did not better his position. His wife, Anne Tonnetie Champion, was a devout Catholic, but her piety did not restrain a narrow and fretful temper, and Diderot's domestic life was irregular and unhappy. He sought consolation, first with a Madame Pussieux, and then with Sophie Voland, to whom he was constant for the rest of her life. His letters to her are among the most graphic of all the pictures that we have of the daily life of the *philosophes* who dined once a week at the baron D'Holbach's, to listen to the wild sallies and the inspiring declamations of Diderot.

Diderot earned a little by doing various translations, among these being one of Shaftesbury's *Inquiry Concerning Virtue and Merit* (1745), with some original notes of his own. He then composed a volume of stories, the *Bijoux indiscrets* (1748), of which he afterwards repented. From tales Diderot went back to the more congenial region of philosophy. During the morning of Good Friday and the evening of Easter Monday he wrote the *Pensées philosophiques* (1746), and he presently added a short complementary essay on the sufficiency of natural religion. In these he pressed the ordinary rationalistic objections to a super-natural revelation. In 1747 he wrote the *Prolegomena ad scepticam*. Diderot's next piece was his famous *Lettre sur les aveugles* (1749). The immediate object of this short but pithy writing was to show the dependence of man's ideas on their five senses. It considers the case of the mullock deprived of the aid of one of the senses, and in a second piece, published afterwards, Diderot considered the case of a similar deprivation in the deaf and dumb. The *Lettre sur les sourds et muets*, however, is substantially a digressive examination of some points in aesthetics. The philosophic significance of the two essays is in the advance they make towards the principle of relativity. But what interested the militant philosophers of that day was an episodic application of the principle of relativity to the master conception of God. What makes the *Lettre sur les aveugles* interesting is its presentation, in a distinct though undigested form, of the modern theory of variability, and of survival by superior adaptation. It is worth noticing, too, as an illustration of the comprehensive freedom with which Diderot felt his way round any subject he approached, that in this theoretic essay he suggests the possibility of teaching the blind to read through the sense of touch. The speculation of the *Lettre sur les aveugles* was too hardy for the authorities, and he was thrown into the prison of Vincennes, where he spent three months, on his release he entered on the gigantic undertaking of his life.

A MONUMENTAL WORK

The Encyclopaedia.—The bookseller Lebreton had suggested to him the publication of a translation into French of Ephraim Chambers's *Cyclopaedia*, undertaken in the first instance by an Englishman, John Mills, and a German, Gottfried Sellius (for particulars see ENCYCLOPAEDIA). Diderot accepted the proposal, but in his busy and pregnant intelligence the scheme became transformed. He persuaded the bookseller to enter upon a new work, which should collect under one roof all the active writers, all the new ideas, all the new knowledge, that were then moving the cultivated class to its depths, but still were comparatively ineffectual by reason of their dispersion. His enthusiasm infected the publishers, D'Alembert was persuaded to become Diderot's colleague, the requisite permission was procured from the Government, and in 1751 the first volume was given to the world. The last of the letterpress was issued in 1765, but it was 1772 before the subscribers received the final volumes of the plates. These 20 years were to Diderot years not merely of incessant drudgery, but of harassing persecution, of sufferings from the cabals of enemies, and of injury from the desertion of friends. The ecclesiastical party detested the *Encyclopaedia*, in which they saw a rising stronghold for their philosophic enemies. By 1757 they could endure the sight no longer. To any one who turns over the pages of these redoubtable volumes now, it seems surprising that their doctrines should have stirred such portentous alarm. There is no atheism, no overt attack on any of the cardinal mysteries of the faith, no direct denunciation even of the notorious abuses of the

church. Yet the atmosphere of the book may well have been displeasing to authorities who had not yet learnt to encounter the modern spirit on equal terms. The *Encyclopædia* takes for granted the justice of religious tolerance and speculative freedom. It asserts in distinct tones the democratic doctrine that it is the common people in a nation whose lot ought to be the main concern of the nation's Government. From beginning to end it is one unbroken process of exaltation of scientific knowledge on the one hand, and pacific industry on the other. All these things were odious to the old governing classes of France, their spirit was absolutist, ecclesiastical and military. Perhaps the most alarming thought of all was the current belief that the *Encyclopædia* was the work of an organized band of conspirators against society, and that a pestilent doctrine was now made truly formidable by the confederation of its preachers into an open league. When the seventh volume appeared, it contained an article on "Geneva," written by D'Alembert. The writer contrived a panegyric on the pastors of Geneva, of which every word was a stinging reproach to the abbés and prelates of Versailles. At the same moment Helvétius's book, *L'Esprit*, appeared, and gave a still more profound shock to the ecclesiastical party. In 1759 the *Encyclopædia* was formally suppressed.

The decree, however, did not arrest the continuance of the work. It went on, but with its difficulties increased by the necessity of being clandestine. D'Alembert, weaned of shifts and indignities, withdrew from the enterprise. Other powerful colleagues, Turgot among them, declined to contribute further. Diderot was left to bring the task to an end as he best could. For seven years he laboured like a slave at the oar. He wrote several hundred articles, some of them very slight, but many of them most laborious, comprehensive and ample. He spent his days in the workshops, mastering the processes of manufactures, and his nights in reproducing on paper what he had learnt during the day. And he was necessarily harassed all the time by alarms of a descent from the police. At the last moment, when his immense work was just drawing to an end, he discovered that the bookseller had struck out from the proof sheets, after they had left Diderot's hands, all passages that he chose to think too hardy. The monument to which Diderot had given the labour of 20 long and oppressive years was irreparably mutilated and defaced. It is calculated that the average annual salary received by Diderot for his share in the *Encyclopædia* was about £120 sterling. "And then to think," said Voltaire, "that an army contractor makes £800 a day!"

Other Works.—Although the *Encyclopædia* was Diderot's monumental work, he is the author of a shower of dispersed pieces that sowed nearly every field of intellectual interest with new and fruitful ideas. He wrote plays—*Le Fils naturel* (1757), and *Le Père de famille* (1758), which he accompanied by essays on dramatic poetry, including especially the *Paradoxe sur le comédien*, in which he announced the principles of a new drama—the serious, domestic, bourgeois drama of real life, in opposition to the stilted conventions of the classic French stage. Diderot's lessons and example gave a decisive bias to the dramatic taste of Lessing, whose plays and *Hamburgische Dramaturgie* (1768) mark an epoch in dramatic history. Diderot's most intimate friend was Grimm, who wrote news letters to various high personages in Germany, reporting what was going on in the world of art and literature in Paris. Diderot helped his friend at one time and another between 1759 and 1779, by writing for him an account of the annual exhibitions of paintings. These *Salons* are among the most readable of all pieces of art criticism. They have a freshness, a reality, a life, which take their readers into a different world from the dry and conceited pedantries of the ordinary virtuoso.

DIDEROT'S VERSATILITY

Diderot's interest in human nature expressed itself in didactic and sympathetic form, in two, however, of the most remarkable of all his pieces, it is not sympathetic, but ironical. *Jacques le fataliste* (written in 1773, but not published until 1796) is in manner an imitation of *Tristram Shandy* and *The Sentimental Journey*. *Le Neveu de Rameau* is a far superior performance. Its intention has been matter of dispute, whether it was designed to be merely a satire on contemporary manners, or a reduction of the

theory of self interest to an absurdity, or the application of an ironical clincher to the ethics of ordinary convention, or a mere setting for a discussion about music, or a vigorous dramatic sketch of a parasite and a human original. There is no dispute as to its curious literary flavour, its mixed qualities of pungency, bitterness, pity and, in places, unflinching shamelessness. Goethe's translation (1805) was the first introduction of *Le Neveu de Rameau* to the European public. After executing it, he gave back the original French manuscript to Schiller, from whom he had it. No authentic French copy of it appeared until 1823.

It would take several pages merely to contain the list of Diderot's miscellaneous pieces, from an infinitely graceful title like the *Regrets sur ma vieille robe de chambre* up to *Le Reve de D'Alembert*, where he plunges into the depths of the controversy as to the ultimate constitution of matter and the meaning of life. It is a mistake to set down Diderot for a coherent and systematic materialist. We ought to look upon him "as a philosopher in whom all the contradictions of the time struggle with one another" (Rosenkranz). That is to say, he is critical and not dogmatic. There is no unity in Diderot, as there was in Voltaire or in Rousseau. Yet he drew at last to the conclusions of materialism, and contributed many of its most declamatory pages to the *Système de la nature* of his friend D'Holbach—the very Bible of atheism, as some one styled it. All that he saw, if we reduce his opinions to formulae, was motion in space, "attraction and repulsion, the only truth." If matter produces life by spontaneous generation, and if man has no alternative but to obey the compulsion of nature, what remains for God to do? In proportion as these conclusions deepened in him, the more did Diderot turn for the hope of the race to virtue, in other words, to such a regulation of conduct and motive as shall make us tender, pitiful, simple, contented. Hence his one great literary passion, his enthusiasm for Richardson, the English novelist. Hence, also, his deepening aversion for the political system of France, which makes the realization of a natural and contented domestic life so hard. Diderot had almost as much to say against society as even Rousseau himself. The difference between them was that Rousseau was a fervent theist. The atheism of the Holbachians, as he called Diderot's group, was intolerable to him, and this feeling, aided by certain private perversities of humour, led to a breach of what had once been an intimate friendship between Rousseau and Diderot (1757). Diderot was still alive when Rousseau's *Confessions* appeared, and he was so exasperated by Rousseau's stories about Grimm, then and always Diderot's intimate, that in 1782 he transformed a life of Seneca, that he had written four years earlier, into an *Essai sur les règnes de Claude et de Néron* (1778–82), which is much less an account of Seneca than a vindication of Diderot and Grimm, and is one of the most rambling and inept productions in literature. As for the merits of the old quarrel between Rousseau and Diderot, we may agree with the latter, that too many sensible people would be in the wrong if Jean Jacques was in the right.

Diderot's mental activity was not of a kind to bring him riches. He could not even obtain that bare official recognition of merit which was implied by being chosen a member of the Academy. The time came for him to provide a dowry for his daughter, and he saw no other alternative than to sell his library. When the empress Catherine of Russia heard of his straits, she commissioned an agent in Paris to buy the library at a price equal to about £1,000 of English money, and then handsomely requested the philosopher to retain the books in Paris until she required them, and to constitute himself her librarian, with a yearly salary. In 1773 Diderot passed some months at St Petersburg. The empress received him cordially. The strange pair passed their afternoons in disputes on a thousand points of high philosophy, and they debated with a vivacity and freedom not usual in courts. "Fy, donc," said Catherine one day, when Diderot hinted that he argued with her at a disadvantage, "is there any difference among men?" Diderot returned home in 1774. Ten years remained to him, and he spent them in the industrious acquisition of new knowledge, in the composition of a host of fragmentary pieces, and in luminous declamations with his friends. Diderot was seen at his best in conversation. "He who only knows Diderot in his writings," says

Montmel, "does not know him at all. When he grew unimpaired in talk, and allowed his thoughts to flow in all their abundance, then he became truly ravishing. In his writings he had not the art of ensemble, the first operation which orders and places everything was too slow and too painful to him."

Diderot died on July 30, 1784, six years after Voltaire and Rousseau, one year after his old colleague D'Alembert, and five years before D'Holbach, his host and intimate for a lifetime. An elaborate and exhaustive collection of his writings in 20 stout volumes, edited by MM. Assézat and Tournoux, was completed in 1875-77 (J Mo, X, 1).

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DIDIUS SALVIUS IULIANUS, MARCUS, Roman emperor for two months (March 28-June 2, A.D. 193). He was the grandson of Salvius Iulianus, a famous jurist under Hadrian and the Antonines, and the son of a distinguished general. On the death of Pertinax, the praetorian guards offered the throne to the highest bidder. Didius and Sulpicianus (prefect of the city) bid against each other, and finally the throne was knocked down to Didius. The senate and nobles professed their loyalty, but the people made no attempt to conceal their indignation at this insult to the State, and the armies of Britain, Syria and Illyricum revolted. Septimius Severus, the commander of the Pannonian legions, was declared emperor and hastened to Italy. Didius, abandoned by the praetorians, was condemned and executed by order of the senate, which at once acknowledged Severus.

BIBLIOGRAPHY—Didius Cassius *Nvii* 11-17, who was actually in Rome at the time, Aelius Spartianus *Didius Iulianus* Julius Cyprianus, *Pertinax*, Herodian 11, Aurelius Victor *De Caesaribus*, 19, Zosimus, 1, 7, Gibbon *Decline and Fall*, chap. 5.

DIDO or **ELISSA**, the reputed founder of Carthage (q.v.), daughter of the Tyrian King Muttion, wife of Acerbas. Her husband having been slain by her brother Pygmalion, Dido fled to Cyprus, and thence to the coast of Africa, where she purchased from a local chieftain, Iarbas, a piece of land on which she built Carthage. The city soon began to prosper and Iarbas sought Dido's hand in marriage, threatening her with war in case of refusal. To escape from him, Dido constructed a funeral pile, on which she stabbed herself before the people (Justin *xviii* 4-7). Virgil, in defiance of the usually accepted chronology, makes Dido a contemporary of Aeneas, with whom she fell in love after his landing in Africa, and attributes her suicide to her abandonment by him at the command of Jupiter. Dido was identified with the Virgo Caelestis, i.e., Tanit, the tutelary goddess of Carthage. Timaeus is the oldest authority for the story, the meaning of the name Dido is uncertain.

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DIDON, HENRI (1840-1900), French Dominican, was born at Trouvet, Isère, on March 17, 1840. Joining the Dominicans in 1858, he completed his theological studies at the Minerva convent at Rome. His brilliant preaching career began on his return to Paris in 1868. He concentrated on the relations between religion and science, and social problems, especially divorce. His disputes with the secular press led his superiors to interdict him from preaching and send him to the convent of Corbari in Corsica, whence he visited Palestine and also the German universities. In 1802 he returned to France, becoming director of the Collège Albert le Grand at Arcueil, and founding three auxiliary institutions, École Lacordaire, École Laplace and École St. Dominique. He wrote several works on educational questions, an often translated *Life of Christ* (Paris, 1890), and *Les Allemands* (Eng. trans. 1884). His *Spiritual Letters* have been translated by A. G. Nash (London, 1906). He died at Toulouse on March 13, 1900.

See the biographies by J. de Romano (1891) and A. du Coussages (1900), and especially Stumsis Reynaud, *Le Père Didon: sa vie et son oeuvre* (1901).

DIDOT, the name of a family of famous French printers and publishers. FRANÇOIS DIDOT (1690-1757) founder of the greatness of his family, was born at Paris. He began business as a bookseller and printer in 1713, and among his famous productions was a collection of the travels of his friend the Abbé Prevost, in twenty volumes (1747). FRANÇOIS AMBROISE DIDOT (1730-1804), son of François, made important improvements in type founding, and was the first to attempt printing on vellum paper (1780). Among the works which he published was the famous collection of French classics prepared by order of Louis XVI for the education of the Dauphin, in *insum Delphinum*, and the folio edition of *L'Art de vérifier les dates*. PIERRE FRANÇOIS DIDOT (1752-1795), his brother, devoted much attention to the art of type founding and to paper making. Among the works which issued from his press was an edition in folio of the *Imitatio Christi* (1788). HENRI DIDOT (1765-1852), son of Pierre François, is celebrated for his "microscopic" editions of various standard works, for which he engraved the type when nearly seventy years of age. He was also the engraver of the *Assiropats* issued by the Constituent and Legislative Assemblies and the Convention. DIDOT SAINT-LUCR (1767-1829), second son of Pierre François, was the inventor of the paper making machine known in England as the Didot machine. PIERRE DIDOT (1760-1853) eldest son of François Ambroise, is celebrated as the publisher of the beautiful "Louvain" editions of Virgil, Horace and Racine. The Racine in three volumes folio, was pronounced in 1801 to be "the most perfect typographical production of all ages." FIRMIN DIDOT (1764-1836), his brother, second son of François Ambroise, invented the process of stereotyping, and coined its name. He was the author of two tragedies—*La Reine de Portugal* (1824) and *La Mort d'Annibal* (1817), and he wrote metrical translations from Virgil, Tyrtæus and Theocritus. AMBROISE FIRMIN DIDOT (1790-1876) was his eldest son. On the retirement of his father in 1827 he undertook, in conjunction with his brother HENRI DIDOT, FIRMIN DIDOT (1794-1880), the direction of the publishing business. Their greatest undertaking was a new edition of the *Saevus Graecae linguae* of H. Estienne, under the editorial care of the brothers Didot and H. Hase (9 vols., 1855-1859). Among the numerous important works published by the brothers, the 200 volumes forming the *Bibliothèque des auteurs grecs*, *Bibliothèque latine*, and *Bibliothèque française*, deserve special mention. Ambroise Firmin Didot was the first to propose (1823) a subscription in favour of the Greeks, then in insurrection against Turkish tyranny. The works include a translation of Thucydides. In 1875 he published a very learned and elaborate monograph on Aldus Manutius. His collection of mss., the richest in France, was said to have been worth, at the time of his death, not less than 2,000,000 francs.

See P. G. Brunet, *Firmin Didot et sa famille* (1870).

DIDYMI or **DIDYMA**, an ancient sanctuary of Apollo in Asia Minor in the territory of Miletus and on the promontory Poseideion. It was sometimes called *Branchidae* from the name of its priestly caste which claimed descent from Branchus, a youth beloved by Apollo. As the seat of a famous oracle, the original temple attracted offerings from Pharaoh Necho (in whose army there was a contingent of Milesian mercenaries), and the Lydian Croesus, and was plundered by Darius of Persia. Xerxes finally sacked and burnt it (481 B.C.) and exiled the Branchidae to the far north east of his empire. The celebrated cult statue of Apollo by C. machos, familiar to us from reproductions on Milesian coins, was also carried to Persia, there to remain till restored by Seleucus I in 295, and the oracle ceased to speak for a century and a half. The Milesians were not able to undertake the rebuilding till about 332 B.C., when the oracle revived at the bidding of Alexander. The work proved too costly, and despite a special effort made by the Asian province nearly 400 years later, at the bidding of the emperor Caligula, the structure was never quite finished, but even as it was, Strabo ranked the Didymæum the greatest of Greek temples and Ptolemy placed it among the four

most splendid and second only to the Artimium at Ephesus. The area covered by the platform measures roughly 360X160 feet.

No excavation was attempted till MM E. Pontremoli and B. Haussoullier were sent out by the French Schools of Rome and Athens in 1895. They cleared the western façade and the *prodomos*, and discovered inscriptions giving information about other parts which they left still buried. Finally the site was purchased by them, and the French rights were ceded to Dr Th. Wiegand, the German explorer of Miletus, who in 1905 began a thorough clearance of what is incomparably the finest temple ruin in Asia Minor.

The temple was a decastyle peripteral structure of the Ionic order, standing on seven steps and possessing double rows of outer columns 60 ft high, twenty one in each row on the flanks. It is remarkable not only for its great size, but (*inter alia*) for (1) the rich ornament of its column bases, which show great variety of design, (2) its various developments of the Ionic capital, e.g. heads of gods, probably of Pergamene art, spring from the "eyes" of the volutes with bulls' heads between them, (3) the massive building two storeys high at least, which served below for *prodomos*, and above for a dispensary of oracles *χρησμογραφία* mentioned in the inscriptions) and a treasury, two flights of stairs called "labyrinths" in the inscriptions, led up to these chambers, (4) the pylon and staircase at the west, (5) the frieze of Medusa heads and foliage. Two outer columns are still erect on the north east flank, carrying their entablature, and one of the inner order stands on the south west.

See Distantist Society, *Johann Antiquities* II (1821), C. T. Newton, *Hist. of Discoveries* etc. (1862) and *Travels in the Levant*, II (1865), O. Rayet and A. Thomas, *Milet et le Golfe Latmique* (1877), E. Pontremoli and B. Haussoullier, *Didymes* (1904).

DIDYMIUM, originally regarded as a chemical element, was found by A. von Welsbach in 1883 to be a mixture of the elements, praseodymium (*qv*) and neodymium (*qv*). (See also RARE EARTHS.)

DIDYMUS (399?-394), surnamed "the Blind," ecclesiastical writer of Alexandria, was, in spite of becoming blind at the age of four, one of the most learned men of his day, respected by Jerome and Athanasius. He became head of the catechetical school of Alexandria. He was condemned by the sixth and seventh general councils as a continuator of Origen, but he stoutly opposed Anan and Macedonian teaching. His surviving writings show a remarkable knowledge of Scripture, and have distinct value as theological literature. They include the *De Trinitate*, *De Spiritu Sancto* (Jerome's Latin trans.), *Adversus Manicheos*, and expositions of various books, especially the Psalms and the Catholic Epistles.

See *Migne, Patrol. Graec.* xxix, J. Lepoldt, "Didymus der Blinde" in *Texte u. Untersuchungen zur Gesch. der christl. Lit.*, vol. xiv (Leipzig, 1906), Thierot, *Hist. of Dogma*, vol. II (1914).

DIDYMUS CHALCANTERUS (c. 63 B.C.-A.D. 10), Greek scholar and grammarian, flourished in the time of Cicero and Augustus, and taught in Alexandria and Rome. His surname, which means "brass-bowelled," came from his industry, he was said to have written more than 3,500 books. He wrote a treatise on Anaxarchus' recension of Homer, of which fragments have been preserved in the Venetian Scholia. He also wrote commentaries on many other Greek poets and prose authors, and the extant scholia to Pindar, Sophocles and Anaxarchus are largely due to Didymus. His work, though it showed no great critical acumen, was valuable because it collected the results reached by earlier scholars (Ammianus Marcellinus, xxii 16).

See M. W. Schmidt (*De Didymo Chalcantero* (1853) and *Didymi Chalcenteri fragmenta* (1854), also F. Susemihl, *Geschichte der griech. Literatur in der Alexandrinerzeit*, II (1891), J. E. Sandys, *History of Classical Scholarship*, I (1906).

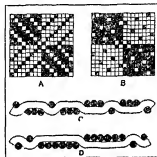
DIE, a town of south-eastern France, capital of an arrondissement in the department of Drôme, 43 m ESE of Valence on the Paris-Lyons railway. Pop. (1936) 3,175. Under the Romans, *Die* (*De Augusta Vocontiorum*) was an important colony. It was formerly the seat of a bishopric, united to that of Valence

from 1276 to 1687 and suppressed in 1790. Previous to the revocation of the Edict of Nantes in 1685 it had a Calvinistic university. The town stands in a plain enclosed by mountains on the right bank of the Drome below its confluence with the May rose, which supplies power to some of the industries. The old cathedral has a porch of the 11th century supported on granite columns from an ancient temple of Cybele, and the Porte St. Marcel is a Roman gateway flanked by massive towers. There are also ruins of Roman aqueducts and altars. Die is the seat of a sub-prefect, and of a tribunal of first instance. The manufactures are silk, cloth, lime and cement, and there are saw mills. Trade is in timber, especially walnut, and in white wine known as *clarette de Die*. The mulberry is largely grown for the rearing of silkworms.

DIE, a word used in various senses for a small cube of ivory, etc. (see DICE), for the engraved stamps used in coming money, etc., and various mechanical appliances in engineering. In architecture a "die" is the term used for the square base of a column, and it is applied also to the vertical face of a pedestal or podium.

The fabrics known as "dice" take their name from the rectangular form of the figure. The original figures would probably be perfectly square, but to day the same principle of weaving is applied, and the name dice is given to all figures of rectangular form. The different effects in the adjacent squares or rectangles are due to precisely the same reasons as those explained in connection with the ground and the figure of damasks (*qv*). The same weaves are used in both damasks and dices, but simpler weaves are generally employed for the commoner classes of the latter. The effect is, in every case, obtained by what are technically called warp and weft float weaves. The illustration B shows the two double damask weaves arranged to form a dice pattern, while A shows a similar pattern made from two four-thread twill weaves. C and D represent respectively the disposition of the threads in A and B with the first pick, and the solid marks represent the floats of warp. The four squares, which are almost as pronounced in the cloth as those of a chess-board, may be made of any size by repeating each weave for the amount of surface required. It is only in the finest cloths that the double damask weaves B are used for dice patterns, the single damask weaves and the twill weaves being employed to a greater extent. This class of pattern is largely employed for the production of table cloths of low and medium qualities. The term damask is often applied to cloths of this character, and especially so when the figure is formed by rectangles of different sizes.

DIEBITSCH, HANS KARL FRIEDRICH ANTON (1785-1831), Count von Diebitsch und Narden, called by the Russians Ivan Ivanovich, Count Diebich Zabalkinsky, Russian field marshal, was born at Grossleipe, Silesia, on May 13, 1785. He was educated at the Berlin cadet school, but passed into the service of Russia in 1801. He served in the campaign of 1805, and was wounded at Austerlitz, fought at Eylau and Friedland, and after Friedland was promoted captain. He distinguished himself very greatly in Wittgenstein's campaign, and in particular at Polotsk (Oct. 18 and 19, 1812), and was promoted major general. In the latter part of the campaign he served against the Prussian contingent of Gen. York (von Wartenburg), with whom, through Clausewitz, he negotiated the convention of Tauraggen serving thereafter with York in the early part of the War of Liberation. After the battle of Lutzen he served in Silesia and took part in negotiating the secret treaty of Reichenbach. He fought at Dresden and Leipzig. At the crisis of the campaign of 1814 he directed the march of the allies on Paris. In 1815 he attended the congress of Vienna, and was afterwards made adjutant general



DICE PATTERNS SHOWING WEAVES

A is formed from two four thread twill weaves. B from two double damask weaves. C shows the arrangement of the warp and weft in A, while D shows the arrangement of B.

to the emperor. In 1810 he had become chief of the general staff and in 1815 he assisted in suppressing the St. Petersburg *revolutions*. His greatest exploits were in the Russo-Turkish War of 1818-29 which was decided by Diebitsch's brilliant campaign of Adrianople, this won him the rank of field marshal and the honorary title of Zabalanskii to commemorate his crossing of the Balkans. In 1830 he was appointed to command the army destined to suppress the insurrection in Poland. He won the terrible battle of Grochów on Feb. 25, and was again victorious at Ostrołęka on May 26, but soon afterward he died of cholera (or by his own hand) at Klekewo near Pultusk, on June 10, 1831.

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DIEDENHOFEN *see* THIONVILLE

DIEKIRCH, a small town of Luxembourg, situated on the banks of the Sure. Pop. (1935) 3,842. Its name is said to be derived from Dide or Dido, granddaughter of Odin and niece of Thor. Diekirch was an important Roman station, and in the 14th century John of Luxembourg, king of Bohemia, fortified it. In the 19th century during their occupation the French changed the fortifications into boulevards.

DIELECTRIC *see* CONDENSER [ELECTRIC] and ELECTRICITY

DIELMANN, FREDERICK (1847-1935), U.S. portrait and figure painter, was born at Hanover, Ger., Dec. 25, 1847. He was taken to the United States in early childhood, studied under Diez at the Royal academy at Munich, was first an illustrator, and became a distinguished draughtsman and painter of genre pictures. His mural decorations and mosaic panels for the Library of Congress, Washington, D.C., are notable. He was president of the National Academy of Design (1899-1909), president of the Fine Arts Federation of New York (1910-15), professor of art at the College of the City of New York (1905-18) and art director of Cooper Union New York city (1905-31).

DIEMEN, ANTHONY VAN (1593-1645), Dutch admiral, became governor general of the East Indian settlements in 1636, and captured the Portuguese possessions in Ceylon and Malacca. He developed the prosperity both of the Indies and of Dutch trade with them, ensuring the Dutch monopoly, e.g., of pepper in Sumatra, etc. He greatly extended the commercial relationships of the Dutch, opening up trade with Tongking, China and Japan. Exploring expeditions were sent to Australia under his auspices in 1636 and 1642, and Abel Tasman named after him (Van Diemen's land) the island now called Tasmania. Van Diemen died at Batavia on April 19, 1645.

DIEPPE, a seaport of northern France, capital of an *arrondissement* in the department of Seine Inférieure, on the English channel, 38 mi. N. of Rouen, and 105 mi. NW. of Paris by the Western railway. Pop. (1946) 21,770. It is suggested that Dieppe owed its origin to Norman adventurers, who found its 'diep' or inlet suitable for their ships, but it was unimportant till the late 12th century.

Its first castle was probably built in 1188 by Henry II of England, and Philip Augustus attacked it in 1195. In 1197 it was bestowed by Richard I of England on the archbishop of Rouen in return for territory near the latter city. In 1339 it was plundered by the English, but soon recovered, and, in spite of opposition from the lords of Hantot, fortified itself. Its commercial activity was already great. It is believed that its seamen visited the coast of Guinea in 1339, and founded there a Petit Dieppe in 1305.

The town was occupied by the English from 1420 to 1435. A siege undertaken in 1442 by John Talbot, first earl of Shrewsbury, was raised by the dauphin, afterward Louis XI, and the day of the deliverance continued for centuries to be celebrated by a great procession and miracle plays. In the beginning of the 16th century Jean Parmentier, a native of the town, made voyages to Brazil and Sumatra, and a little later its merchant prince, Jacques Ango, was able to blockade the Portuguese fleet in the Tagus. Francis I began improvements, continued under his successor. Its inhabitants in great number embraced the reformed

religion and they were among the first to acknowledge Henry IV, who fought one of his great battles at the neighbouring village of Arques. Few cities suffered more from the revocation of the edict of Nantes in 1685, and this blow was followed in 1694 by a terrible bombardment on the part of the English and Dutch. The town was rebuilt after the peace of Ryswick, but its modern prosperity dates only from the 19th century, partly because of Marie Caroline, duchess of Berry who brought it into fashion as a watering place, and also because the railway gave an impetus to its trade.

During the Franco-German War the town was occupied by the Germans from Dec. 1870 till July 1871. It stands at the mouth of the river Arques in a valley bordered on each side by steep white cliffs. The main part of the town lies to the west, and the fishing suburb of Le Pollet to the east of the river and harbour.

The sea front of Dieppe, which in summer attracts large numbers of visitors, consists of a pebbly beach backed by a broad stone marine promenade. Dieppe has a modern aspect, and two squares side by side and immediately to the west of the outer harbour form the nucleus of the town. The church of St. Jacques, founded in the 13th century, consists largely of later workmanship and was restored in the 19th century. The castle, overlooking the beach from the summit of the western cliff, was built in 1435. The church of Notre Dame de Bon Secours on the opposite cliff, and the church of St. Remy, of the 16th and 17th centuries, are noteworthy. A well equipped casino stands on the sea front.

The public institutions include the subprefecture, tribunals of first instance and commerce, a chamber of commerce and a school of navigation.

Dieppe has one of the safest and deepest harbours on the English channel. A curved passage cut in the bed of the Arques and protected by an eastern and a western jetty gives access to the outer harbour, which communicates at the east end by a lock gate with the Bassin Duquesne and the Bassin Berigny, and at the west end by the New channel with an inner tidal harbour and two other basins. Vessels drawing 20 ft. can enter at neap tide. A dry dock and a grondron are among the repairing facilities of the port. The harbour railway station is on the northwest quay of the outer harbour.

The distance of Dieppe from Newhaven, with which there has long been daily communication, is 64 mi. The imports include silk and cotton goods, thread, oils, timber, coal, iron, patent fuel cement, china clay, machinery, tobacco and mineral oil, leading exports are wine, silk, woollen and cotton fabrics, vegetables and fruit and flint pebbles. The industries comprise shipbuilding, oil refining steam sawing the manufacture of machinery, rope, porcelain bricquettes and articles in ivory and bone, the production of which dates from the 15th century. The fishermen of Le Pollet, traditionally of Venetian origin, are among the main providers of the Parisian market. The sea bathing attracts many visitors in the summer.

Two miles to the northeast of the town is the ancient camp known as the Cîte de Limes, which perhaps furnished the nucleus of the population of Dieppe.

See L. Vitet, *Histoire de Dieppe* (Paris, 1844); D. Asseline, *Les Antiquités et chroniques de la ville de Dieppe*, a 17th century account published at Paris in 1874.

DIERX, LEON (1838-1912), French poet, was born on the island of Réunion in 1838, and died in Paris on June 11, 1912. He came to Paris to study at the Central School of Arts and Manufactures. A friend and disciple of Leconte de Lisle, Dierx was one of the most distinguished of the Parnassians. On the death of Stéphane Mallarmé in 1898 he was acclaimed 'prince of poets' by 'les jeunes'. The most significant of his volumes of verse is *Lèvres closes* (1867). His *Oeuvres* (2 vol., 1894-96) contain much exquisite verse.

DIESEL, RUDOLF (1858-1913), German engineer, was born in Paris, March 18, 1858, of German parents. He was educated at the Munich Polytechnic school and spent a short time in Paris as manager of a company which manufactured refrigerating equipment, but returned to Munich, where in 1883 he

published *The Theory and Construction of a Rational Heat Motor*, the result of his studies on what was to become the diesel oil engine. In the same year work began at the Krupp and Augsburg machine factories on the construction of the diesel engine (qv). Work continued on the motor until 1897, and in 1898 it was publicly displayed for the first time at Munich. In 1899 Diesel founded a factory for the construction of the engines at Augsburg and spent the greater part of the rest of his life perfecting the machine, although he did not live to see its possibilities fully exploited. On the night of Sept. 29-30, 1913, he fell overboard from the Antwerp mail steamer in the English channel and was drowned. In the last year of his life he wrote *The Genesis of Diesel Motors*.

For a discussion of the practical uses of Diesel's invention, see ALBRO ENGINES; MARINE ENGINEERING; LOCOMOTIVE.

DIESEL ENGINE In 1892 Rudolf Diesel, a German engineer, patented a type of internal combustion engine which became inseparably associated with his name. His first successful engine was a 25 h.p. unit completed in 1897 and tested by Schroter at Augsburg, Ger., in the same year. Diesel engines were exhibited publicly for the first time in 1898 at the Munich exhibition.

The diesel engine was taken to the United States in 1898 by Adolphus Busch of St. Louis, Mo., who paid Diesel 1,000,000 gold marks for patents and exclusive manufacturing and sales rights in the United States and Canada. Busch formed the Diesel Motor Company of America in 1898, he later changed its name to American Diesel Engine company, since the word motor was an apparent misnomer when applied to diesels. In 1898 this company built the first successful diesel in the world to operate commercially in regular power service.

In 1900, Diesel announced before the congress at Paris that the cycle of operations finally adopted by him after extended experiments was as follows:

- 1 A suction stroke during which air alone at atmospheric pressure was drawn into the cylinder
- 2 A compression stroke in which this air was next compressed to a pressure of 500-600 lb. per square inch
- 3 From the end of the compression stroke, and for a short period after, regulated admission of the fuel in the form of a fine spray in such manner as to cause combustion to occur at (approximately) constant pressure
- 4 Expansion of the ignited mixture of fuel spray and air during the remainder of the working stroke
- 5 Expulsion of the burned products during the next stroke

The cycle thus described was of the four-stroke type with a stroke sequence of suction, compression, expansion and exhaust. The first diesels were air injection engines that used high pressure compressors to inject the fuel supply into the engine cylinder with a blast of air. In 1910 James McKechnie of England developed an airless or solid-injection system which used a simple high pressure fuel oil pump for injection purposes. The solid-injection system became the predominant method of fuel injection about 1930. Irrespective of its fuel system the essential feature of the diesel cycle is the compression of atmospheric air to a pressure of about 500 lb. per square inch which raises the air temperature to about 1,000° F. A controlled amount of atomized oil is injected into the highly compressed red-hot air, causing it to ignite spontaneously, burn and expand. Thus, no ignition apparatus is required with an engine that operates on the true diesel cycle.

Definition of a Diesel Engine—A diesel engine is defined as an internal combustion engine so constructed that the air supplied for combustion is compressed within the engine cylinder to the point where its temperature is sufficient to ignite the injected fuel spontaneously.

The spark-ignition gasoline engine differs from the compression-ignition diesel engine in the nature of the fuel charge. Gasoline and air are thoroughly mixed in the cylinder of the spark-ignition engine and this homogeneous mixture is introduced into the engine cylinder in a definite proportion by the valves at the inlet. The proportion of air to fuel, called the air-fuel ratio, is constant for gasoline engines in the ratio of 14.5 to 1, i.e., 14.5 lb. of air to 1 lb. of fuel. Since the diesel has no scavenging or mixing chamber for air and fuel oil, the mixing must be accomplished within the

cylinder itself. The diesel always compresses the same amount of air while the amount of injected fuel is varied to suit the load conditions. Thus the air-fuel ratio varies from about 22 to 1 at full load to about 85 to 1 when the engine is idling. The diesel engine requires an excess amount of air as compared to the gasoline engine. High air-fuel ratios and high compression pressures give the diesel its advantage in fuel economy and it is not unusual to find a diesel motored vehicle giving double the fuel mileage as compared with a similar gasoline motored vehicle. A further advantage is its ability to burn a cheaper fuel and to enjoy a lessened fire hazard.

Operating Cycles—Diesel engines operate on either the four-stroke or the two-stroke cycle. Basically, this means that the four-stroke cycle engine requires four complete strokes of the piston or two revolutions of the crankshaft to complete one operating cycle while the two-stroke cycle engine completes this sequence in two piston strokes or in one revolution of the crankshaft. The two extra strokes in the four-stroke cycle engine are used to get fresh air into and exhaust gases out of the cylinder. The two-stroke cycle engine eliminates these strokes by substituting a scavenging period during which the spent exhaust gas is blown from the cylinder and replaced by a fresh charge of air. Scavenging then, requires an external source of low pressure air.

The stroke sequence of the four-stroke cycle engine is illustrated in fig. 1.

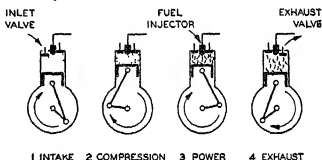


FIG. 1—SCHEMATIC VIEW OF A FOUR-STROKE CYCLE DIESEL ENGINE ILLUSTRATING THE SEQUENCE OF CYCLE EVENTS

The four-stroke cycle engine operates as follows: (1) intake the inlet valve opens and the descending piston draws a fresh charge of air into the cylinder, (2) compression the inlet valve closes and the rising piston compresses air within the cylinder to a pressure of about 500 lb. per square inch, (3) power toward the end of the compression stroke fuel is injected, it ignites spontaneously and expands, thus forcing the piston down through the power or expansion stroke, (4) exhaust the exhaust valve opens and the rising piston forces the burned gases out of the cylinder, the cycle then repeats.

The sequence of events in a two-stroke cycle, port scavenged engine is illustrated in fig. 2. Scavenging air is maintained in the air header at a pressure of a few pounds above the atmospheric pressure by a blower, not shown.

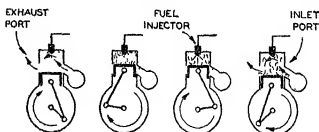


FIG. 2—SCHEMATIC VIEW OF A TWO-STROKE CYCLE DIESEL ENGINE ILLUSTRATING THE SEQUENCE OF CYCLE EVENTS

The two-stroke cycle engine operates as follows: (1) intake the descending piston uncovers the inlet and exhaust ports and scavenging air enters the cylinder from the inlet port, a flushes the

cylinder, and leaves via the exhaust port, (2) compression the rising piston covers both the inlet and exhaust ports and compresses the air in the cylinder to a pressure of about 500 lb per square inch, (3) power a charge of fuel is injected into the highly heated air, it ignites spontaneously and expands, forcing the piston down through the power stroke, (4) exhaust the descending piston uncovers the exhaust and inlet ports, scavenging air under pressure enters through the inlet port and forces the burned gases to leave the cylinder via the exhaust port, thus completing the cycle.

The ideal two cycle engine would develop twice the power of a four cycle of equal size and speed, actually, the ideal is not achieved since the two cycle has a less effective stroke because of the presence of ports in the cylinder. The two cycle does, however, possess important advantages over the four cycle, particularly in the larger size engines, in that it is lighter for the same power output, has fewer moving parts and is simpler. These characteristics give the two and four cycle engines their particular fields of application. The tendency is to build the large engines two cycle and the smaller engines four cycle. There is, of course, an overlapping of sizes in both cycles with very high grade engines of each type being built.

Scavenging air is supplied to two cycle engines by reciprocating pumps, blowers, or by means of the crankcase scavenging method. Crankcase scavenging was widely used in early two stroke cycle engines up to 100 h.p. per cylinder and found favour because of its simplicity and its low initial and maintenance costs. The crankcase scavenged engine was, however, found to be less economical and had a lower power output than some engines using later scavenging developments. The underside of the engine's power pistons, the cylinders and the crankcase form a low pressure compressor. Fresh air is drawn into the crankcase as the piston upstroke and is compressed within the crankcase as the piston descends. Suitable port arrangement releases air from the crankcase for scavenging. Reciprocating scavenging pumps are usually large diameter, double acting, attached units, actuated by a connecting rod from a crank extension of the engine crankshaft. The pumps are simple low pressure compressors and are used in successful engines of modern design. Scavenging blowers of the Roots type are positive displacement blowers, usually attached and gear or chain driven from the engine. Centrifugal scavenging blowers are fanlike in principle and because of their high operating speeds are usually driven by a turbine or electric motor and are not usually built as an integral part of the engine. The air discharge from either pump or blower is delivered to an air manifold where the engine cylinders receive their supply of scavenging air. The method of admittance and the path of scavenging air through the engine cylinder is determined by various arrangements of ports or valves or combination of both. In uniflow scavenging, air is admitted through ports at the lower end of the cylinder and exhaust is forced out through valves at the upper end. The uniflow type system is used in both high- and low speed engines of modern design. The all ported cylinder which provides the simplest and most widely used method of scavenging is shown in fig 3. Inclined air ports direct scavenging air in a loop path as indicated by arrows in fig 3. Automatic feather type scavenging valves, located in the air header, allow scavenging air to flow in the out direction only, to prevent exhaust gas from entering the header and contaminating the fresh air supply.

Diesel Construction—Designs and sizes of diesel engines had not been standardized in either Europe or the United States by mid-20th century. Different designs reflected the individual opinions of various diesel manufacturers. As a result, the engine had been built in many sizes and each operated in different speed classifications and assumed different general design and constructional form. The cylinder arrangement might be in-line, radial V, X, or of the opposed piston, the usual single-acting or even the double acting type. In either two- or four cycle, the engines might have individual cylinders and columns or be built en bloc. Two cycles have variations of air flow caused by different port and valve arrangements. Diesels might have trunk pistons or cross-

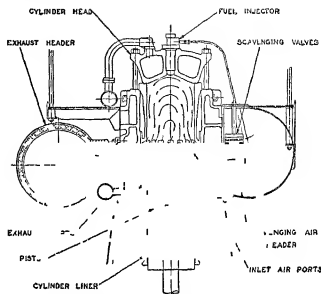


FIG 3—SECTIONAL VIEW OF A TWO STROKE CYCLE PORT SCAVENGED ENGINE. ARROWS INDICATE SCAVENGING AIR PATH.

heads be supercharged and intercooled or not. They might operate on varying types of gaseous fuels such as natural gas, illuminating, producer, blast furnace, or sewer gas, or on varying types of fuel oils from heavy crudes through the range to lighter distillates, or even on both gaseous and oil type fuels. Various engines might use turbulence or precombustion chambers, air or energy cells or be of the open chamber design. All designs were compromises and each manufacturer was building diesels for certain broad fields of application.

The diesel was practically unknown to the public until it made its appearance in trucks, buses and railroad locomotives. Other applications, however, had become equally important but not as apparent. Diesels are used to drive ships, generators, pumps, compressors, mills, rock crushers, earth moving machinery, tractors and for many other purposes where economy and dependability are requisite. Each application determines certain design characteristics. Although diesels have been classified by various methods, the most common grouping is by rotative speed. There was little agreement in mid century as to what constituted a high or low speed diesel but for purposes of convenience the following arbitrary classification is established. Engines that operate above 1,200 r.p.m. will be referred to as high speed engines, those operating below 500 r.p.m. will be classified low speed engines, and those in the range between these limits will be termed medium speed engines.

High speed diesels are essentially small bore engines, 6 in. and under, built to compete with gasoline engines in both physical dimensions and power output. Cylinder arrangement is usually in line or of the V type. The auxiliaries such as electric starters, lube oil pumps, water pumps and cooling systems are contained as an integral part of the engine. The engine is seldom if ever built as a direct reversing unit and where reversing is required it is accomplished through an attached reverse gear. High-speed engines frequently use turbulence chambers, air or energy cells to facilitate fuel combustion. There is seldom any provision for auxiliary piston cooling. This size engine develops a maximum of about 30 h.p. per cylinder and uses a light grade diesel oil for fuel.

Medium speed diesels embrace the largest single group in the classification, having cylinder bores in a range from 6 to 14 in. The engine may be built in any of the previously mentioned cylinder arrangements, radial, in line, V, X, etc. Medium speed engines usually have attached auxiliaries. They may be started electrically, started by a small attached gasoline engine, or be air started. When reversing is required the engine may be constructed for direct reversing or have an attached reverse gear.

Diesels of this size went through the auxiliary combustion chamber stage, but open type chambers were generally preferred in mid-century. Pistons are usually cooled by means of an oil spray directed at the underside of the piston head. Engines of this size develop between 30 and 700 h.p. per cylinder. Appropriate design enables individual engines to burn any of a variety of fuels of the gaseous or oil types.

Low speed diesels include the largest built, having cylinder bores ranging upward from 14 in. in diameter. The smaller bore size of low speed diesels may have any one of the cylinder arrangements, but the larger bore engines, 20 in. and up, are usually built in an in-line arrangement. Auxiliaries are sometimes contained as an integral part of the engine but are usually separated from the engine proper in large installations. Air starting systems are invariably used. Where reversing is required the engine rarely operates through a reverse gear and is usually constructed as a direct reversing unit. Auxiliary combustion chambers are never used. Pistons are always cooled, the forced oil system being preferred. The power rating per cylinder is upward from 200 h.p. Any type of fuel may be burned, and combustion efficiency is always best in well designed engines of large size.

Fig. 4 shows a cross section through the power cylinder of a medium speed four cycle engine. The unit illustrated in fig. 4 is typical of four cycle design. A one-piece bedplate forms the foundation on which the engine is built. A forged steel crankshaft, rotates in main bearings that are lined with soft bearing metal and pressure lubricated for long life. The cast frame is secured to the bedplate by tie rods. A removable cylinder is contained in the frame and has ample water jackets for efficient cooling. An oil cooled trunk type piston reciprocates in the cylinder liner and translates its motion through a forged steel connecting rod to the crankshaft. A water jacketed cylinder head seals the combustion end of the cylinder and contains the injection nozzle the inlet, exhaust and starting air valves.

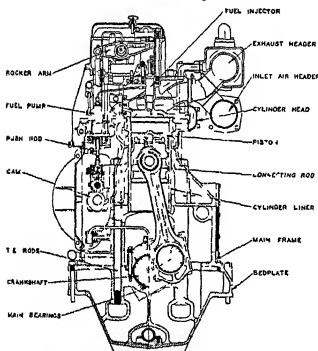


FIG. 4—SECTIONAL VIEW OF A MODERN MEDIUM SPEED FOUR STROKE CYCLE DIESEL ENGINE

A cross sectional view through the power cylinder of a large single-acting two-cycle diesel built in the United States is illustrated in fig. 5.

Although its size precludes many specialized manufacturing problems, the general design is typical of large low-speed heavy-duty two-cycle engines. The piston is built in two pieces and has a separate pistonhead to facilitate efficient oil cooling. Attached to the connecting rod is a crosshead travelling in guides which

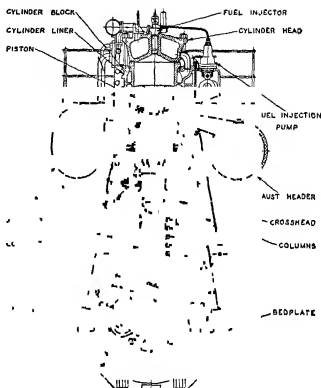


FIG. 5—SECTIONAL VIEW OF A MODERN LOW SPEED PORT SCAVENGED TWO STROKE CYCLE DIESEL ENGINE

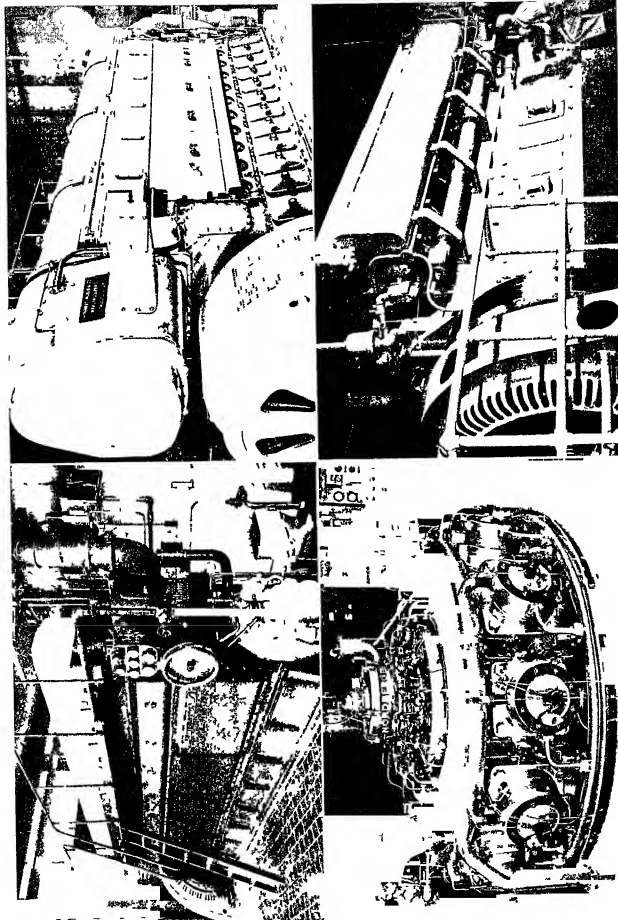
absorbs the side thrust caused by the angularity of the connecting rod. The piston is attached to the crosshead and since it bears no side thrust it may be proportionally shorter than the corresponding piston of a trunk type engine. Fig. 4 is an example of trunk type piston construction. A bedplate supports a series of individual A columns which, in turn, support individual cylinder blocks. These major parts are held together with tie rods to form a rigid unit. The similar elements in fig. 4 and fig. 5 perform identical functions, and the constructional variation other than that required for two- and four cycle operation is due primarily to size difference. The specific power output of the large engine is nearly 12 times greater than the smaller one.

Supercharging—When an amount of air in excess of the normal displacement volume is introduced into an engine cylinder under pressure and is retained at the start of the compression stroke, the engine is said to be supercharged. Scavenging air under pressure is supplied to all two cycle engines and it would seem, therefore, that all engines of this type are supercharged, actually, however, they are not, unless a portion of this more dense air is retained at the start of compression.

The power output of an engine is limited by the amount of oxygen, i.e., air that can be taken into its cylinders per stroke. With additional air available for combustion, the engine is able to burn a greater amount of fuel, and its power output is increased. There are two ways of increasing an engine's breathing capacity: (1) increase the rotative speed, i.e., fill the cylinders more frequently, and (2) force more air into the same cylinder space by means of pressure, i.e., supercharging. In the evolution of the diesel engine these paths were explored and both speeds and operating pressures became increasingly greater.

The barrier to higher speeds for automotive types, and to even greater efficiency for all diesels, is the difficulty in mixing the fuel spray intimately with the air. Imperfect mixing delays fuel ignition and tends to impair combustion efficiency. Although these effects are aggravated as speeds go higher, modern automotive-type diesels, where revolutions per minute is important, have been developed to the point where they attain good efficiencies at speeds of about 3,000 r.p.m.

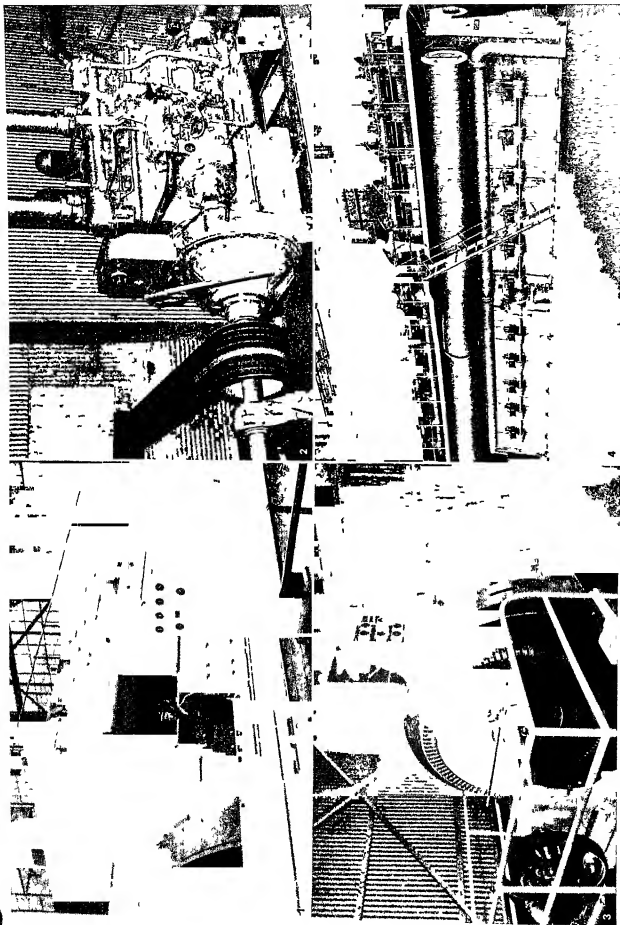
Special port, valve and blower arrangement is required in both



1. Eight cylinders, 1,750-h.p. supercharged diesel in municipal generating service
2. Four cylinders, 1,000-h.p. opposed piston diesel of the type used to drive diesel locomotives
3. Eleven cylinders, 1,640-h.p. radial type diesel electric motor in a full floor boat
4. Eight cylinders, 1,000-h.p. supercharged diesel in electric utility service

BY COURTESY OF (1) BOSTONIAN PUMP AND MACHINERY CORPORATION (2) FAIRBANKS MORSE & COMPANY (3) GULF PUMP AND MACHINERY

DIESEL ENGINE



- BY GUESTS OF (1) FARMERS MORGAN & COMPANY (2) MARSHALL MOTOR COMPANY (3) WESTINGHOUSE PUMP AND MACHINERY CORPORATION (4) HOBBS MANUFACTURING COMPANY
1. Ten cylinder 3500 h.p. diesel in electric generating service
 2. Six-cylinder diesel with a piston displacement of 1,197 cu. in., a packaged type unit, adapted to amphibious service
 3. Six-cylinder 580 h.p. diesel in industrial generating service
 4. Twelve-cylinder 8,650 h.p. diesel, largest single-acting diesel built in the western hemisphere at the time of its construction

two and four cycle engines to provide a supercharging effect. Two cycle supercharge rarely exceeds two to four pounds per square inch above atmospheric pressure. Beyond this the blowers absorb more power than they provide. Four cycle supercharge ranges from 3 to 15 lb per square inch and provides an increase in power output from 30% to 80%, with 50% being a conservative figure. Engines are supercharged for two reasons: (1) to increase power output for a given sized engine and (2) to provide the additional air required to sustain power output in the less dense air at high altitudes.

Supercharging blowers may be driven mechanically or by means of an exhaust gas turbine. The mechanically driven blower may operate directly from the engine or be separately driven from another power source. The most efficient supercharging method utilizes part of the exhaust gas energy to drive a gas turbine that is directly connected to a blower. This type of turbocharging system was applied by Alfred V. Buchi of Switzerland. The Buchi system uses special valve timing in combination with multiple exhaust manifolding, and is able to attain a substantial power increase (50% is common), with no increase in specific fuel consumption. Supercharging effect is sometimes increased by the addition of an intercooler located between the supercharger and intake air manifold. Its function is to cool the inlet air and thereby increase its density so that additional fuel can be burned. Like supercharging, intercooling increases the power capacity of an engine of given displacement.

Diesel Auxiliaries—Fig. 6 shows a view of the auxiliary equipment used in a typical, large stationary diesel plant. While individual plant conditions determine the specific location of auxiliaries, their respective functions remain the same.

The auxiliary equipment may be divided into the following systems: lubricating oil (called lube oil), cooling water, fuel, governor, inlet, exhaust and starting air.

The **lube oil system** consists of a filter, a strainer, an oil cooler and two oil pumps. The lube oil pump draws oil from the sump, sends it through the strainer, the cooler and then forces oil under pressure to various bearing surfaces. The lubricant drains from the engine and collects in the sump. The lube oil filter pump continually recirculates a portion of the sump oil and forces it through a filter.

The **cooling system** consists of a cooling tower, a water pump and a heat exchanger. The closed circuit type system is illustrated in fig. 6 and is usually recommended because of its comparatively small water requirement and further, because the circulating jacketwater may be treated to eliminate scale forming agents. Cooling water is pumped into the cylinder jacket, flows through the cylinder head and out of the engine into a heat ex-

changer. The best exchanger cools the jacket water which is then passed through the oil cooler. Cool water is continually pumped from the cooling tower through the heat exchangers.

The **fuel system** consists of a large storage tank, a smaller day tank, and the necessary filters, strainers and pumps to insure that clean oil is supplied to the high pressure or fuel injection pumps. The system illustrated in fig. 6 is for oil operation.

The **governor** is a sensitive device that controls and maintains the engine speed at a constant level by regulating the amount of fuel that is admitted into the engine cylinder.

The **inlet air system** consists of piping from a source of fresh air leading to the engine air header. A filter is provided to remove harmful grit and dust from the inlet air.

The **exhaust system** consists of piping from the engine leading to the outside atmosphere where exhaust gases can be of no danger. An exhaust silencer or muffler is provided to reduce engine exhaust noises. A waste-heat boiler, not shown in fig. 6, may be added to the exhaust system so that some of the heat from exhaust gases can be recovered for use.

The **starting air system** consists of a compressor, air storage tank, piping and a means of timing the admission of compressed air to the engine cylinder.

Gas Diesel—The gas diesel was developed in the United States in 1928 and is capable of burning any form of combustible gas in combination with a small amount of pilot oil. Pilot oil is injected to ignite and stabilize the combustion of the compressed gas air mixture. There are two methods of getting gas into the two cycle cylinder. It may either be admitted under low pressure immediately after scavenging, or it may be compressed to about 1,000 lb per square inch and forced into the cylinder as the piston approaches the end of its compression stroke. When a diesel is arranged to operate on either gas or oil or a combination of both fuels it is called a dual-fuel diesel, which may be either two or four cycle.

Fig. 7 shows a sectional view of a four cycle dual-fuel diesel that can convert instantaneously under load from oil to gas or from gas to oil operation. It is capable of running on any proportion of either fuel down to 5% of oil, an adjustment that is made by simply turning a single control wheel. The operation is as follows: an engine governor interprets the load requirement and regulates the flow of low-pressure gas fuel to a gas header. Individual gas and inlet air valves open simultaneously at the start of the intake stroke to admit and thoroughly mix the entering air and gas. All valves are closed on the next stroke as the rising piston compresses the combustible mixture to about 500 lb per square inch. Toward the end of the compression stroke pilot oil is injected and the mixture ignites and expands. The

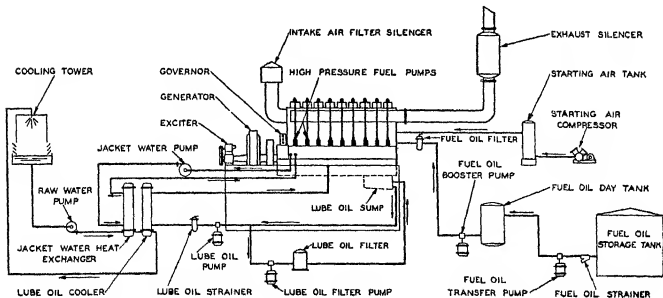


FIG. 6—SCHEMATIC VIEW SHOWING THE AUXILIARY EQUIPMENT USED IN A TYPICAL STATIONARY DIESEL PLANT

remainder of the cycle proceeds as in the four stroke oil burning diesel. While Fig. 7 illustrates one method of four cycle dual fuel

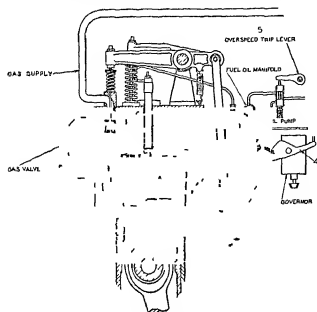


FIG. 7—SECTIONAL VIEW OF A FOUR STROKE CYCLE DUAL FUEL DIESEL ENGINE

operation there were other successful means in general use at mid century. The main variation is the method in which the gas is introduced into the cylinder. Regardless of the method of admittance, gas injection is always timed to prevent its being wasted during scavenging.

Fuel Oil Injection—After the conception of the diesel engine, fuel injection equipment became the subject of intensive research and development as a means of further increasing combustion efficiency. Two principal methods of fuel injection were in use at mid-century: air injection and solid injection. In air injection, the earliest successful method a metered quantity of fuel is delivered to the nozzle by a fuel pump and blown into the combustion chamber by compressed air at 700 to 1,400 lb. per square inch when an actuated nozzle valve is lifted. This system was still sometimes used at mid-century in large low speed engines operating on heavy crudes, but was no longer popular for use with light oil-fuels because of the expense, bulk and hazards of the com-

between the pump and spray nozzle.

Two basic types of spray nozzles are developed to suit different combustion chamber designs. Pintle type nozzles produce a cone shaped spray and are used in engines with pre-combustion, divided or air cell chambers, hole type nozzles are used in open chambers and produce a relatively dense and compact fuel spray. Nozzles are also classified as open or closed. The open type consists of a plug with drilled fuel passages and orifices. Although it is simple it is susceptible to poor atomization at the beginning and end of each injection. The closed type, came into more general use, it has its fuel passages sealed from the orifices by a spring loaded valve which is opened during injection either mechanically from the engine cams or hydraulically by oil pressure from the fuel pump.

Fig. 8 shows a cross section of the main components of a popular commercial jerk pump system.

The single cylinder pump is of the constant stroke variable by pass type in which the plunger with its follower and return spring, is actuated by an engine cam. The pump delivers oil when the plunger covers the fuel inlet ports on its upstroke. The quantity of fuel injected is varied by changing the effective plunger stroke by turning the plunger so as to change the time of by pass, i.e., by-pass occurs when the upper helical edge of the wide plunger groove uncovers the spill port. Fuel delivery then ceases, and the seating of the special delivery valve retracts fuel from the discharge tubing to sharply terminate injection. The nozzle and holder assembly incorporates a nozzle of the multifluid, closed, hydraulically operated type. From the inlet at the top, fuel is led through drilled passages to an annular groove surrounding the stepped portion of the valve above its conical seat. Fuel pressure acts on the exposed cross sectional area of the valve and lifts it so that fuel is injected during the period that the fuel oil pressure exceeds the spring setting.

Advantages of the Diesel—The inherent advantage of the diesel becomes more apparent when its heat efficiency is compared with other prime movers including steam turbines, gas turbines, steam engines and gasoline engines. The compression-ignition feature not only simplifies the diesel by eliminating a separate ignition system but is also directly responsible for its good heat or thermal efficiency. The average

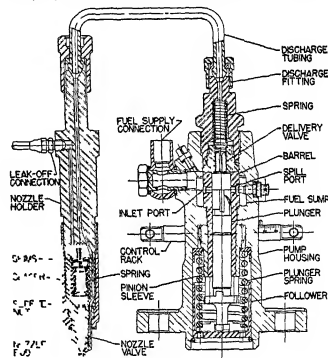


FIG. 8—NATURAL VIEW SHOWING THE COMPONENTS OF A JERK PUMP

of the diesel is about 36% as compared with 25% for steam and gas turbines, and 12% for internal combustion engines. These percentage figures are approximate to full load capacity. At partial loads the comparative efficiency is even greater.

R. T. Sawyer, *The Modern Gas Turbine* (1945),
 Progress Diesel Engine Catalogue (1949), American
 Bosch Corporation (comp.), *Fuel Oil Injection* (Jan.
 1949), V. L. Maleev, *Internal-Combustion Engines*,
 (B. V. N.)

DIESEL LOCOMOTIVE

DIESINKING, art of making tools, called dies, by means of which metals and other materials are pressed or cut into various shapes by a hammer or an arrangement of levers. The die is usually cut from steel by a machine, but where extreme accuracy is required (e.g., when engraving dies for coins, goldsmiths' work and for some parts of machines) handwork predominates. Here an exact copy of the design is traced on a thin coating of wax spread over the prepared smooth surface, and is then engraved on the metal by recessing or sinking.

The tools used are chisels, gravers and rifflers, which are small files with curved ends for negotiating curves and recessed portions. First the sinker receives the master die by engraving in intaglio the design on a piece of soft steel called the *hub*, which is then hardened to form the *matrix*. By means of the matrix, the design is expressed in relief on a second piece of softened steel called the *punch* which in turn is hardened and held in the press to strike the softened face of the working die. Several operations are necessary to bring the impression to a perfect state, the first blow being made on the die while in cone shape (see fig. 1).

The blow changes the form to that in the second view. The working die must then be annealed, and its edge turned off a little smaller, a complete, perfectly clean impression is produced, the die appearing as in the third view.

Considerable quantities of metal must be removed in sinking dies, and machine cutting, as far as possible, is essential to save hand labour. Dies which have the shape cut through from top to bottom for presswork, are roughed out on a metal jigsawing machine, and finished on a slotting machine or a bling machine which passes a file up and down while the die is held on a table and moved about as required. Large dies are often cut out by means of the oxyacetylene blowpipe. A diesinking machine, which is a milling machine, uses a variety of revolving cutters (see fig. 2). The difficulty with half dies, pairs of which make cylindrical or spherical shapes, is the cutting of the half round recesses. A *cherry cutter* is utilized for these, instead of revolving it is made to oscillate by the action of a curved slide on the

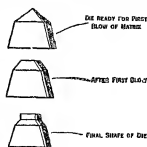


FIG. 1—EVOLUTION OF COINING DIE

Dies for stamping coins are not actually cut by hand but are milled from a hardened matrix which has been struck from an engraved die. A number of heavy blows cause the matrix to impress its pattern upon the soft working die.

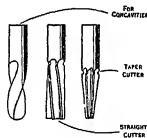


FIG. 2—THREE MILLING CUTTERS

Milling cutters eliminate hand cutting. The die is moved about under the cutters as required by slides controlled with screws and handwheels.

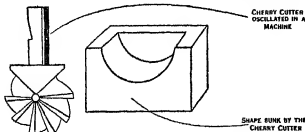


FIG. 3—CHERRY CUTTER AND CROSS SECTION OF A DIE CUT THROUGH IN THE VERTICAL DIRECTION. AS EACH END OF THE CONCAVITY IS CLOSED THE CHERRY CUTTER IS NECESSARY TO MILL OUT THE CURVE.

machine, this motion (not required in other metalworking operations) cutting a half round recess as sketched. The principle of

the copying lathe applied to the diesinking machine, enables it to cut very intricate shapes from a pattern in sheet metal, or sunk in iron or brass, the milling cutters being guided by the movement of an arm controlled by the pattern. Puntograph engraving and diesinking machines also work from a copy, and cut the dies to an enlarged or reduced scale. A celluloid or sheet metal copy can be used also for guidance when cutting lettering, the copy being either in one piece or made up of the separate letters or figures clamped in a holder.

DIES IRAE (Lat. 'dies of wrath'), the opening words of a Latin hymn on the Last Judgment, ascribed to Thomas of Celano (c. 1250) and forming part of the office for the dead and requiem mass, in music the traditional plain song melody to which the words are sung and setting, in general of this portion of the mass. Among famous examples of the latter may be mentioned those of Mozart, Chabubini, Beethoven and Verdi.

DIEST, a town in the province of Brabant, Belg., on the Demer at its junction with the Bever. Pop. (est. 1939) 8,499. The chief industry is brewing.

DIESTERWEG, FRIEDRICH ADOLF WILHELM (1790–1866), German educationist, was born at Siegen on Oct. 29, 1790. Educated at Herborn and Tübingen universities, he began teaching in 1811. In 1810 he was appointed director of the teachers' seminary at Mors where in practice the methods of J. H. Pestalozzi. In 1815 he became director of the new state schools seminary in Berlin. In 1846 he established the Pestalozzi institution at Pankow, and the Pestalozzi societies for the support of teachers' widows and orphans. In 1853 he was elected to the chamber of deputies as member for Berlin, and voted with the Liberal opposition. He died in Berlin on July 7, 1866. Diesterweg wrote several textbooks and educational works, including *Wegweiser für deutsche Lehrer* (1834), and in 1837 established *Rheinische Blätter für Erziehung u. Unterricht*.

See W. Kretz, *Diesterweg und die Lehrerbildung* (1890); K. Richter, *Diesterweg nach seinem Leben und Wirken* (1890).

DIET, a term used in two senses: (1) food or the regulation of feeding (see DIET AND DIETETICS), and (2) an assembly or council. We are concerned here only with this second sense, and in particular with the diet of the Holy Roman empire and its relation to its successors in modern Germany.

The origin of the diet, or deliberative assembly of the Holy Roman empire must be sought in the *placitum* of the Frankish empire. This represented the tribal assembly of the Franks meeting partly for a military review on the eve of the summer campaign, partly for deliberation on important matters of politics and justice. By the side of this larger assembly, however, which continued in theory, if not in practice, the whole body of Franks available for war, there had developed, even before Carolingian times, a smaller body composed of the magnates of the empire, both lay and ecclesiastical. The germ of this smaller body is to be found in the episcopal synods, which, afforded by the attendance of lay magnates, came to be used by the king for the settlement of national affairs. It is from this assembly of magnates that the diet of mediæval Germany springs. The general assembly became meaningless and unnecessary as the feudal army gradually superseded the old levy en masse, in which each freeman had been liable to service, and after the close of the 10th century it no longer existed.

The imperial diet (*reichstag*) of the middle ages might some times contain representatives of Italy, but it was nearly always confined to the magnates of Germany. The regular members were the princes (*Fürsten*), both lay and ecclesiastical. In the 13th century the seven electors began to disengage themselves from the prince as a separate element, and the Golden Bull (1356) made their separation complete, from the 14th century onward the nobles (both counts and other lords) attended along with the princes, and after 1250 the imperial and episcopal towns often appeared through their representatives. By the 14th century, therefore, the originally homogeneous diet of princes was already in practice, if not yet in legal form, divided into three colleges—the electors, the princes and nobles and the representatives of the towns (though, as will be seen, the latter could hardly be reckoned

as regular members until the century of the Reformation). The power of the diet during the middle age extended to matters such as legislation the decision upon military expeditions (especially the *expeditio Romana*) taxation and changes in the constitution of the principalities or the empire. The election of the king, which was originally regarded as one of the powers of the diet, had passed to the electors by the middle of the 13th century.

A new era in the history of the diet began with the Reformation. The division of the diet into three colleges was thereafter definite and piece by piece. The representatives of the towns became regular members, but it was not until 1648 that they were recognized as equal to the other estates of the diet. The estates of the princes and counts, which stood midway between the electors and the towns, also retained, in the years that followed the Reformation, its final organization. The vote of the great princes ceased to be personal and began to be territorial. It was not the status of princely rank but the possession of a principality which was therewith a title to membership. The position of the counts and other lords, who joined with the princes in forming the middle estate, was also finally fixed by the middle of the 17th century. While each of the princes enjoyed an individual vote the counts and other lords were ranged in groups, each of which voted as a whole, though the whole of its vote (*Kurkollegium*) counted only as equal to the vote of a single prince (*Virilstimme*).

There were six of these groups, but as the votes of the whole college of princes and counts (at any rate in the 18th century) numbered too they could exercise but little weight.

The last era in the history of the diet may be said to open with the treaty of Westphalia (1648). The treaty acknowledged that Germany was no longer a unitary state but a loose confederation of sovereign princes and the diet accordingly ceased to bear the character of a national assembly and became a mere congress of envoys. The last diet which issued a regular "recess" (*reichshausbuch*—the term applied to the acts of the diet, as formally compiled and enunciated at its dissolution) was that of Regensburg in 1654. The next diet, which met at Regensburg in 1663, never issued a recess and was never dissolved, it continued in permanent session, as it were, till the dissolution of the empire in 1806. This result was achieved by the process of turning the diet from an assembly of principals into a congress of envoys. The emperor was represented by two *commissarii*, the electors princes and towns were similarly represented by their accredited agents. In practice, the diet had nothing to do and its members occupied themselves in "wrangling about chairs"—that is to say, in unending disputes about rights of precedence.

In the Germanic confederation, which occupied the interval between the death of the Holy Roman empire and the formation of the North German confederation (1815-66), a diet (*bundestag*) existed which was modelled on the old diet of the 18th century. It was a standing congress of envoys at Frankfurt on Main. In the North German confederation (1867-70) a new departure was made, which was followed in the constitution of the German empire after 1870. Two bodies were instituted—a *bundesrat*, which resembled the old diet in being a congress of envoys sent by the different states of the confederation and a *reichstag*, which bore the name of the old diet but differed entirely in composition. The new *reichstag* was a popular representative assembly, based on wide suffrage and elected by ballot, and, above all, it was an assembly representing not the several states, but the whole empire, which was divided for this purpose into electoral districts. Both as a popular assembly and as an assembly which represented the whole of a united Germany, the *reichstag* of modern Germany went back, one might almost say, beyond the diet even of the middle ages to the days of the old Teutonic folk-moot.

See R. Schröder, *Lehrbuch der deutschen Rechtsgeschichte* (1902), pp. 149, 408, 820, 880. Schröder gives a bibliography of monographs bearing on the history of the medieval diet. (E. B.)

DIET AND DIETETICS. Dietetics is the science and art of feeding human beings. It involves a knowledge of foods, their composition and preparation, and what they contribute in essential

nutrients for tissue repair and growth, for heat and energy and the normal functioning of the body.

Most if not all foods contribute more than one essential nutrient. Nutrients are chemical substances or compounds which make specific contributions to some phase of the body economy. Bread, milk, apples, oranges and carrots are examples of foods, while nutrients are such things as ascorbic acid (vitamin C), found abundantly in citrus fruits, calcium, found abundantly in milk, iron, found in fruits, vegetables, meat, enriched white bread and other foods, and proteins, found in varying amounts in milk, meat, eggs, fish, poultry, beans, nuts and, to a lesser extent, in cereals and other foods. By satisfying hunger with a reasonable variety of foods the normal individual is provided with essential nutrients in amounts sufficient to maintain the body in a state of health.

In any consideration of food needs it is essential to bear in mind the fact that wholesome foods all contain a variety of nutrients, each capable of contributing to body needs. In fact, it is characteristic of foods that they contribute more than one nutrient. Granulated sugar is often thought of as a food, but it is actually an isolated nutrient. It is a pure carbohydrate sucrose, which contributes calories only. On the other hand, white flour is often thought of as merely starch. In reality, it contributes a variety of nutrients. Whole wheat flour and white flour, enriched with nutrients known to be lost in milling, contribute a great variety of essential nutrients. Both of these make important contributions to the body's supply of needed protein, iron, thiamine and other B vitamins. The laudable practice of adding significant amounts of milk to bread (as much as 6% of moist milk solids may be added in the preparation of bread) permits this food to contribute to the body's need for calcium, and has improved the protein content of bread. Meats ordinarily thought of as protein foods furnish many other constituents. They supply varying amounts of fat in addition to B vitamins, iron and other minerals. Milk is often called man's most nearly perfect food because it supplies such a variety of nutrients. It contributes fats, carbohydrates, proteins, minerals and vitamins. Without milk in the diet it is difficult to meet the calcium needs of the body. Vegetables supply a great variety of minerals and vitamins when cooked properly or when eaten fresh. Green and yellow vegetables contribute importantly to vitamin A needs. Ripe fruits supply sugars as well as vitamins and minerals.

Basic Food Groups.—Most of our foods are included in the following five groups: (1) cereals and cereal products, (2) meat, eggs, poultry and fish, (3) milk and milk products, (4) fruits, and (5) vegetables.

For purposes of giving emphasis to certain foods these basic natural food groups may be subdivided still further. For example, milk and milk products are sometimes divided into two groups, one including butter and another including milk and the other milk products. Sometimes vitamin C rich foods are considered as a special group for emphasis. Such a group would include the citrus fruits, tomatoes, cantaloupes and strawberries.

These basic food groups furnish a guide to the preparation of an adequate diet without recourse to more profound scientific knowledge. More precise selections and greater variety may be obtained by taking advantage of technical information concerning nutrient values which are discussed later in this section.

Acceptable diets, containing all essential nutrients and capable of sustaining good nutrition, can be obtained when the daily diet includes foods from each of the five groups of foods mentioned above. By varying the selection of foods in each group, meals can be made interesting as well as fully nourishing. Furthermore, for variety or economic reasons it is often possible to supplement the foods of one group with those of another. The daily allowances indicated below are suggestive only, but they do indicate a simple manner of selecting an acceptable diet.

Basic Food Guide.—*Whole Grain or Enriched Cereals and Breads.*—Daily allowances for adults and children are three servings, for adolescents more is required, sometimes as much as six servings daily.

Meats, Fish, Poultry, Eggs—These include beef, veal, lamb, mutton and lean pork, the organ meats, such as liver, heart, kidney, brains, sweetbreads, also fish, poultry eggs and game. Sources of vegetable protein which may be used as supplements or extenders are soybeans, dried beans, peanuts, peas and nuts. Eggs and cheeses including cottage cheese are excellent sources of animal protein. Daily allowances about two servings daily for adults and school children, three for adolescents and one for preschool children. In pregnant and lactating women a liberal intake of protein foods is usually recommended.

Milk and Milk Products—These include whole skimmed, evaporated and dried milk, acidified milks and cheeses. Daily allowances for adults, two to three cups, for school children and preschool children, about three to four cups, for adolescents four cups.

Fruits—Daily allowance is two or three servings. In the selection of fruits it is essential to include fruits which are good sources of ascorbic acid (vitamin C), such as the citrus fruits, tomatoes, cantaloupes, strawberries and fresh pineapple. (Many green vegetables are also good sources of vitamin C.) The daily allowance of citrus or tomato juice is as follows for adults and school-age children, one half cup, for adolescents, three-fourths cup, and for preschool children one-third cup—more if desired.

Other fruits include apples, apricots, avocados, bananas, cherries, cranberries, currants, berries, dates, figs, grapes, peaches, pears, persimmons, prunes, rhubarb and watermelon. Daily allowance, one or more servings for individuals of all ages.

Vegetables—Daily allowance of green or yellow vegetables for adolescents and school children is one half cup or more, for preschool children, one fourth cup or more. One or more servings of other vegetables should be included daily.

Exceptions to the rule that the five basic food groups will supply all nutrients known to be essential may occur in certain circumstances. Iodine is an essential nutrient, but it is lacking or present only in negligible amounts in the drinking water and food in parts of most continents. In Canada the lack has been remedied by making it mandatory for manufacturers of salt to add minute but specified amounts of iodine to all table salt. The lack of sufficient iodine to supply body needs is an important factor in the production of simple goitre (*q.v.*). The regular supply of traces of iodine in food or water appears to be an important weapon against this disease.

Vitamin D, important in tooth and bone development and in the prevention of rickets in babies, is not always present in the diet or otherwise available unless special precautions are taken. When not present in foods this lack can be remedied by sunbathing, but when this is not possible the deficiency may be remedied by adding vitamin D concentrate or the pure vitamin to the diet. Four hundred international units is generally regarded as an adequate daily intake. Infantile rickets has been greatly reduced by the widespread use of vitamin D preparations and by the use of vitamin D milk. (See also VITAMINS.)

Nutrients and Nutrient Needs in Diet Planning—Essential nutrients are supplied in the form of proteins, carbohydrates, fats, vitamins and minerals. All of them fall into these five general groups.

Proteins—G. J. Mulder, in 1838, gave us the name "protein," which has come to include a large group of related nitrogen-bearing organic compounds. The proteins are widely distributed in nature and no life is known without them. Man builds the proteins that he needs for growth and repair of tissues by breaking down into their component parts the proteins obtained in food, and by building up these components, the amino acids, into proteins of the type needed. Plants, on the other hand, build their proteins from the simpler inorganic materials found in the soil and air.

The dietary protein needs of man are supplied from both plant and animal sources. The protein rich foods from animal sources, such as milk, eggs, meat, fish and poultry, contain complete proteins. Complete proteins supply all the amino acids necessary in the human diet. The vegetable proteins vary in their biological value in that they supply varying amounts of the

essential amino acids. Combination of proteins of plant and animal origin work well together in supplying in a protein needs. Of the vegetable proteins the chief source is grain. Other sources include soybeans, pea proteins, beans and nuts. Fruits and vegetables contribute little to the total protein requirement.

A protein allowance of one gram per kilogram of body weight per day for the normal adult is widely accepted as allowing a good margin of safety. (Special dietary needs for protein are discussed elsewhere in this section under the heading *Special Dietary Needs of Population Groups*.) The minimal requirement of protein is apparently in the neighbourhood of one half gram per kilogram of body weight per day.

Carbohydrates—The most abundant and least expensive food sources of heat and energy are the carbohydrates. There is a great variety of them. Important dietary carbohydrates are divided into two groups: starches and sugars. The starches may be converted into utilisable sugars in plants or in our bodies. Important sugar include the monosaccharides, the disaccharide (common table sugar is in this group) and the polysaccharides. Starches are abundant in the grains and in potatoes, both of which are important staple items of most diets. Starches are present in vegetables in varying amounts. In fruits starches tend to be converted into sugars with ripening. Most of the starch in a banana, for example, has been changed to sugar by the time it is fully ripe.

Actually, the caloric need of an individual (supplied by fats and proteins in addition to carbohydrates) is that amount of energy food which will maintain body weight over a prolonged period at an optimal level, in the case of a growing child the caloric need is the amount that will maintain a satisfactory rate of growth. (Caloric needs are also discussed under the section *Special Dietary Needs of Population Groups*.)

Fats—The fats are widely distributed in nature and are a concentrated food source of heat and energy. Some fat is apparently essential in the diet although the precise mechanism of the role of essential fatty acids requires further study. Fats are glycerol esters of fatty acids. When broken down by hydrolysis fats yield fatty acids and glycerine. After digestion and absorption fats are used as sources of heat and energy or they may be stored in the fat deposits of the body. Body fat can be produced from the carbohydrate taken in the diet and may be stored likewise as fat deposits when more is taken than is needed. The ordinary diet containing milk and meat usually contains a full quota of fat.

The Vitamins—The vitamin needs of the body with the possible exception of vitamin D in infancy and childhood, are supplied in quantities sufficient to meet dietary requirements in the foods which compose an acceptable wholesome diet. These substances are required only in minute amounts daily, often in amounts so small as to be invisible to the naked eye. Basic requirements for some are reasonably well established, but like most essential nutrients nature tends to supply more than is needed for basic body needs in health. Lack of individual vitamins produces characteristic deficiency states and the overuse of some of them has been shown to have harmful effects. It is desirable, therefore, that the intake should be adequate but not excessive. When vitamins are taken in the form of foods the likelihood of excessive use is remote. The therapeutic use of chemically pure vitamins in excess of normal needs is not within the purview of this report. The recommended daily dietary allowances as reported by the Food and Nutrition Board of the National Research Council will be found in their bulletin on dietary allowances (see *Bibliography*) for the following vitamins: vitamins A and D, thiamine, riboflavin, niacin and ascorbic acid. In the case of a physically active man weighing 70 kg (154 lb) the following daily allowances are recommended: vitamin A, 5,000 international units, thiamine, 1.5 mg, riboflavin, 1.8 mg, niacin, 15.0 mg, ascorbic acid, 75.0 mg. In cases of special stress, as in adolescence and in pregnancy and lactation, slight to moderate increases are recommended.

Vitamin A is found abundantly in green and yellow vegetables, in eggs and milk and butter. Thiamine (vitamin B₁) is widely

The Quality of Foods—What are some of the criteria by which the quality of foods is evaluated? First and foremost, a food must make a significant contribution to the human dietary requirements. Ideally, the food should make the expected contribution of the best specimens in its particular group. Efforts are constantly made to improve foods through the selection of better varieties of plants and breeds of animals. Most fruits and vegetables are richest in nutritive values when freshly picked. Unless refrigerated or otherwise properly stored they deteriorate with standing. Cool or cold storage temperatures are important considerations. Nutrient losses tend to be accelerated by high storage temperatures. Cold storage and the development of quick freezing techniques have done much to conserve nutrient quality.

Foods must be clean. Surfaces must be clean or capable of being cleaned by washing or scouring or removal of the surface layers. Foods must be free from insect parts, rodent hairs or excreta or other filth. These are usually things that the ordinary consumer cannot recognize. For protection he must depend upon the technical ability and vigilance of food handlers and government experts.

Foods must be free from harmful bacteria. Milk, particularly, is likely to be the carrier of harmful organisms unless especially protected through care in handling and pasteurization. Infected milk is known to have been the carrier of tuberculous typhoid fever, septic sore throat and other infectious diseases. Advances have been made in the quality of cheese. Certain communities require that all cheese either be made from pasteurized milk or aged for a sufficient length of time to ensure that harmful bacteria have been rendered innocuous. In certain parts of the world where the soil is contaminated with the eggs of intestinal parasites an important criterion of quality is freedom from these contaminations. In such areas it is usually necessary, however, to scrub, wash, peel or cook vegetables and fruits carefully in order to ensure their safety.

Wholesome foods are free from the presence of chemical contaminants. Chemical contamination of foods may occur either by accident or by intent. During and after World War II large numbers of pesticides (poisons developed for the control of insects and other pests) were developed. The health hazards of pesticide residues on foods brought about intensive research on this problem and active steps were taken to establish safe methods of use. Many chemicals are proposed each year for use in foods for the purpose of improving their colour, texture and appearance. Some of these are harmless, others are not. A wholesome food must contain no added chemicals unless they have been proved beyond reasonable doubt to be harmless, the chemicals must not be employed to conceal evidence of inferior quality. A number of chemicals and hormones have been used experimentally in animals for the purpose of improving milk production or the quality of meat. Milk or meat produced from such animals must be regarded as of questionable quality unless the substances used can be demonstrated to be harmless when consumed with the milk or meat.

The Preservation of Foods—New ways of preserving food are being developed and old techniques improved constantly. One of the oldest methods is dehydration. Preservation with spices, pickling fluids and salt and by cooking and the use of cold were originally introduced long ago. Refinements of some of these methods were developed by mid 20th century, one of special interest being the quick freezing technique. Quick freezing, of course, does not improve the quality of foods. It simply is a good method of conserving the original nutrients of the food at the time when the process was started. The quality of frozen foods depends to a large extent upon the quality of the foods put into the freezer. This fact is true of other techniques but is often overlooked.

Cooking—One of the chief reasons for cooking many foods lies in the fact that it makes them more palatable and easier to eat, and sometimes easier to digest. For example, long, slow cooking will often make a tough piece of meat tender. Cooking improves the digestibility of certain classes of foods. It splits the

envelopes of starchy granules, it favourably affects milk curds so that they are smaller and softer when they reach the stomach and thus more readily digested. Cooking kills micro organisms and the eggs of parasites. Raw or smoked pork for example should never be eaten, it should always be cooked in order to kill the parasite which produces trichinosis. Cooking reduces or destroys some of the vitamins, especially those which are easily affected by heat. Vitamin C, or ascorbic acid is one of the nutrients which is readily destroyed by heat in the presence of oxygen. This is one of the reasons why fresh fruit and garden vegetables in salads are useful additions to the diet. Generally speaking, when vegetables are cooked they should be subjected to heat for the shortest time possible, to accomplish the desired results. A minimum of cooking water should be used. When the cooking water is thrown away valuable nutrients usually go with it. **Minimal Daily Requirements of Nutrients**—The milk at a minimum of an individual nutrient that will sustain normal nutrition is said to be the minimal requirement of the nutrient in question. These minimal requirements vary with age, with the amount of food taken and for other reasons. In actual practice nature has provided when a diet of wholesome foods is ingested, that nutrients shall be present in slight to moderate excess of the basic or minimal requirement. Thus, in actual practice and in the calculation of diets, the dietitian and nutritionist usually estimate food nutrient requirements sufficiently above the level requirement to permit a reasonable margin of safety. One of the important contributions of the Food and Nutrition board of the National Research Council has been the preparation of a report called *Recommended Dietary Allowances*. This report has had important effects on the thinking and practice of most dietitians and nutritionists.

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DIETARY see DIET and DIETETICS
DIETRICH, FRIEDRICH (1821-1903), German orientalist and a pioneer in mediaeval Arabic studies, was born on July 6 1821 in Berlin where he died on Aug. 18, 1903. He travelled in Egypt and the near east from 1847-49 and on his return became professor at Berlin. His writings did much to stimulate an appreciation of the speculations of the mediaeval Arabs; they include *Alfihrah carmen grammaticum auctore Ibn Malik* (1851), *Mulanabhi carmina cum commentario Whiddu* (1858), *Die Philosophie der Ibrer im 9 u 10 Jhr n Chr* (1876-94), *Die sogenannte Theologie des Aristoteles*, trans. from Arabic (1883), *Der Streit zwischen Mensch u Thier* (1884), *aus den Schriften der lauterer Bruder ubersetzt* (1888), *Alfarabi philosophische Abhandlungen*, Arabic ed. (1892), *Der Musterstaat von Alfarabi* trans. from Arabic (1900), *Christomathie Ottomane* (1854), and an oriental novel, *Murjan* (1886).

DIETHER VON ISENBURG (1412-1461), second son of Count Diether of Isenburg-Budingen, was rector of the University of Erfurt in 1434 and became archbishop of Mainz in 1450. He led the movement for the reform of the empire, and the opposition to the papal encroachments, supporting the theory of church government enunciated at the councils of Basel and Constance and condemned in Pius II's bull, *Faithfuli*. (See PAPACY.)

DIETRICH, CHRISTIAN WILHELM ERNST (1712-1774), German painter and engraver, was born at Weimar on Oct. 31, 1712 and died at Dresden on April 24, 1774. He was taught by his father, Johann George, painter of miniatures to the court, and was then sent to Dresden to work under Alexander Thiele the landscape painter. Augustus II, king of Saxony sent him to Italy and the Netherlands where he learned to imitate the masters of the previous century with amazing fidelity. At Dresden there are pictures acknowledged to be his, bearing the fictitious dates of 1636 and 1638 and the name of Rembrandt. His "Itinerant Musicians," in the manner of Ostade, is in the National gallery, London. In 1741 he was appointed court painter to Augustus III at Dresden, with an annual salary conditional on the production of

four pictures a year and there are 50 of his canvases and panels in one room at the Dresden museum. A collection of his engravings at the British museum produced on the lines of earlier men, such as Ostade and Rembrandt, and both spirit and skill. Dietrich after his return from Italy generally signed himself 'Dieterich'. He was director of printing at the Meissen porcelain factory and professor at the Dresden academy of arts.

DIETRICH OF BERNE, name given in popular story to Theodoric the Great. The legend differs so widely from the true history that even in mythical times some doubted the connection and noted the glaring anachronisms. But the identity seems to be proved by the names Dietrich (Theodoric), Dietmar (Theudemir) Berne (Verona), Raben (Ravenna), and there is some resemblance in character between Theodoric and Dietrich. The south German cycle of Dietrich songs is partially preserved in the *Heldenbuch* (q.v.), *DiETRICHs Flucht*, the *Rubenschlacht* and *Alpharts Tod*, but it was reserved for a 13th century Icelandic to compile a consecutive account. This prose redaction (*Vilkinsa* or *Thidrekssaga*) incorporates much matter from the Nibelungen and Wayland legends, in fact, nearly the whole south German epos.

There are traces of a form of the story in which the hero started out from Byzantium for the conquest of Italy. But this was very early superseded by the existing legend, in which, perhaps by epic fusion with his father Theudemir, he was associated first with Attila and then with Ermanaric, by whom he was driven from his kingdom of Berne. After years of exile at Attila's court he returned with a Hunnish army and defeated Ermanaric in the Rubenschlacht (battle of Ravenna). Attila's two sons fell in the fight, and Dietrich returned to Attila to answer for their death; this seems to suggest that originally the Rubenschlacht was a defeat. In *Ermenrichs Tod* he slays Ermanaric, as in fact Theodoric slew Odovacer, in the *Hildebrandslied*. "Otacher" takes the place of Ermanaric. Dietrich's long stay with Attila represents Theodoric's youth spent at the Byzantine court. The period of exile was as usual adorned with marvellous exploits, most of which had no connection with the cycle, the poems of *König Laurin*, *Sigenot*, *Eckensteine* and *Virginal* are based largely on independent traditions. Through Attila, Dietrich enters the Nibelung cycle. In the final catastrophe it is he who, to avenge his Amelung, at last delivers Hagen to Kriemhild. His "flame breath" seems to be pure myth, but the tales of his demonic origin and of his being carried off by the devil may be ascribed to clerical hostility to Theodoric's Arianism.

Dietrich typifies the wise and just ruler as opposed to Ermanaric the typical tyrant. He is invariably represented as slow to anger, but once roused he overcomes even Siegfried (but probably the fight in the rose garden at Worms is a late accretion). The chief heroes of the Dietrich cycle are his tutor and comrade Hildebrand (see *HILDEBRAND*, *LAY* OF), with his nephews the Wolfings Alphart and Wolfhart, Wittich, who renounced his allegiance and slew Attila's sons, and Heime and Biterolf.

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DIEZ, FRIEDRICH CHRISTIAN (1794-1876), German philologist, the founder of Romance philology, was born at Gießen, Hesse-Darmstadt, on March 15, 1794. A visit to Johann von Goethe in 1818 decided the direction to his studies. Goethe had been reading François Raynouard's *Chansons de poésies originales des troubadours*, and advised the young scholar to explore the rich mine of Provençal literature which the French savant had opened up. Henceforth Diez devoted himself to Romance literature. He

moved in 1822 to Bonn, where he held the position of *Privatdozent*. His *Poésie der Troubadours* (1846) and *Leben und Werke der Troubadours* (1829), of both of which there are modern editions edited by Karl Bartsch, were his earliest important studies. In 1830 he became professor of modern literature at Bonn. The rest of his life was mainly occupied with the composition of the two great works on which his fame rests, the *Grammatik der romanischen Sprachen* (3 vol., Bonn, 1836-44, 5th ed., 1883) and the *Etymologisches Wörterbuch der romanischen Sprachen* (2 vol., Bonn, 1853, 5th ed., 1887), in these two works Diez did for the Romance group of languages what Jacob Grimm did for the Teutonic family. He died at Bonn on May 29, 1876. He also wrote works on Spanish and Portuguese language and early literature.

See W. Foerster, *Friedrich Diez* (1894).

DIEZ, town of Hesse Nassau, Ger., in the deep valley of the Lahn, crossed by an old bridge, 30 mi. E from Coblenz on the railway to Wetzlar. Population 3,850. It is overlooked by a former castle of the counts of Nassau Dillenburg, now a prison. Close by, on an eminence above the river, lies the castle of Oranienstein, formerly a Benedictine nunnery. The industries include iron works, machine making, colour preparation, lime burning and quarrying. In the vicinity are Fachingen, celebrated for its mineral waters, and the castle of Schaumburg.

DIFFERENTIAL, in a motor car (q.v.), the system of gears (usually situated in the back axle) by means of which one driving wheel may revolve with increased speed while the other is checked (in taking corners, etc.). In physics, differential apparatus (e.g., a differential thermometer) is designed in such a manner that errors caused by extraneous effects in the experiments are eliminated. (See THERMOMETRY.)

DIFFERENTIAL CALCULUS, ABSOLUTE see TENSOR ANALYSIS.

DIFFERENTIAL EQUATIONS In any scientific or technological field, such as astronomy, chemistry, engineering, physics, etc., the formulation of a natural law is regarded as completely precise and definitive only when it is expressed as a mathematical equation. This equation effectively relates the quantity, or function, upon which the attention is focused, with the independent variables such as time, position, etc., upon which it may depend. Now it is frequently—even prevalently—the case that the equation which does this involves besides the function itself, also one or more of its derivatives. Such an equation, specifically one in which a derivative or derivatives occur, is called a differential equation. The following are examples of such equations

$$\frac{dy}{dt} = -ky, \quad (1)$$

$$m \frac{d^2y}{dt^2} = -ky, \quad (2)$$

$$\left\{ t + \left(\frac{dy}{dx} \right) \right\} \frac{d^2y}{dx^2} - 3 \frac{dy}{dx} \left(\frac{d^2y}{dx^2} \right)^2 = 0 \quad (3)$$

In these y stands for the function, and either t or x is the independent variable. The symbols k and m are used here to stand for specific constants.

1. Classifications—Differential equations are classified in the first instance into several broad categories, and these are in turn subdivided into many subcategories. Of the former the most important are (a) the category of the so called ordinary differential equations and (b) that of the so called partial differential equations. When the function involved in the equation depends upon only a single variable its derivatives are ordinary derivatives, and the differential equation is classed as an ordinary differential equation. If, on the other hand, the function depends upon several independent variables, so that its derivatives are partial derivatives, then the differential equation is classed as a partial differential equation.

Whichever the type may be, a differential equation is said to be of the n th order if it involves a derivative of the n th order but no derivative of an order higher than this. The differential equations (1), (2) and (3) are all ordinary differential equations

They are, respectively, of the first, second and third orders. The equation

$$\frac{d^3u}{dt^3} = k \left[\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} \right], \quad (1)$$

is an example of a partial differential equation. It is of the second order. The theories of ordinary and partial differential equations are markedly different. In almost all respects the former is the simpler.

Some Examples of the Formulation of Natural Laws

—The way in which differential equations are utilized for the expression of natural laws is indicated in some small measure by the following examples.

A certain lot of radioactive chemical is constantly disintegrating, the rate of this process being at each instant proportional to the amount of the material which is then left. If the chemical is designated by y , and t is taken to stand for the time, the rate of the disintegration is $-dy/dt$. The stated law asserts that this value is always proportional to y , namely, that it is always equal to ky with k an appropriate constant. The law is, therefore, expressed by the differential equation (2) above.

If a heavy particle is suspended from a coiled spring, the position in which it will hang in a continued state of rest is called its position of equilibrium. On a vertical y axis this position can be taken as the point $y=0$. If the particle is vertically displaced from this position it will be subject to a restoring force that is always proportional to its co-ordinate of position y , and is opposite to this in sign. The formula for this force is, therefore, $-ky$ with an appropriate constant k . By Newton's second law of motion, the product of the mass m of the particle by its acceleration d^2y/dt^2 , is equal to the force. The law of motion in accordance with which the particle oscillates up and down is, therefore, expressed by the differential equation (2) above.

It is shown in the calculus that the curvature K of a curve $y=f(x)$ is given by the formula

$$K = \left[1 + \left(\frac{dy}{dx} \right)^2 \right]^{-3/2} \frac{d^2y}{dx^2}$$

The fact that a certain curve is a circular arc, may, therefore, be brought to expression by the assertion that along it K does not change, namely, by the equation $dK/ds=0$. This is found to be given explicitly by the differential equation (3) above. That equation thus formulates mathematically the law of the circular nature of the given arc.

Further illustrations of this process of the translation of scientific laws into differential equations will be found in practically all text books on the subject. The references given in the bibliography at the end of this article, numbered (3), (5), (9), (12) and (15), are typical in this respect.

3 Solutions of Differential Equations—An ordinary differential equation in which, for example, the function and the independent variable are denoted by y and x , is in effect an implicit summary of the essential characteristics of y as a function of x . These characteristics would presumably be more accessible to analysis if an explicit formula for y could be produced. Such a formula, or at least an equation in x and y (involving no derivatives), which is deducible from the differential equation is called a solution of the differential equation. The process of deducing a solution from the equation by the applications of algebra and the calculus is called that of solving or integrating the equation. Some methods that serve for the integration of certain classes of differential equations will be explained below. In the broadest sense, however, it must be said that the differential equations which can be integrated form but a small minority. The chances are large, in the instance of a differential equation selected at random, that the equation is itself the simplest mode of summarizing the characteristics of the function, and that even theoretically no solving formula in the usual sense exists. The function must in such instances be studied by indirect methods. Even its existence must be proved when no possibility of producing it for inspection maintains. These subjects find their place in the more advanced theory (cf. references (2), (7) and (8)).

4 Quadratures—An ordinary differential equation which is of so simple a type that their integration depends only upon an obvious application of the calculus, let us consider the equations of the form

$$\frac{dy}{dx} = f(x), \quad (5)$$

in which $f(x)$ is a given function. The solution of this equation, namely

$$y = \int f(x) dx + c, \quad (6)$$

affords us the occasion for some remarks which are of rather general applicability. In the relation (6) the indicated integration calls for some (any) indefinite integral of the function $f(x)$. For many types of functions such integrals are to be found in "tables of integral," such as that given below by the reference (11). Not all functions $f(x)$, however, and not even all simple ones, have integrals that can be expressed by elementary closed formulas. Hence an indicated integration is not always replaceable by an expression that is more explicit. For this reason a relation in the form (6) is generally regarded as a satisfactory solution of the equation (5), just as it stands. The term quadrature is frequently used in the place of indefinite integral, the relation (6) being styled as a solution in terms of an indicated quadrature.

5 The General Solution—The final term of the relation (6), being a constant of integration, and hence being eligible to any value whatever, is called an arbitrary constant. For each specific value of the constant the equation (6) defines a curve in the (x, y) plane, and while the constant remains arbitrary the equation refers to the whole aggregate or family of these curves. This family is the solution of the differential equation. What is thus observed in the simple case of the equation (5) is generally true of differential equations. The process of solution draws one or more arbitrary constants into the relations, and these as a result represent a family of curves. A solution which includes the maximum possible number of arbitrary constants is called the general solution of the differential equation. It can be shown that this maximum number is precisely (equal to) the order of the differential equation, namely that the general solution of an ordinary differential equation of the n th order involves n arbitrary constants.

For any set of specific values of the constants the solving relation still yields a solution. Such a one is called a particular solution. In an obvious sense the general solution includes all the particular solutions. In the case of some differential equations still other solutions exist. These are called singular solutions. Discussions of them may be found in the references (5), (8), (9) and (12).

6 Initial and Boundary Conditions—The presence of arbitrary constants in the general solutions of ordinary differential equations is a matter of fundamental significance for the application of these equations to scientific problems, for such problems ordinarily call not merely for a solution of the equation, but for the solution which fulfills also certain other relations that are pertinent to it. These auxiliary relations must, therefore, be fulfilled by the appropriate assignment of values to the arbitrary constants. Some examples will illustrate this.

In §2 it was shown how the disintegration of a chemical substance is formulated by the differential equation (1). The general solution of this equation is

$$y = ce^{-kt}, \quad (9)$$

in which the constant c is arbitrary. Now in any specific case the chemical is of a definite amount, say 20 grams, at some definite time, say at $t=2$. These values, upon being substituted for y and t in the equation, impose upon c the relation $20 = ce^{-2k}$, in accordance with which $c = 20e^{2k}$. The solution which fits this case is, therefore, $y = 20e^{k(2-t)}$.

It was also shown in §2 how the motion of a suspended particle is formulated by the differential equation (2). The general solution of this equation (obtained by a method described below) is

$$y = c_1 \cos \frac{kt}{\sqrt{m}} + c_2 \sin \frac{kt}{\sqrt{m}} \quad (10)$$

Now in any specific case the particle is at a definite place, say at $y=1$, and is moving with a definite velocity, say $dy/dt = -1$, at a definite time, say at $t=0$. These values substituted into (10) and the derived equation impose upon c_1 and c_2 the relations $t=c_1$, and $-k=c_2/\sqrt{m}$. Thus it is requisite that $c_1=1$, $c_2=-\sqrt{m}/2k$, and accordingly the solution that fits the problem is

$$y = \cos \frac{kt}{\sqrt{m}} - \frac{\sqrt{m}}{2k} \sin \frac{kt}{\sqrt{m}}$$

Auxiliary conditions that are imposed upon the solution of a differential equation at some one value of the independent variable, as in the examples above, are called initial conditions. If the auxiliary conditions apply at two or more values of the independent variable, they are more usually called boundary conditions. Problems leading to such conditions are called differential boundary problems. The references (3) and (4) are primarily concerned with such problems. Considerable numbers of elementary initial value problems are to be found in the references (5), (9), (12) and (15).

DIFFERENTIAL EQUATIONS OF THE FIRST ORDER

Some Elementary Types

7 **Equations with Separable Variables**—The ordinary differential equation of the first order, when it is solved for the derivative is of the form

$$\frac{dy}{dx} = f(x, y), \quad (11)$$

in which $f(x, y)$ is an explicit function. A form which is obviously equivalent to this but which is in some respects more convenient, is

$$M(x, y)dx + N(x, y)dy = 0 \quad (12)$$

The case to which attention is to be given first is that in which the equation (12) is of the more special form

$$P(x)dx + Q(y)dy = 0, \quad (13)$$

or in which it can be brought into this form by multiplying it through by appropriate factors that are functions of x or of y . The salient specialization which distinguishes (13) from the general form (12) is that P , the coefficient of dx , does not involve y , and Q , the coefficient of dy , does not involve x . In the equation (13) the variables are said to be separated, and a differential equation which can be reduced to such a form is classified as an equation with separable variables. When the variables have been separated the integration of the differential equation devolves into a mere matter of quadrature. Thus the general solution of the differential equation (13) is given by the relation

$$\int P(x)dx + \int Q(y)dy = c, \quad (14)$$

with c denoting the arbitrary constant.

By way of example consider the differential equation

$$dy + ky \, dt = 0$$

This will be recognized as the equation (11) above. In this equation the variables are separable, for upon multiplication by the factor $1/y$ the form is changed to

$$\frac{1}{y} dy + k \, dt = 0,$$

in which the variables are separated. The integration now yields the solution

$$\log y + kt = c$$

The differential equation

$$y^2 dx + (4y-3) \cos^2 x \, dy = 0,$$

if multiplied through by the factors y^{-1} and $\sec^2 x$ takes the form

$$\sec^2 x \, dx + \left(\frac{4}{y} - 3\right) dy = 0,$$

in which the variables are separated. The integration of it

yields the solution

$$\tan x - \frac{2}{y^2} + \frac{1}{y} = c$$

The differential equations

$$1 + 5\frac{dy}{dx} = 3 + v\frac{dy}{dx},$$

$$y^2 dx + \sqrt{1-x^2} \, dy = 4dx,$$

are of this type. Their solutions are respectively

$$\log(v-5) - \frac{1}{2} \log(3^2 - 5) = c,$$

$$4 \sin x + \log \left(\frac{y-x}{y+x} \right) = c$$

8 **Exact Equations**—It is shown in the calculus that if two functions $M(x, y)$, $N(x, y)$, fulfill the relation

$$\frac{\partial M}{\partial y}(x, y) = \frac{\partial N}{\partial x}(x, y) \quad (15)$$

then there exists a function $\phi(x, y)$ concerning which it is true that $\partial\phi(x, y)/\partial x = M(x, y)$, and $\partial\phi(x, y)/\partial y = N(x, y)$. In accordance with this it is clear that if the differential equation (12) is one whose coefficients fulfill the identity (15) then the equation permits of being written in the form

$$\frac{\partial\phi(x, y)}{\partial x} dx + \frac{\partial\phi(x, y)}{\partial y} dy = 0$$

This may, however, be more concisely written as $d\phi=0$, and thus it must be concluded that $\phi(x, y)=c$. This is, then, the general solution of the given equation. It remains only to describe the means by which the function $\phi(x, y)$ may be found. This may be done as follows: treating y as though it were a constant, evaluate the integral $\int M(x, y)dx$. Then treating x as though it were a constant, evaluate the integral $\int N(x, y)dy$. The sum of all unlike terms in these two evaluations (i.e. including no repetitions) is the function $\phi(x, y)$.

As an example consider the differential equation

$$(\cos y - y + 1)dx + (3y^2 - y \sin y - x)dy = 0$$

The two members of the identity (15) are in this case each $(-\sin y - 1)$, and thus the equation is exact. Regarding y as a constant, the first member of the equation integrates into $x \cos y - xy + 1$. Regarding x as a constant, the second member integrates into $y^3 + x \cos y - xy$. Setting the sum of unlike terms equal to an arbitrary constant gives as the general solution

$$x \cos y - xy + 1 + y^3 = c$$

The differential equations

$$y(e^{xy} - \sin x)dx + (\cos x + xe^{xy})dy = 0,$$

$$(21y^3 - 3)dx + (3xy + 8y - \frac{1}{y})dy = 0,$$

may be verified to be exact. Their solutions are respectively

$$y \cos x + e^{xy} = c,$$

$$y^2 y^3 - 3y + 4y^2 - \log y = c$$

9 **Integrating Factors**—Although a differential equation, in the form in which it is come upon, may not be exact, it is possible to prove that by the multiplication with a suitable factor it may be made exact. Thus the differential equation

$$\left(xy + \frac{1}{y}\right)dx + \left(1 - \frac{1}{y^2}\right)dy = 0, \quad (16)$$

is not exact, but if it is multiplied through by the factor x it becomes so. A multiplier, such as x in this instance, which makes a differential equation exact is called an integrating factor. Other integrating factors for the equation (16) are $y/(xy^2+1)$, and $x^2(xy+\frac{1}{y})$. It can be proved that for every differential equation of the form (12) an unlimited number of integrating factors exists. In some simple cases it is possible to guess an integrating factor. Many text books point out errors made to be sought in the differential equation as guides to such guessing. In actual

practice, however, integrating factors are usually not easily found

10. **The Linear Equation**—A differential equation which can be written in the form

$$\frac{dy}{dx} + Py = Q, \quad (17)$$

in which the coefficients P and Q may be constants or functions of x , but do not involve y , is called a linear differential equation of the first order. This is a type of equation which is of considerable importance in many different connections. When the equation is given in the alternative form

$$[yP(x) - Q(x)]dx + dy = 0,$$

the remarks of §9 apply to it, and it is, in fact, found that the multiplier $e^{\int P(x)dx}$ is an integrating factor. By the method of §8 the general solution of the equation is thus found to be

$$ye^{\int P(x)dx} - \int Q(x)e^{\int P(x)dx} dx = C \quad (18)$$

As an example consider the differential equation

$$\frac{dy}{dx} + \left(1 + \frac{1}{x}\right)y = \frac{5}{x}$$

The integrating factor is $e^{\int (1 + \frac{1}{x})dx}$, a function which is more briefly written xe^x , and the solution of the equation is

$$xye^x - 5e^x = C$$

The differential equations

$$\frac{dy}{dx} + 2y \tan x = 2x \cos^2 x$$

$$(xe^{2x} - 2y\sqrt{1+x^2})dx + \sqrt{1+x^2}dy = 0,$$

are of this type. Their solutions are respectively

$$y \sec^2 x - x^2 = C,$$

$$ye^{-x} + \sqrt{1+x^2} = C$$

11. **Change of Variable**—When no convenient method for the integration of a differential equation suggests itself, a procedure which is frequently resorted to is the following one. Some combination of the variables x and y is taken as a new variable, say s , and the differential equation is then expressed in terms of this new variable and one or the other of the original variables. In its new aspect the differential equation may be of a form quite different from its original one. New possibilities for its integration may thus present themselves. It is not always possible to foretell how such a change of variable may profitably be made. In some instances certain combinations of the variables are obviously prominent in the differential equation and the clue as to a desirable change may therein be seen. Some examples will serve to explain and illustrate the procedure.

Consider the differential equation

$$(1+3y+2)x^2dx + (2x^2+6y+3)dy = 0 \quad (19)$$

The combination $x+3y$ appears with some prominence in this. If we set $s = x+3y$, namely $x = s-3y$, then in virtue of this latter we must set $dx = ds - 3dy$. On substituting these values for x and dx in the equation, this latter becomes

$$(s+2)(ds-3dy) + (2s+3)dy = 0$$

This is found to be an equation with separable variables. By the method of §7 it may be integrated into the relation

$$s - \log(s+3) - y = C$$

On replacing s by its value in terms of the original variables, it is found that

$$x+3y - \log(1+3y+x) = C,$$

and this is the solution of the given differential equation. As a second case let the differential equation given be

$$2xydx + (x^2y + y^2)dy = 0$$

In this all terms are of the same degree (the third) in x and y ,

and hence a multiplication of the equation by x^{-3} gives it the form

$$2\left(\frac{y}{x}\right)dx + \left[\left(\frac{y}{x}\right)^2 + 1\right]dy = 0$$

The change $s = y/x$, namely $y = xs$, is strongly suggested. In accordance with it $dy = xsds + sdx$ and with the substitution of these values of y and dy , the equation becomes

$$-sdx + (s^2 + 1)(xds + sdx) = 0$$

This has separable variables, and has the solution $\log(s^2 + 3s) = C$. Upon replacing s by its value in terms of x and y the solution of the given equation is obtained, namely

$$\log x + \log\left(\frac{y^2}{x^2} + \frac{3y}{x}\right) = C$$

A standard form of differential equation which yields to this method of integration is the equation

$$\frac{dy}{dx} + P(x)y = Q(x)y^k, \quad (20)$$

in which the coefficients P and Q do not involve y . If $k = 1$, the variables are separable, and if $k = 0$, the equation is linear. The integration in these cases has, therefore, been already discussed. In the remaining cases, namely $k \neq 0, k \neq 1$, the change of variable $s = y^{1-k}$ reduces the equation to the linear form

DIFFERENTIAL EQUATIONS OF THE SECOND ORDER

12. **The Linear Equation**—The differential equation of the n th order which is of the form

$$a_n \frac{d^2 y}{dx^2} + a_{n-1} \frac{dy}{dx} + a_{n-2} y = f(x), \quad (21)$$

in which the coefficients a_0, a_1, \dots, a_n , may be functions of x but do not involve y or any of its derivatives, is called the linear differential equation of the n th order. The equation which differs from this only by having zero as its right hand member in the place of $f(x)$, is called the corresponding reduced or homogeneous equation. Certain facts concerning equations of this type greatly facilitate the construction of their solutions. These are primarily the following. If $y_0(x)$ is any solution (particular) of the differential equation (21), and $y_1(x), y_2(x), \dots, y_{p-1}(x)$ are any linearly independent solutions of the corresponding reduced equation, then the relation

$$y = y_0(x) + c_1 y_1(x) + c_2 y_2(x) + \dots + c_{p-1} y_{p-1}(x), \quad (22)$$

in which the coefficients c_1, c_2, \dots, c_{p-1} are arbitrary constants, is also a solution of the equation (21). If, in particular, the number p is n , the solution (22) is the general solution since it involves n arbitrary constants. Because of these facts the integration of an equation (21) is achievable by the determination, in any manner, of a particular solution of that equation, and of n functionally distinct particular solutions of the reduced equation.

Insofar as the application of differential equations to physics and engineering are concerned, the linear type of equation is of very great importance. Since by far the largest number of applications lead, moreover, to differential equations of the second order, we shall confine our discussion to these in the following. Such equations are solvable by elementary methods, as will be shown, whenever the coefficients are constants. When these coefficients are more general functions of x , on the other hand, explicit solutions in simple closed formulas usually do not exist. Because of their very great importance a number of equations of this kind have been endowed with proper names, such as the Bessel equation, the Legendre equation, the Mathieu equation, etc., and volumes have been written about them.

13. **Some Examples from Physics**—When the differential equation (21) is of the second order, it is explicitly

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = f(x), \quad (23)$$

and its reduced equation is

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = 0 \quad (24)$$

If a_0 is a constant, it is assumed to be different from zero, since the equation would otherwise be of a lower order than the second.

In §2 the physical problem of a weight suspended from a coiled spring and oscillating in the vertical direction about the point $y=0$ was shown to be formulated by the differential equation (2). It will be observed at once that this equation is of the type (24). Had the position of equilibrium been chosen to be some value of y different from zero, the resulting differential equation would have been of the type (23). In the following, some other formulations from the field of physics are shown to lead to differential equations of this type.

If a body of mass m and weight w is permitted to fall in a vacuum, the pull of gravity exerts upon it a force equal to its weight. By Newton's second law of motion this force is equal to the product of its mass by its acceleration, the latter being $d^2 y/dt^2$, if y denotes the distance through which it has fallen. The motion is thus formulated by the differential equation

$$m \frac{d^2 y}{dt^2} = w,$$

and this is of the form (23). For the case of a fall, not in a vacuum, but in a medium, such as air, which resists the motion with a force which is at any instant a constant k times the velocity, the effective downward force is $w - k^2 dy/dt$. The law of motion is accordingly

$$m \frac{d^2 y}{dt^2} = w - k^2 \frac{dy}{dt},$$

and this is again a differential equation of the type (23).

The discharge of an electrical condenser through an inductive coil of wire may also be readily formulated in symbols. The potential difference V between the terminals of the condenser is at each instant proportional to the charge Q upon it, the constant C in the relation $Q=CV$, being called the condenser's capacity. The current I of the discharge is the rate $-dQ/dt$ at which the charge diminishes, and thus $I = -CdI/dt$. The counter e.m.f. interposed by the coil is equal to the coil's inductance L times the rate of current change, and thus the effective voltage is $V - LdI/dt$. This is equal to the current times the resistance R , namely $V - LdI/dt = RI$. Upon substituting the value of I above, this equation becomes

$$V + LC \frac{d^2 V}{dt^2} = -RC \frac{dV}{dt},$$

and this differential equation is of the form (24).

14 A Solution of the Equation with Constant Coefficients—When the coefficients of the equation (24) are constants, as in the case of each of the equations which were derived in §13, the substitution

$$y = e^{rx} \quad (25)$$

with r standing for a constant, leads to the relation

$$(a_0 r^2 + a_1 r + a_2) e^{rx} = 0$$

This is fulfilled if r is a root of the equation

$$a_0 r^2 + a_1 r + a_2 = 0, \quad (26)$$

this being called the auxiliary equation of (24). When this auxiliary equation has two unequal roots, say $r=r_1$ and $r=r_2$, the formula (25) with either one of these values of r solves the differential equation (24). The same is true of the formula

$$y = c_1 e^{r_1 x} + c_2 e^{r_2 x}, \quad (27)$$

irrespective of the values of the constants c_1, c_2 . Since the relation (27) thus involves two arbitrary constants, it is the general solution of the differential equation (24).

The reasoning obviously requires some modification when the auxiliary equation (26) has a multiple root, when, in effect, it has only one root, say $r=r_1$. The exponentials on the right of (27) are then the same, and that relation involves only one arbitrary constant, namely $(c_1 + c_2)$. It is, however, easily veri-

fied that in this case the formula $y = x e^{r_1 x}$ is also a solution of the differential equation. The general solution is, therefore, in this instance given by the relation

$$y = c_1 e^{r_1 x} + c_2 x e^{r_1 x} \quad (28)$$

Let us consider now the equation (23). If a particular solution $y_0(x)$ of this equation is in any way obtainable, the general solution is given at once by the addition of this $y_0(x)$ to the right hand member of the appropriate relation (27) or (28). This was observed in §12, and was formulated in the relation (22). The matter at issue is, therefore, only the deduction of a particular solution $y_0(x)$. There are a number of procedures in common practice for achieving this. One such is the following.

The differential equation (23) may be written in the form

$$\frac{d}{dx} \left(\frac{dy}{dx} - r_1 y \right) - r_1 \left(\frac{dy}{dx} - r_2 y \right) = \frac{1}{a_0} f(x) \quad (29)$$

If the symbol $\varphi(x)$ is introduced with the significance

$$\frac{dy}{dx} - r_1 y = \varphi(x), \quad (30)$$

the equation (29) appears in the form

$$\frac{d\varphi}{dx} - r_1 \varphi = \frac{1}{a_0} f(x) \quad (31)$$

This, however, is a linear differential equation of the first order for the value of $\varphi(x)$, and by the relation (18) (with $c_0=0$) it is fulfilled if

$$\varphi(x) = e^{r_1 x} \int \frac{f(x)}{a_0} e^{-r_1 x} dx$$

The function $\varphi(x)$ has thus been made known, and, this being so, the solution $y(x)$ sought is shown by (30) to be obtainable by the integration of that equation. This is again an equation of the first order and the linear type. As applied to it the relation (18) (with $c_0=0$) yields

$$y = e^{r_1 x} \int \varphi(x) e^{-r_1 x} dx,$$

and this is the evaluation of the desired particular solution $y_0(x)$.

An example may not be amiss. Let us consider the differential equation

$$2 \frac{d^2 y}{dx^2} - 6 \frac{dy}{dx} + 4y = e^{-3x}$$

The auxiliary equation has the roots $r_1 = 1$, and $r_2 = 2$, and thus the general solution of the reduced equation is

$$y = c_1 e^x + c_2 e^{2x}$$

The equation (31) is in this case

$$\frac{d\varphi}{dx} - \varphi = \frac{1}{8} e^{-3x},$$

and a solution of it is $\varphi(x) = -\frac{1}{8} e^{-3x}$. The equation (30) is accordingly

$$\frac{dy}{dx} - 2y = -\frac{1}{8} e^{-3x},$$

and this admits as a solution $y = \frac{1}{40} e^{-3x}$. The general solution of the equation considered is, therefore,

$$y = \frac{1}{40} e^{-3x} + c_1 e^x + c_2 e^{2x}$$

15 The Method of Undetermined Coefficients — A procedure for finding a solution $y_0(x)$ which is in wide practical use, although it is not always applicable, is the following one. Suppose the right hand member $f(x)$ is expressible in terms of the functions of a set $\varphi_1(x), \varphi_2(x), \dots, \varphi_p(x)$, in the manner

$$f(x) = k_1 \varphi_1(x) + k_2 \varphi_2(x) + \dots + k_p \varphi_p(x), \quad (32)$$

with constant coefficients k_1, k_2, \dots, k_p , the functions of this set being such that the derivative of each one of them can also be so expressed. Then if $y_0(x)$ is assumed to be of the form

$$y_0(x) = b_1 \varphi_1(x) + b_2 \varphi_2(x) + \dots + b_p \varphi_p(x), \quad (33)$$

the coefficients a_1, a_2, \dots, b_n , may be determined. An example will illustrate the way in which this follows.

Consider the differential equation

$$\frac{d^2 y}{dx^2} + 3 \frac{dy}{dx} + 2y = 4x + 11 \cos x$$

In this case the right hand member is expressible in the form (32) with $\varphi_1 = x$, $\varphi_2 = 1$, $\varphi_3 = \cos x$, $\varphi_4 = \sin x$, and the derivative of each of these can be so expressed. Hence if we assume

$$y_0 = b_1 x + b_2 + b_3 \cos x + b_4 \sin x,$$

the result of substituting this into the differential equation is the relation

$$2b_1 x + (3b_1 + 2b_2) + (b_3 + 3b_4) \cos x + (b_1 - 3b_4) \sin x = 4x + 11 \cos x$$

Equating coefficients of similar terms we find that $2b_1 = 4$, $3b_1 + 2b_2 = 0$, $b_3 + 3b_4 = 11$, $b_1 - 3b_4 = 0$. These equations determine the evaluations $b_1 = 2$, $b_2 = -3$, $b_3 = -1$, $b_4 = 3$, and thus

$$y_0 = 2x - 3 - \cos x + 3 \sin x.$$

The methods of this and the preceding sections, as well as a number of other methods, are set forth in the references (5), (8), (9), (12) and (15).

16 The Method of Power Series—When the coefficients of the differential equation (23) are not constants but are continuous functions of x , the character of the solutions near any specific point x depends significantly upon whether the leading coefficient $a_0(x)$ is or is not zero at this point. In the former case the point is called a singular point, and such points are classified into several categories. For discussions of these matters the references (2), (3), (8) and (13) should be consulted. We shall assume in proceeding that for the values of x in question $a_0(x) \neq 0$, and that this and the other coefficients as well as the function A , are either polynomials or are representable in power series. The method is one of assuming a solution to be given by an infinite series

$$y = c_0 + c_1 x + c_2 x^2 + c_3 x^3 + \dots, \quad (34)$$

and then, by the substitution of this form into the equation, determining the coefficients. An example will make the procedure clear.

Thus consider the differential equation

$$(1-x) \frac{d^2 y}{dx^2} - 4 \frac{dy}{dx} + \frac{2}{1-x} y = 0$$

Since from (34)

$$\frac{dy}{dx} = c_1 + 2c_2 x + 3c_3 x^2 + 4c_4 x^3 + \dots,$$

$$\frac{d^2 y}{dx^2} = 2c_2 + 6c_3 x + 12c_4 x^2 + \dots,$$

whereas

$$\frac{2}{1-x} = 2 + 2x + 2x^2 + 2x^3 + \dots,$$

the terms of the differential equation (35) are respectively

$$(1-x) \frac{d^2 y}{dx^2} = 2c_2 + (6c_3 - 2c_2)x + (12c_4 - 6c_3)x^2 + \dots,$$

$$-4 \frac{dy}{dx} = -4c_1 - 8c_2 x - 12c_3 x^2 + \dots,$$

$$\frac{2}{1-x} y = 2c_0 + (2c_0 + 2c_1)x + (2c_0 + 2c_1 + 2c_2)x^2 + \dots$$

The result of substituting the form (34) into the differential equation is thus the relation

$$(2c_2 - 4c_1 + 2c_0) + (6c_3 - 10c_2 + 2c_1 + 2c_0)x + (12c_4 - 18c_3 + 2c_2 + 2c_1 + 2c_0)x^2 + \dots = 0$$

This is fulfilled if the coefficient of each power of x is zero, namely if

$$2c_2 - 4c_1 + 2c_0 = 0,$$

$$6c_3 - 10c_2 + 2c_1 + 2c_0 = 0,$$

$$12c_4 - 18c_3 + 2c_2 + 2c_1 + 2c_0 = 0,$$

If any choice is made of c_0 and c_1 these equations serve in turn

to give evaluations for c_2, c_3, c_4, \dots

Specifically let the choice $c_0 = 0$, $c_1 = 1$ be made. The values $c_2 = 2$, $c_3 = 3$, $c_4 = 4$, are found to result, and the series

$$y_1 = x + 2x^2 + 3x^3 + 4x^4 + \dots$$

is accordingly a solution. The alternative choice $c_0 = 1$, $c_1 = 0$, leads to the values $c_2 = -1$, $c_3 = -1$, $c_4 = -3$, and the series

$$y_2 = 1 - x^2 - 2x^3 - 3x^4 - \dots$$

is a second solution. When combined with arbitrary constants as multipliers these yield the general solution. The values of x for which solutions are thus obtained, are, of course, only those for which the infinite series are convergent.

17 Other Branches of the Subject—The field of differential equations is so vast that any short but adequate summary of it is quite impossible. It must suffice, therefore, to mention, aside from the topics already discussed, only some of the more prominent ramifications of it. In the place of only a single differential equation the object of study may be a simultaneous system of such equations. The formulation of the laws of dynamics frequently leads to such systems. In many cases a single differential equation of the n th order is advantageously replaceable by a system of n simultaneous equations each of which is of the first order. On this subject material is to be found in the references (1), (5), (8) and (9).

Certain problems call for the solutions of differential equations of a type called total differential equations. They are typified by the equation of the form

$$P(x, y, z)dx + Q(x, y, z)dy + R(x, y, z)dz = 0$$

(cf. the references (5), (8) and (9)).

When the number of independent variables is greater than one, the derivatives which come into question are partial derivatives, and equations involving them are partial differential equations. The theory of such equations is extensive and on the whole quite intricate. They are, however, of the greatest importance in the applications of mathematics to the sciences. Problems, such as the flow of heat in a body, the vibrations of stretched wires or membranes, the flow of electric current in cables, the deflections of elastic beams when loaded and others in great variety, require for their formulations partial differential equations. Elementary theory concerning these is to be found in the references (3), (5), (9), (10), (12) and (15). More advanced material is presented in the references (4) and (6).

As in the case of ordinary differential equations, so also in partial equations, the physical problem calls not merely for a solution but for the solution that also fulfills certain auxiliary conditions. A fundamental method for dealing with such problems, known as the method of separation of variables, effectively replaces the partial differential equation by certain related families of ordinary differential equations with appropriate boundary conditions. The theory of such families, which are generally designated as differential equations involving a parameter, is known as the theory of boundary value problems. This theory is the principal subject of the references (3) and (13), and is also treated in (4) and (8). Much theory of this kind, however, is only accessible in the literature of original mathematical research.

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DIFFERENTIAL FORMS The theory of differential forms is a branch of mathematics which presupposes several other branches, including differential calculus, algebra, and theory of functions. In essence, it is a theory of transformations of co-ordinates, such as

$$\begin{aligned}x &= f(x', y', z') \\ y &= g(x', y', z') \\ z &= h(x', y', z')\end{aligned}\quad (1)$$

which are differentiable and have single-valued inverses. This transformation carries any set of values of the variables x, y, z into a definite set of values of x', y', z' . It also induces the transformation of differentials

$$\begin{aligned}dx &= \frac{\partial f}{\partial x'} dx' + \frac{\partial f}{\partial y'} dy' + \frac{\partial f}{\partial z'} dz', \\ dy &= \frac{\partial g}{\partial x'} dx' + \frac{\partial g}{\partial y'} dy' + \frac{\partial g}{\partial z'} dz', \\ dz &= \frac{\partial h}{\partial x'} dx' + \frac{\partial h}{\partial y'} dy' + \frac{\partial h}{\partial z'} dz'\end{aligned}\quad (2)$$

Now consider a function

$$P(x, y, z)dx + Q(x, y, z)dy + R(x, y, z)dz, \quad (3)$$

in which P, Q , and R are differentiable functions of x, y , and z . This function has a definite numerical value whenever definite values are assigned to the variables x, y, z, dx, dy, dz . If we substitute for these variables according to the equations (1) and (2) we obtain a function

$$P'(x', y', z')dx' + Q'(x', y', z')dy' + R'(x', y', z')dz', \quad (4)$$

which has the same value as (3) whenever $x', y', z', dx', dy', dz'$ and x, y, z, dx, dy, dz are assigned values which are related by the equations (1) and (2). The two functions (3) and (4) are representations or components in different co-ordinate systems of the same differential form. In this case, since the expressions (3) and (4) are both linear functions, the differential form is said to be linear.

The components of a differential form can also be quadratic in the differentials, for example,

$$Edu^2 + 2Fdu dv + Gdv^2, \quad (5)$$

in which E, F , and G are functions of two variables u and v . In general, the components of a differential form are required to be functions which are differentiable in the variables x, y , etc., and differentiable and homogeneous in the differentials dx, dy , etc. In the cases usually considered they are homogeneous polynomials in the differentials. They may also be functions of several sets of differentials. For example, the quadratic form (5) is intimately related to the bilinear form,

$$Edu\delta u + F(du\delta v + dv\delta u) + Gdv\delta v$$

It is obviously a fundamental problem to determine whether two differential expressions, such as (3) and (4) for example, are or are not components of the same differential form. This is known as the equivalence problem. The study of this problem, as well as of related problems, has led to the discovery of differential invariants of various kinds. The simplest of these are functions formed from the given form which are unchanged in value by transformations of coordinates. For example, an invariant of (3) is the bilinear form,

$$\begin{aligned}\left(\frac{\partial P}{\partial y} - \frac{\partial Q}{\partial x}\right)(dx\delta y - dy\delta x) + \left(\frac{\partial Q}{\partial z} - \frac{\partial R}{\partial y}\right)(dy\delta z - dz\delta y) \\ + \left(\frac{\partial R}{\partial x} - \frac{\partial P}{\partial z}\right)(dz\delta x - dx\delta z)\end{aligned}$$

This example illustrates one of the uses to which differential invariants are put. For the vanishing of this bilinear form is a necessary and sufficient condition that (3) be a "complete differential." In other words, there exists a function $F(x, y, z)$ such that

$$dF(x, y, z) = Pdx + Qdy + Rdz,$$

if and only if this bilinear form vanishes. Other properties of

the differential form (3) are expressed by the vanishing of other invariants. Indeed, the typical way of saying anything about a differential form is to assert that such and such an invariant vanishes—and a very large proportion of the theorems of geometry and physics reduce to such statements.

Returning to the example of a linear differential form which has the components (3) and (4) in two coordinate systems we find, on carrying out the substitution of (1) and (2) in (3), that

$$\begin{aligned}P'(x', y', z') &= P \frac{\partial f}{\partial x'} + Q \frac{\partial g}{\partial x'} + R \frac{\partial h}{\partial x'}, \\ Q'(x', y', z') &= P \frac{\partial f}{\partial y'} + Q \frac{\partial g}{\partial y'} + R \frac{\partial h}{\partial y'}, \\ R'(x', y', z') &= P \frac{\partial f}{\partial z'} + Q \frac{\partial g}{\partial z'} + R \frac{\partial h}{\partial z'}.\end{aligned}\quad (6)$$

In these equations P stands for the function of x', y', z' , obtained by substituting (1) in $P(x, y, z)$, similarly Q and R . In the language of Tensor Analysis (*qqv*) the equations (6) state that the coefficients of a linear differential form are the components of a covariant vector. In like manner we can work out the equations of transformation, analogous to (6), of the coefficients of a differential form of any degree. It comes out that whenever the differential form is a polynomial in the differentials, the coefficients are the components of a covariant tensor. The theory of these differential forms is therefore co-extensive with that of covariant tensors.

The theory even of linear differential forms is very extensive and has applications in a wide variety of fields of mathematics and physics. We need only mention line integrals, vector analysis (*qqv*), and electricity and magnetism (*qqv*). The higher theory of linear differential forms and systems of linear differential forms is to be found in mathematical books usually under the heading "The problem of Pfaff," so called because the first investigations of the subject were made by Pfaff in 1814 and 1815.

The theory of quadratic differential forms was initiated in 1827 by Gauss, who showed that the metric properties of surfaces depend on forms of the type (5). This work of Gauss is also the foundation of modern differential geometry (*metric*) (*qqv*). From the point of view of differential forms his chief contribution was the discovery of an invariant, called the curvature, which is a function of E, F , and G , and their first and second derivatives, which is unaltered by all differentiable transformations of the variables u, v . The next important step was taken by Riemann, who in 1854 outlined the theory in its full generality and used it as the basis of what has come to be known as Riemannian geometry. He also showed that the curvature of Gauss must be replaced in the general case by what is now called the curvature tensor. The work of Riemann was followed immediately by that of Christoffel and Lipschitz. The former introduced the functions often called Christoffel symbols or the components of affine connection, and gave a solution of the equivalence problem. Lipschitz developed the calculus of variations (*qqv*) side of the subject and also the system of normal coordinates which had been sketched by Riemann. This work was followed by a long series of researches by many mathematicians.

The theory of quadratic differential forms has found many applications in geometry and physics, notably in dynamics. In recent years it has received a great deal of attention and been generalized in various directions because it is the foundation of Einstein's theory of relativity. In the researches of Einstein, as extended by Weyl and others, the phenomena of gravitation and electricity are described by means of a quadratic and a linear differential form restricted by the vanishing of certain invariants.

The theory of differential forms has been extended and generalized along various directions. The theories of topological spaces and the modern differential calculus in linear topological spaces have played and will no doubt continue to play a fundamental role in these developments.

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DIFFERENTIAL GEOMETRY (METRIC) Differential geometry is the theory of the properties of curved surfaces and higher manifolds in the vicinity of a general one of its elements, for example, a study of the properties of a curve in the vicinity of one of its points is a study in differential geometry. Straight lines, circles, planes and spheres have the property that any part of any one of them has the same shape as any other part. Other curves and surfaces do not have that property. The study makes much use of the calculus. Metric differential geometry concerns itself primarily with those properties with which the notion of measurement is associated.

The older metric differential geometry assumed that the curves and surfaces lay in Euclidean space of three dimensions, that is in ordinary space. It could be defined as the study of the differential properties of curves and surfaces invariant under rigid motions. The measurement of magnitudes was based on Euclidean measure. The Euclidean distance between two points whose rectangular Cartesian co-ordinates are (x, y, z) , $(x+d\bar{x}, y+d\bar{y}, z+d\bar{z})$ is given by the formula

$$(ds)^2 = (d\bar{x})^2 + (d\bar{y})^2 + (d\bar{z})^2 \quad (1)$$

The equation of a curve C , defined to be the locus of a one parameter family of points, may be written in the form

$$\bar{x} = f_1(t), \quad \bar{y} = f_2(t), \quad \bar{z} = f_3(t) \quad (2)$$

where t is the parameter. A value t of the parameter determines a point P , and a value $t+\Delta t$ determines a second point Q . If the line PQ approaches a limiting position as Δt approaches zero that limiting position is called the *tangent line* to C at P . This example shows that the property of a curve having a tangent line at a point is a differential property since it requires a knowledge of the curve in the vicinity of P and involves the limiting process. Computing the differentials $d\bar{x}$, $d\bar{y}$, $d\bar{z}$ from (2) and substituting these in (1), there is computed the length of an arc of C by integrating an expression of the form $ds = F(t)dt$.

If all of the points of a curve lie in a plane the curve is said to be a *plane*, otherwise it is *skew*. Let P be any point on C , and Q_1, Q_2 be any two other points on C in the vicinity of P . The plane determined by P, Q_1, Q_2 assumes a limiting position called the *osculating plane* of C at P as Q_1, Q_2 approach P independently along C . The circle determined by P, Q_1, Q_2 assumes a limiting position called the *osculating circle* or *circle of curvature*. It follows that the osculating plane of a plane curve is the plane of the curve, and the osculating circle of a circle is that circle. The normals to a curve at a point all lie in a plane called the *normal plane*. That normal which lies in the osculating plane is called the *principal normal*, and that one perpendicular to the osculating plane is called the *binormal*.

The rates of change, κ and τ , of the angles which the tangent and binormal respectively make with a fixed line per unit arc length s are called the *curvature* and *torsion* of C at P . The curvature κ is the reciprocal of the radius of the circle of curvature, whence the name of that circle. The quantities κ, τ and s are intrinsic properties of the curve, in the sense that given κ and τ as functions of s , the curve is uniquely determined except for its position in space. For example, if the curvature is a constant and the torsion is zero, the curve is a circle. Or again, if the curvature and the torsion are constants, the curve is a helix, that is, it forms the threads of a cylindrical screw (or bolt). The reader is referred to the many treatises and texts for further information concerning the theory of curves.

A surface S may be defined as the locus of a two parameter family of points. Its parametric equations may be written in the form

$$\bar{x} = f_1(u, v), \quad \bar{y} = f_2(u, v), \quad \bar{z} = f_3(u, v), \quad (3)$$

a formulation due to K. F. Gauss. A curve C on S may be defined by an equation of the form

$$v = v(u) \quad (4)$$

If the point P on S is an ordinary point of S , that is, is not a point like the vertex of a cone, all of the tangents to all of the curves on S through P lie in a plane called the *tangent plane*. The line perpendicular to the tangent plane to S at P is called the *normal* to S at P . Usually the tangent plane to a surface depends on two parameters, if it depends only on one, the surface S is said to be *developable*. Such a surface may be rolled out or *developed* on a plane. Cones and cylinders are examples of developable surfaces. Except for these two kinds of developable surfaces, a developable surface may be visualized as the locus of the tangents to a skew curve.

If $d\bar{x}, d\bar{y}, d\bar{z}$ are computed from (3) and substituted in (1) there is obtained an expression of the form

$$ds^2 = E du^2 + 2F du dv + G dv^2 \quad (5)$$

The differential form appearing in the right member of (5) is called the *first fundamental form* of S , and the coefficients E, F, G are called the *first fundamental coefficients*, they involve only the first derivatives of $\bar{x}, \bar{y}, \bar{z}$ with respect to u and v . Using (4) the length of a curve may be found from (5) by integrating an expression of the form $ds = f(u)du$. Angles between curves on S , and areas of portions of S involve E, F and G only.

If one imposes the condition on a curve C on S given by (4) that at each of its points its osculating plane coincides with the tangent plane to S at those points the differentials du, dv satisfy an equation of the form

$$Ddu^2 + 2D' du dv + D'' dv^2 = 0 \quad (6)$$

Such a curve is called an *asymptotic curve*. The quadratic form appearing in the left member of (6), into which a convenient factor of proportionality has been introduced, is called the *second fundamental form*, and D, D', D'' are called the *second fundamental coefficients*. These six fundamental coefficients subject to certain restrictions called the Gauss-Codazzi conditions play a role in the theory of surfaces similar to that played by the curvature and torsion in the theory of curves, in the sense that given these six coefficients as functions of u and v the surface is uniquely determined except for its position in space. For example, if the second fundamental coefficients are proportional to the first fundamental coefficients, the surface is a sphere.

Suppose that a curve C_1 through a point P on S is determined in such a manner that the tangents to C_1 at its points of intersection with a given fixed curve C_2 through P form a developable surface, that is, they are tangent to a third curve C_3 . The tangents to C_1 and C_2 are called *conjugate tangents*, implying that the roles of C_1 and C_2 may be interchanged. Any tangent to S at P has a conjugate tangent. Two sets of curves on S having for their tangent lines conjugate tangents form a *conjugate net*. The determination of conjugate tangents involves the second fundamental coefficients.

A section of a surface by a plane through the normal at P is called a *normal section*, and the curvature of the normal section is called the *normal curvature*. The normal curvature usually depends on the sectioning plane, if at a particular point the normal curvature is the same for every section, the point is called an *umbilical point*. For example every point on a sphere is an umbilical point. If P is not an umbilical point, there exist two sections of S at P such that one section has maximum and the other minimum curvature. These sections lie in perpendicular planes. The tangents to the sections are called *principal directions*. The principal directions are perpendicular and conjugate. The curves on S which are tangent at every point on S to the principal directions are called the *lines of curvature*. Their dif-

ferential equations involve both the first and second fundamental coefficients since they are both orthogonal and conjugate. The normals to S at points of a line of curvature form a developable surface.

The sum of the maximum and minimum normal curvatures is called the *mean curvature*, and their product is called the *Gaussian curvature* K . The Gaussian curvature may be described geometrically as follows: let Σ be a small portion of S including a point P , and let C be the bounding curve of Σ . Draw lines through the centre of a sphere with unit radius parallel to the normals of S at points of C . These lines will intersect the sphere in points of a closed curve C' . The limit as Σ shrinks to P of the ratio of the area enclosed by C' to the area of the portion ω of S is the Gaussian curvature K , the value of K is given by the formula

$$K = \frac{DD'' - D'^2}{EG - F^2} \quad (7)$$

Due to the Gauss-Codazzi conditions, K may be expressed in terms of E, F, G and their derivatives. Hence, the Gaussian curvature depends on the surface alone and not on the space in which the surface lies. The Gaussian curvature of a developable surface is zero, it is a positive constant for a sphere. A surface for which K is a negative constant is called a *pseudo-sphere*.

Through each point P of S and in each direction through P there is a curve whose osculating plane passes through the normal to S at P . Such a curve is called a *geodesic* since among them are the curves of shortest length on S . The geodesics on a sphere are the great circles. The differential equation of the geodesics involve only E, F, G and their first derivatives.

One of the important invariants of the curve on a surface is called the *geodesic curvature* of the curve. This invariant may be described in the following manner. Let there be given a curve C through a point P on S . Draw lines through the points of C parallel to the normal to S at P . These lines intersect the tangent plane to S at P in the points of a curve C' . The curve C' being plane has zero torsion, the curvature of C' at P is called the geodesic curvature of the given curve C at P . Another definition of the geodesic curvature indicates more clearly the reason for its name. Consider on C the point P and a second point P' on C at a distance of s from P measured along C . Let g and g' be geodesics tangent to C at P and P' respectively. Let these geodesics intersect at an angle of ϕ . Then the limit of ϕ/s as s approaches zero is the geodesic curvature of C at P . It is evident from this definition that the geodesic curvature of a geodesic is zero at each of its points, and conversely if the geodesic curvature of a curve is zero at each of its points, the curve is a geodesic.

Another invariant of a curve on a surface is called the *geodesic torsion* of the curve. Let g be the geodesic tangent to C at P . The torsion τ of the geodesic g at P is called the geodesic torsion of C at P . In particular the geodesic torsion of a line of curvature is zero.

It is not necessary to consider a surface as being immersed in Euclidean space or in any surrounding space for that matter. One may define the element of arc length ds by the formula

$$ds^2 = 2Eds^2 + 2Fduds + Gdv^2, EG - F^2 > 0$$

Definitions of lengths of curves, magnitudes of angles between curves, geodesics, curvature or in fact anything which involves only E, F, G may be made. We say that such a geometry on S is *Riemannian*. Or more generally let a point be defined as the ordered set of numbers (x^1, x^2, \dots, x^n) and the distance ds between that point and $(x^1 + dx^1, x^2 + dx^2, \dots, x^n + dx^n)$ be defined by the formula

$$ds^2 = g_{ij} dx^i dx^j \quad (8)$$

wherein g is taken to be ± 1 to insure that ds^2 be positive. Lengths of curves, magnitudes of angles, geodesics, etc. may be defined in terms of the g 's. Just as the Euclidean metric (1) induces the Riemannian metric (8) on a surface, the metric defined by (8)

induces a metric on a subspace $v = v^i(u^1, u^2, \dots, u^r)$, $i \leq r$. This metric will be of the form $ds^2 = g_{ij} dv^i dv^j$. That such a definition of a metric is not necessarily Euclidean follows from the fact that there may not be (and there usually isn't) a transformation $v = v^i(y^1, y^2, \dots, y^r)$ such that (8) reduces to the simple Euclidean form

$$ds^2 = (dy^1)^2 + (dy^2)^2 + \dots + (dy^r)^2$$

The tensor calculus, or absolute calculus of Ricci is a convenient tool for studying this Riemannian or non-Riemannian geometry.

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DIFFERENTIAL GEOMETRY (PROJECTIVE)

Projective differential geometry studies those properties of a geometric figure in the vicinity of one of its general elements which are unchanged by the general projective transformation. For example, the property that a curve have a tangent (or not have a tangent) at one of its points is a projective differential property of the curve at that point. The possession of an osculating plane by a curve at one of its points is a projective differential property of the curve at that point. However the existence of geodesics on a surface is not a projective property of the surface since the possession of a normal is not a projective property, or since the concept of length is not a projective concept.

At least three methods of studying projective differential properties of figures have been used. These three methods use respectively defining differential equations, power series expansions of the projective co-ordinates of a point of the figure in terms of a parameter or differential forms. The first and the last of these methods may use the tensor calculus, all use the calculus.

The reader is doubtless familiar with the fact that if the co-ordinate system is uniquely defined by the curve, the coefficients of the equation of the curve express in some fashion geometric properties of the curve. For example if, as in elementary analytic geometry, the co-ordinate axes are chosen as the major and minor axes of an ellipse, the equation of the ellipse becomes

$$x^2/a^2 + y^2/b^2 = 1$$

The geometric interpretations of the numbers a and b appearing in the coefficients are of course familiar. In a similar manner, if the co-ordinate system, the triangle of reference, be chosen in a proper and unique manner, the equation of a plane curve may be written in the form

$$y = x^3 + ax^2 + bx + c + (b + 2a^2)x^4 + \dots$$

Every coefficient in this power series is an absolute invariant of the curve under the general projective transformation, and hence they express all of the projective differential properties of the curve at the origin. The co-ordinate system is determined by using among other concepts, the concepts of tangent line, osculating conic and osculating cubic. The notion of a tangent line to a curve at a point on the curve is of course familiar, the osculating conic of a curve at a point O may be defined as the limit of the conic determined by the point and four other points on the curve as these latter points approach the given point O independently along the curve. The osculating cubic is defined similarly using the fact that a plane cubic is determined by nine unspecialized points. Since the concept of limit is so prevalent in the study of projective differential properties, it follows that

the calculus is a much used tool in the study. The reader will find full details of these and other matters concerning plane and skew curves in the references at the end of this section.

The locus of a two parameter family of points is called a surface S . A curve C on S is called an asymptotic curve if the osculating plane to C at each of its points coincides with the tangent plane to S at those points. There are ordinarily two one parameter families of asymptotic curves on a surface in a projective space of three dimensions, if there are less the surface is developable, if there are more the surface is a plane. Excluding the developables and planes, and using the asymptotic parameters as parameters for the surface, the homogeneous projective co-ordinates may be chosen so as to satisfy a system of differential equations known as the Fubini differential equations, namely

$$\begin{aligned}\frac{\partial^2 x}{\partial u^2} &= \frac{\partial \theta}{\partial u} \frac{\partial x}{\partial u} + \beta \frac{\partial x}{\partial v} + p x, \\ \frac{\partial^2 x}{\partial v^2} &= \gamma \frac{\partial x}{\partial u} + \frac{\partial \theta}{\partial v} \frac{\partial x}{\partial v} + q x, \\ \theta &= \log(\beta \gamma)\end{aligned}$$

The coefficients β , γ , p , q of this system are invariants of the surface.

Among the projective properties of a surface at one of its points, is the "order of contact" of the surface with a second surface. In particular there is a three parameter family of quadric surfaces having second order contact with S at a point O . Each of these quadrics intersects S in a curve with a triple point at O . If the quadrics are chosen so that the tangents at O to this curve of intersection are apolar to the asymptotic tangents at O , the quadrics are called *quadrics of Darboux*, and the triple point tangents are called *tangents of Darboux*. There is a one-parameter family of quadrics of Darboux at each point of S . Among these are many special quadrics, the *quadric of Lie* being probably the most interesting. It may be described in the following manner. Construct at O and at two other points P_1 , P_2 on an asymptotic curve C through O the tangents to the other asymptotic curves through these points. These three tangents determine a quadric whose limit as P_1 and P_2 approach O along C is the quadric of Lie.

A two parameter family of lines is called a *congruence*. For example, the metric normals to a surface form a congruence. If to a point O on S there is associated a line which varies with O the totality of these lines forms a congruence. As O moves along a properly chosen curve on S , the associated line of the congruence is tangent to a curve, that is, the line generates a developable surface. Ordinarily there are two one-parameter families of such curves on S . They are said to *correspond* to the developables of the congruence. If now a congruence is composed of lines through the points of a surface S but not lying in the tangent plane to S at those points, the reciprocal polars of these lines with respect to any quadric of Darboux form a congruence, the lines of which lie in the tangent planes of S but do not pass through their points of contact with S . Such pairs of congruences are called *reciprocal congruences*. Many pairs of reciprocal congruences have been studied. Among them are the *directrix congruences of Wilczynski*. These may be defined in the following simple manner. If the two sets of curves in S corresponding to the developables of a pair of reciprocal congruences coincide, then these congruences are the *directrix congruences* of Wilczynski.

In attempts to find a congruence which plays a role in projective geometry similar to that played by the congruence of metric normals, the concepts of conjugacy of tangent lines and *conjugate nets* are fundamental. These may be described briefly in the following manner: a tangent line to S at a point and its harmonic conjugate with respect to the tangents to the asymptotic curves through the point are called *conjugate tangents*. If one of a pair of conjugate tangents is chosen as the tangent to the curves of a one-parameter family of curves, the other of the pair is tangent to the curves of a second one-parameter family. Such two sets of curves form a *conjugate net*. Another characteristic property of conjugate nets may be stated in the follow-

ing manner: as a point O moves along one curve of a conjugate net, the tangents at O to the other curve of the conjugate net through O generate a developable surface. As a point moves along a curve on S , the metric normal generates a ruled surface. If the curve is chosen as a line of curvature, this ruled surface is a developable surface. The net composed of the lines of curvature is a conjugate net, and corresponds to the developables of the metric normal congruence. It is said that the metric normal congruence is *conjugate to the surface*. In general any congruence composed of lines protruding from the surface is said to be conjugate to the surface if the curves corresponding to its developables form a conjugate net. The reciprocal congruence of a congruence conjugate to a surface is said to be *harmonic to the surface*, its developables also correspond to a conjugate net on S . There are many congruences in projective differential geometry which could serve as a generalized normal congruence in the sense that the congruence is geometrically determined by the surface and is conjugate to the surface. Among these is the so-called Green-Fubini projective normal.

The curve whose tangents form a developable surface is called the *cuspidal edge of the surface*. From the characteristic property of conjugate tangents through O , each of the pair is tangent to a cuspidal edge at the *ray-point*. The two ray points so defined determine the ray of the net at O . The osculating planes at O of the curves of the net intersect in the axis of the net. The ray and axis, and the congruences generated by them have been the subjects of much study.

Geodesics play an important role in metric differential geometry. Attempts have been made to generalize the concept of geodesics to projective geometry. In the first place the extremals of the invariant integral $\int \sqrt{\beta \gamma} du dv$ are called *projective geodesics*. The osculating planes to all of the projective geodesics through a point is a cone of class three, the cusp axis of this cone is the projective normal of Green and Fubini. A second generalization of geodesics is the *union curves* of a congruence. They are the curves on S at each of whose points the osculating plane contains the line of the congruence through the point. This is a direct generalization of the concept of a geodesic since the union curves of the metric normal congruence are the geodesics.

Considerable attention is paid in projective differential geometry, as in metric, to general types of transformations of surfaces. One of the most important of these is the transformation F . This transformation may be described in the following simple manner. Two surfaces in one to one-point correspondence are said to be related by the transformation F if the developables of the congruence of lines joining corresponding points correspond to conjugate nets on each of the surfaces, these conjugate nets also corresponding in the one-to-one correspondence between the surfaces. Other transformations of conjugate nets into conjugate nets form an important part of the theory of transformation of surfaces in projective differential geometry. The reader is referred to the treatises below for complete details of these and related topics.

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DIFFERENTIAL PARALLELISM—see TENSOR ANALYSIS

DIFFERENTIAL PSYCHOLOGY is that branch of psychology which deals with differences among individuals and groups in mental traits and performances. Individual differences are attributable broadly to the two closely interwoven forces of nature and nurture, or heredity and environment. In the first category are intrinsic factors, race, sex, age, immediate ancestry, in the second category are extrinsic factors, the social, educa-

tional, cultural, physiological and other influences which shape and mould the developing individual from birth until death.

In a general sense, the complex and more recently acquired traits tend to be more variable than the simple, biologically more fundamental. The feeble minded, for example, differ least from the normal in physical and motor abilities and most in the ability to use language, deal with ideas and employ abstract thought. Even among groups relatively homogeneous in general ability, we find greater variability in those functions requiring the education of intricate verbal relations, learning and association, than in those functions requiring speed of voluntary movement, perception or rote memory. Individuals do not fall into sharply separated groups or "types" in mental or in physical traits. People differ widely, for example, in the vividness and the character of the mental imagery which they possess. In other traits the same condition obtains, mediocrity is the status most often encountered, marked superiority or inferiority being relatively and about equally infrequent.

Careful studies of primitive peoples have shown that these groups do not differ markedly from modern Europeans in sensory equipment such as keenness of vision and hearing, sensitivity to pain and pressure and delicacy of the skin senses. Simple intelligence tests of the form board variety (a form board is a board containing cutout depressions into which blocks of different shapes and sizes are to be fitted) show no marked differences between whites and many primitive folk (e.g., Eskimos, American Indians, etc.) although a few groups, the Igorot, the Negrito and the Pygmies, do no better than low grade and even imbecile whites. The inferiority of the Negro to the white in innate mental capacity has often been asserted as the result of comparative studies, but it is difficult to say how much of the differences found is to be attributed to cultural, rather than to native factors. It is not known, for example, whether the superior performance of northern American Negroes as compared with southern is attributable to selective migration of the more able, or whether it is the result of better social and educational advantages. Negro high school children in New York city remain in school longer, are older on the average and are inferior in school work to whites of approximately the same social status. The greater admixture of white blood, the closer does the Negro approach the white in performance. Intelligence tests given in 1917-18 to large groups of white and Negro soldiers in the U.S. army place the Negro consistently below the white in both language and non-language functions. Several investigations have suggested that the Negro is more overtly emotional and less inhibited in his reactions than is the white. The American Indian ranks generally below the white man on tests of mental capacity, the greater the race admixture, the smaller the deviation from the performance of the white. There is evidence indicating that the American Indian, while slower in motor performances than the white, is more accurate and painstaking.

In comparative studies of general intelligence made in America, Chinese children have ranked slightly below whites in English language tests. Chinese and Japanese children do not differ significantly in intelligence, however, from comparable groups of whites, when due allowance is made for cultural and social status. The most extensive comparative data on intelligence differences among national groups are those obtained from tests given in the U.S. army during World War I. These tests indicated a superiority of those foreign-born men from northern European countries (the Nordics) over those from central and southern European countries (the Alpines and the Mediterraneans). Differences in selection plus differences in language, schooling and cultural background probably account for most if not all of the difference found.

Comparative studies of men and women have indicated few differences in mental ability which might be attributed to the factor of sex apart from social and cultural influences. Differences within either sex are much greater than differences between the sexes. Women have been reported to have a finer sense of touch, better colour discrimination and to be faster in verbal association, men to be superior in the discrimination of differ-

ences in weight and in visual magnitudes and in the speed of motor response (reaction time). In general females are superior to males in tests of memory, males to females in tests of logical construction and in problems involving abstract and spatial relationships. Women are probably somewhat less stable emotionally than men. It has been asserted that women are more interested in people, more religious, more patient and more sympathetic, while men are said to be more interested in physical activity, to possess a superior sense of humour and to be more independent. Girls are definitely better in school work than boys. This result has been explained as owing to the slower physical development of boys, to the greater docility of girls and to native differences in ability.

The fact that men have excelled women in practically every field of endeavour is probably to be attributed to social, cultural and traditional factors, and to the greater physical strength and endurance of men, rather than to native differences in endowment. One explanation is based upon the reputed greater variability within the male sex. Greater variability, i.e., greater range of ability, would tend to produce more gifted men than women, even though the average man and average woman rank about the same in mental ability. The existence of greater variability in the male sex has been disputed by competent investigators.

Investigators are fairly well agreed that there is a regular and progressive increase in mental ability from infancy up to and through adolescence. This mental growth roughly parallels the steady increase in physical size and strength. The claim has been made (the Iowa studies) that the IQ can be greatly increased by special school training, but the evidence on this point is not convincing to most psychologists. After adolescence growth in mental abilities (perception, associative learning, memory) increases slowly if at all, while in many cases it ceases altogether. Performances which are based upon experience, such as judgment, reasoning ability in practical situations and rational learning probably improve up through middle life and show no great loss until old age.

There is a general loss in the speed and flexibility of mental processes in old age. Sensory acuity in general—auditory, visual and tactual—is considerably reduced and there is some loss in learning ability, speed of reaction and memory. Curiosity and enthusiasm are lost as physical and mental vigour wane. A part at least of the drop in test score with increasing age can be attributed to the loss in speed of response, and a part to the lack of recent practice with the kind of operations demanded by the tests. Suggestibility, or the ability to resist suggestion, is another complex trait which has been found to vary with age and sex. Tests applied to children indicate that the ability to resist suggestion increases progressively with age from six or seven years through adolescence.

The influence of immediate ancestry is best studied by comparing the resemblances shown by twins, siblings and unrelated persons. Twins are more alike mentally and physically than siblings (ordinary brothers and sisters). The fact that older twins are no more alike than younger twins argues for the greater potency of heredity in determining behaviour. Brothers, and brothers and fathers, are more alike as measured by the correlation of mental and physical traits than are unrelated persons. A considerable part of the resemblances noted among those of the same family or closely related families, such as habits of speech and thought, common opinions, ideas and attitudes, arises from a common fund of environmental stimuli and associations.

See A. Anastasi, *Differential Psychology* (1937), E. B. Greene, *Measurements of Human Behaviour* (1941).

(H. E. G.)

DIFFERENTIATION, a term used in biology signifying the evolutionary process, by which certain modifications of the body both structural and functional take place in plants and animals. In the vegetable kingdom the evolution of growth is usually from the simple to the complex form, the organs developing into more specialized parts of the body. See PLANTS AND PLANT SCIENCE, EXPERIMENTAL EMBRYOLOGY, DEDIFFERENTIATION. See also CALCULUS, DIFFERENTIAL AND INTEGRAL.

DIFFRACTION see LIGHT

DIFFRACTION GRATING, a series of parallel straight lines spaced at equal intervals in one plane or on a concave surface. A beam of radiation after falling on such a grating, is resolved into a spectrum (see SPECTROSCOPY and LIGHT)

DIFFUSION, in general, a spreading out, scattering or circulation, in physics the term is applied to a special phenomenon, treated below. The word is from the Latin *diffundere* *dis-*, *asunder*, and *fundere*, to pour out.

1. **General Description**—When a few crystals of copper sulphate are placed in the bottom of a tall jar filled with water and the mixture then allowed to stand undisturbed, the blue colour of the copper ions is observed to spread slowly throughout the liquid. Initially the colour is concentrated around the crystals at the bottom of the jar, but after several weeks a faint blue coloration is seen at the surface of the water, deepening uniformly toward the bottom. Eventually (in this case after some years) a uniform solution will result.

This experiment illustrates a process which is extremely widespread in nature, whereby molecules of one substance gradually interpenetrate another substance. The phenomenon is known as (molecular) *diffusion*, we say the copper ions diffuse through the water. Diffusion is a consequence of the continuous motion of the molecules of all substances, gaseous, liquid and solid. It is the ultimate process by which irregularities in concentration of solutions disappear.

Simple cases of diffusion are easily observed qualitatively. The experiment described above is a typical example of diffusion in liquids. The diffusion of strong aniline colouring matter into the interior of gelatine is commonly seen in copying apparatus. Diffusion of gases may be shown to exist by placing a few drops of bromine in the bottom of a closed flask; the brown colour of bromine will become distributed throughout the air in the flask just as the blue of the copper became distributed throughout the liquid.

In fluid media, whether liquids or gases, the process of mixing is greatly accelerated by stirring or agitating the fluids, and liquids which might take years to mix if left to themselves can thus be mixed in a few seconds. It is necessary to distinguish carefully the effects of agitation from those of diffusion proper. Agitation brings together portions of the fluid between which considerable differences of concentration may exist. The interchange between such portions then proceeds much more rapidly. In many cases, especially in gases, the intermixing goes on until the concentration is uniform throughout. In other cases, the material remains divided into two or more regions (or phases) in each of which the relative concentration of the components is uniform, but changes in passing from one phase to the next. The passing of one or more components across the boundary between two phases is known as solution or evaporation or condensation, but the process by which the uniform distribution in each phase is set up is diffusion.

The diffusion of gases and liquids through solids is also observed (e.g. the passage of hydrogen through platinum). When the process is considered with reference to a membrane or partition taken as a whole, the passage of a substance from one side to the other is commonly known as "osmosis" or "transpiration" (see SOLUTIONS) but what occurs in the material of the membrane itself is correctly described as diffusion.

It will be shown later that ordinary diffusion due to molecular motion satisfies a partial differential equation of the form

$$\frac{\partial \rho}{\partial t} = D \frac{\partial^2 \rho}{\partial x^2}$$

where ρ is the density of the material diffusing. It can be shown that this relation is a result of the random motion of the individual molecules. The concept of diffusion has been extended on the one hand to processes which are governed by this differential equation (e.g. the slowing down of neutrons by collisions), and on the other to random mixing processes (e.g. eddy diffusion due to turbulent motion in fluids), even if the processes do not possess both properties. (In the former example given the

quantity which diffuses is not a density, in the latter the differential equation is not the same.)

Diffusion due to molecular motion is rate determining in the transfer of material across stationary layers of air or liquid. The rate of evaporation of water from a free surface (one with no blanket of gas molecules) at 20° C. is about $\frac{1}{2}$ gm per cm² per second while the diffusion controlled rate of transfer across 0.1 mm of stagnant air is 1,000 times smaller. Consequently the diffusion rate is extremely important in the design of equipment for the chemical industry, as well as in many natural processes such as evaporation of surface waters.

The process of mixing in turbulent fluids (eddy diffusion) is in many ways quite similar to molecular diffusion in quiet fluids. The motion responsible for turbulent transfer of material is that of small but appreciable quantities of fluid (eddies), unlike molecular diffusion where the thermal agitation of individual molecules is concerned. However the eddy motion is like molecular motion in that it is random with respect to the motion of the fluid as a whole. The change from molecular diffusion to eddy diffusion, which is naturally much faster, corresponds to the change from laminar or streamline flow to turbulent flow. Generally speaking the turbulence of a fluid increases with its velocity, the eddy diffusion coefficient varies with the local velocity. In the remainder of this article we shall confine our selves to the better understood phenomenon of molecular diffusion (see the bibliography for references to eddy diffusion) and shall assume as in our initial example that the fluids are at rest or in laminar flow.

In the next section we shall introduce the *coefficient of diffusion*, which is the ratio between the amount of material transferred across a unit of surface to the concentration gradient perpendicular to that surface. When this coefficient is known, the concentrations and transfer rates for a diffusing system are then determinable by mathematical analysis. Most of the remainder of the article concerns itself with theoretical and experimental methods for determining the diffusion coefficient. It is characteristic both of the diffusing substance and of the medium in which it diffuses.

In section 3 we examine the microscopic motion of a diffusing molecule according to kinetic theory, and find the diffusion coefficient to be proportional to the product of the molecular velocity and the average distance a molecule moves between collisions. In section 4 the analogies between material transfer (diffusion), momentum transfer (viscosity) and heat transfer (thermal conductivity) are developed, showing how the coefficients of diffusion, viscosity and thermal conduction are related. An expression for the diffusion coefficient of a pair of gases, according to Chapman and Enskog, is also given. Section 5 considers the phenomenon of diffusion in a field of force (for example a gravitational field). The field tends to create concentration inequalities by arranging the molecules into a state of lowest potential energy, while diffusion tends to iron out concentration gradients. A balance between the two effects is reached which is useful as a measure of one in terms of the other. (The point is illustrated by considering the experiments by Jean Perrin on Brownian motion, and molecular weight determination of proteins by centrifugation.)

After a brief discussion of thermal diffusion (section 6) the coefficients of diffusion of liquids in liquids, solids in solids and gases through porous solids are discussed (sections 7-9).

The wide new field of diffusion of neutrons in matter, which is so important in modern nuclear physics, is the subject of section 10. Similarities and differences with classical gas diffusion theory are pointed out. The final section gives a survey of experimental techniques for measuring coefficients of diffusion.

2. **Definitions of the Coefficient of Diffusion**—The simplest case of diffusion is that of a substance, say a gas, diffusing in the interior of a homogeneous solid medium which remains at rest, when no external forces act on the system. We may regard it as the result of experience that (1) if the density of the diffusing substance (ρ), the mass of that substance per unit volume, is everywhere the same, no diffusion takes place, and (2)

if the density of the diffusing substance is different at different points, diffusion will take place from places of greater to those of lesser density, and will not cease until the density is everywhere the same. It follows that the rate of flow of the diffusing substance at any point in any direction must depend on the density gradient at that point in that direction, i.e., on the rate at which the density of the diffusing substance decreases as we move in that direction. We may define the *coefficient of diffusion* as the ratio of the total mass which flows per unit area across any small section, to the rate of decrease of the density with distance in a direction perpendicular to that section.

In the case of steady diffusion parallel to the axis of x , if p be the density of the diffusing substance, and q the mass which flows across a unit of area in a plane perpendicular to the axis of x in unit time, then the density gradient is $-dp/dx$ and the ratio of q to this is therefore the coefficient of diffusion. By what has been said this ratio remains finite, however small the actual gradient and flow may be, and it is natural to assume, at any rate as a first approximation, that it is constant as far as the quantities in question are concerned. Thus if the coefficient of diffusion be denoted by D we have $q = -D(dp/dx)$.

Further, the rate at which the quantity of substance is increasing in an element between the distances x and $x+dx$ is equal to the difference of the rates of flow in and out of the two faces, whence as in hydrodynamics, we have $dp/dt = -dq/dx$.

It follows that the equation of diffusion in this case assumes the form

$$(1) \quad \frac{\partial p}{\partial t} = D \frac{\partial^2 p}{\partial x^2},$$

which is identical with the equations representing conduction of heat, flow of electricity and other physical phenomena. For diffusion in three dimensions we have in like manner

$$(2) \quad \frac{\partial p}{\partial t} = D \left(\frac{\partial^2 p}{\partial x^2} + \frac{\partial^2 p}{\partial y^2} + \frac{\partial^2 p}{\partial z^2} \right) = \text{div } D \text{ grad } p$$

The solution of such an equation can usually be expressed in terms of an expansion in an infinite series (see FOURIER SERIES, SPHERICAL HARMONICS, etc.). For a homogeneous medium we have the equation

$$(3) \quad \frac{\partial p}{\partial t} = D \nabla^2 p$$

where ∇^2 represents the Laplacian operator.

In the case of a very dilute solution, the coefficient of diffusion of the dissolved substance can be defined in the same way as when the diffusion takes place in a solid, because the effects of diffusion will not have any perceptible influence on the solvent, and the latter may therefore be regarded as remaining practically at rest. But in most cases of diffusion between two fluids, both of the fluids are in motion, and hence there is far greater difficulty in determining the motion, and even in defining the coefficient of diffusion.

The experimental conditions under which diffusion is studied usually preclude such bodily motion of the whole fluid, and in other cases it is more convenient to treat such a mass motion as a separate phenomenon to be handled by the usual methods of hydrodynamics.

Accordingly a pure case of fluid diffusion is arbitrarily defined to be one in which any tendency of either constituent to move with excessive rapidity toward one side is offset by a current of the whole in the opposite direction, this current being of such a magnitude that the total net transfer of fluid as measured in terms of volume, is zero. The velocity of the fluid as a whole is then considered to be zero. The transfer of volume is thus balanced out by deflection, but there will usually be a net transfer of mass in one direction. In defining the velocity of a diffusing fluid we are compelled to choose between a criterion in terms of volume and one in terms of mass, and the advantage seems to lie with the former.

We confine our attention to a perfect binary solution, where the volume is the sum of the volumes of the components. If N_1 and N_2 be the mole fractions of the two kinds of molecules V_1

and V_2 their mole volumes, and V the volume of one mole of mixture then

$$(4) \quad V = N_1 V_1 + N_2 V_2$$

Denoting the partial densities at any point by $\rho_1(x)$ and $\rho_2(x)$, the molecular weights by M_1 and M_2 ,

$$(5) \quad \rho_1 = \frac{N_1 M_1}{V}, \quad \rho_2 = \frac{N_2 M_2}{V}$$

Now let Γ_1 and Γ_2 denote the net volumes of each kind of molecule that pass per second across a unit area whose normal is the concentration gradient. We assume according to our discussion above that

$$(6) \quad \Gamma_1 + \Gamma_2 = 0$$

The respective mass flows are $\Gamma_1 M_1/V_1$ and $\Gamma_2 M_2/V_2$.

We define the diffusion coefficient as before by either of the equations

$$(7) \quad \frac{\Gamma_1 M_1}{V_1} = -D_1 \text{ grad } \rho_1$$

$$(8) \quad \frac{\Gamma_2 M_2}{V_2} = -D_2 \text{ grad } \rho_2$$

We notice that these equations may be written

$$(9) \quad \Gamma_1 = -D_1 \text{ grad } \frac{\rho_1 V_1}{M_1} = -D_1 \text{ grad } \frac{N_1}{V}$$

$$(10) \quad \Gamma_2 = -D_2 \text{ grad } \frac{\rho_2 V_2}{M_2} = -D_2 \text{ grad } \frac{N_2}{V}$$

and since $\Gamma_1 = -\Gamma_2$ and $\text{grad } \frac{N_1 V_1 + N_2 V_2}{V} = \text{grad } 1 = 0$

it follows that

$$(11) \quad D_1 = D_2 = D,$$

that is, the two definitions are consistent.

If we attempt to treat nonequal solutions by a similar method we are led to introduce partial molal volumes, fugacities and osmotic pressure (see SOLUTIONS). The foregoing procedure is adequate for many important cases of diffusion where the laws of perfect solutions apply, namely in gas mixtures, liquid mixtures of isotopes, dilute solutions and so on.

It is possible to consider the limiting case where a substance diffuses through itself; this is called self-diffusion. The diffusion coefficient for a pair of unlike fluids is often written D_{12} , the coefficient of self-diffusion is written D_{11} .

It will be observed from these definitions that D has the dimensions $(\text{length})^2 / \text{time} = \text{length} \times \text{velocity}$.

3 Diffusion as a Random Walk.—In a gas at low pressures, in which the forces between molecules are of short range, the motion of a molecule is an exceedingly irregular track consisting of short steps of varying length at sharp corners with each other.

Each corner is the result of a collision with another molecule (Fig. 1). Such a path is studied in treatises on probability and is called a (three-dimensional) random walk. If a particle is placed at the origin of a set of co-ordinates at time $t=0$, it can be shown that after a large number of steps the likelihood of finding the particle within a small volume surrounding a point (x, y, z) after a time t follows the Gaussian distribution law

$$(12) \quad P(x, y, z, t) dx dy dz = \frac{1}{(2\pi R^2/3)^{3/2}} \exp(-3r^2/2R^2) dx dy dz$$

Here we have taken $r^2 = x^2 + y^2 + z^2$.

In this expression R^2 is the mean square displacement after time t for

$$(13) \quad \int P r^2 dx dy dz = R^2$$

Now the displacement after n steps is

$$(14) \quad r = r_1 + r_2 + \dots + r_n$$

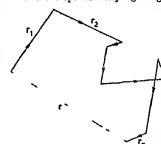


FIG. 1—PATH OF A DIFFUSING PARTICLE. EACH ANGLE MARKS THE POINT OF A COLLISION.

and the mean square displacement is

$$(15) \quad R^2 = \overline{r \cdot r} = \overline{r_1 \cdot r_1 + r_2 \cdot r_2 + r_3 \cdot r_3 + r_4 \cdot r_4} \\ + 2(\overline{r_1 \cdot r_2 + r_1 \cdot r_3 + r_1 \cdot r_4} \\ + \overline{r_2 \cdot r_3 + r_2 \cdot r_4} + \overline{r_3 \cdot r_4}) +$$

($\overline{r_1 \cdot r_1}$ reads average scalar product of vectors r_1 and r_1)

The magnitude r_i of the displacements r_i are distributed according to the law

$$(16) \quad \phi(r_i) dr_i = \frac{1}{\lambda} \exp(-r_i/\lambda) dr_i,$$

where λ is the mean free path. For simplicity let us assume all the molecules move with constant speed v . Then

$$(17) \quad r_i = \lambda \quad r_i^2 = 2\lambda^2$$

and if the average cosine of the angle between two successive paths (the average cosine of the scattering angle) is $\overline{\cos \theta}$, it is easy to show that

$$(18) \quad \overline{r_1 \cdot r_2} = \overline{r_1 \cdot r_3} = \overline{r_1 \cdot r_4} = \overline{r_2 \cdot r_3} = \overline{r_2 \cdot r_4} = \overline{r_3 \cdot r_4} = \lambda^2 \overline{\cos \theta}$$

whence

$$(19) \quad R^2 = 2n\lambda^2 + (2n-2)\lambda^2 \overline{\cos \theta} + (2n-4)\lambda^2 \overline{\cos \theta}^2 +$$

which for large n is closely

$$(20) \quad R^2 = \frac{2n\lambda^2}{1 - \overline{\cos \theta}}$$

We also have

$$(21) \quad v t = n\lambda$$

and defining

$$(22) \quad D = \frac{1}{3} \frac{\lambda v}{1 - \overline{\cos \theta}},$$

we have

$$(23) \quad R^2 = \frac{2v\lambda}{1 - \overline{\cos \theta}} = 6Dt$$

and finally

$$(24) \quad P(r, t) = \frac{1}{(4\pi Dt)^{3/2}} \exp(-r^2/4Dt)$$

Up to the present we have spoken of a *single* particle suffering displacement according to a given probability law and asked for the probability of finding this particle in some given element of volume at a later time. It is clear that we can instead imagine a very large number N of particles starting under the same initial conditions and undergoing the displacements without mutual interference. On this picture $NP(r, t)$ represents the density of particles found at (x, y, z) at time t if all the particles started from the origin at time $t=0$. This density satisfies the diffusion equation

$$(25) \quad \frac{\partial P}{\partial t} = D \nabla^2 P$$

and is in fact the solution of it representing a point source.

We have therefore shown that in the case of a point source the distribution of density by diffusion and by a random walk is the same, if we make the identification (23). It is easy to show that this parallelism holds whatever the initial distribution. Thus the phenomenon of diffusion is the result of the random motions executed by the individual particles, and the connection between the diffusion coefficient and the quantities characteristic of this motion is given by equations (22) and (23). It is useful to define the "transport mean free path" λ_t by the equation

$$(26) \quad \lambda_t = \frac{\lambda}{1 - \overline{\cos \theta}}$$

λ_t is a mean free path corrected for the moderate tendency of a succeeding path to favour the direction of the preceding one. As a consequence of this persistence of velocities the dispersion and the diffusion coefficient are increased. We have then for a constant speed system

$$(27) \quad D = \frac{1}{3} \lambda_t v$$

4. Transport Phenomena in Gases.—Diffusion resembles the phenomena of thermal conductivity and viscosity in that it represents a tendency to uniformity of composition, while the others represent tendencies toward uniformity of temperature and mass velocity. According to the kinetic theory, the tendencies all result from the thermal motion of the molecules. This tends to equalize conditions at both ends of a free path by transporting to the further end an average

amount of momentum and energy that is characteristic of the starting point. Thus the phenomena are all known as transport phenomena. We shall give an elementary kinetic theory of the process of diffusion and derive approximate relations between the coefficients of diffusion, viscosity and thermal conductivity.

We consider a binary gas mixture at constant pressure and temperature, with composition changing along the x -axis. According to kinetic theory the number of molecules per second crossing unit area of a plane in either direction is

$$\frac{1}{4} n \bar{v}$$

where n = number of molecules per c.c.

\bar{v} = mean velocity of thermal motion.

Thus the number of molecules m_1 crossing a unit area of the plane $x=0$ in an elementary kinetic theory of the process of diffusion and derive approximate relations between the coefficients of diffusion, viscosity and thermal conductivity.

$$\frac{1}{4} n_1 \bar{v}_1$$

Here n_1 represents the mean density, not at $x=0$, but at the mean layer where the free paths of the molecules began, say at $x = -\alpha_1 \lambda_1$ where λ_1 = mean free path of molecules m_1 .

α_1 = number of the order of unity.

The number of molecules in question is thus

$$(28) \quad \frac{1}{4} n_1 (\bar{v}_1)_{x=-\alpha_1 \lambda_1} = \frac{1}{4} \bar{v}_1 (n_1 - \alpha_1 \lambda_1 \frac{dn_1}{dx})$$

Similarly the number of molecules crossing in the opposite direction is

$$(29) \quad \frac{1}{4} \bar{v}_2 (n_2)_{x=\alpha_2 \lambda_2} = \frac{1}{4} \bar{v}_2 (n_2 + \alpha_2 \lambda_2 \frac{dn_2}{dx})$$

The net flow in the direction of positive x is therefore

$$-\frac{1}{2} \bar{v}_1 \alpha_1 \lambda_1 \frac{dn_1}{dx}$$

The diffusion coefficient (since ordinary density and number density are proportional in a gas) is therefore

$$(30) \quad D_{12} = +\frac{1}{2} \bar{v}_1 \alpha_1 \lambda_1 = +\frac{1}{2} \bar{v}_2 \alpha_2 \lambda_2$$

In a similar way we can show that the viscosity η and the thermal conductivity K are related to molecular constants by the equations

$$(31) \quad \eta = \frac{1}{2} \rho \bar{v} \lambda$$

$$(32) \quad K = \frac{1}{2} \rho \gamma \bar{v} \lambda c_v$$

where ρ = density, c_v = specific heat at constant volume of 1 gram of gas and β and γ are again numbers of the order of unity.

By considering the case of self-diffusion we can get relations between D_{11} , K and η by eliminating λ . We find

$$(33) \quad D_{11} = -\left(\frac{\alpha}{\beta}\right) \frac{\eta}{\rho}$$

and also

$$(34) \quad K = \left(\frac{\gamma}{\beta}\right) \eta c_v$$

The determination of the numerical constants α , β and γ requires a deeper investigation than that given above. Factors which enter are the distribution of the molecular velocities, persistence of velocities after collisions, etc. The free path calculation of the transport coefficients, given here in an elementary form, has been largely superseded by another attack due to Chapman and Enskog. This takes account of the fact that the origin of the phenomena is a departure from the Maxwellian distribution of velocities. For details of this method the reader is referred to Chapman and Cowling, *The Mathematical Theory of Non Uniform Gases* (Cambridge University Press, 1939).

The values of the number $\rho D_{11}/\eta$ vary, depending on the law of force between the molecules. For rigid elastic spheres, $\rho D_{11}/\eta = 1.20$, for so called Maxwellian molecules, which are centres of force repelling proportionately to the inverse fifth power of the distance, $\rho D_{11}/\eta = 1.54$.

Experimental results give $\rho D_{11}/\eta$ between 1.3 and 1.5, in reasonable agreement with theory (Chapman and Cowling, p. 251).

The expression for $K/\eta c_v$ was shown by Eucken to be

$$(35) \quad K/\eta c_v = \frac{1}{4} \left(\frac{5}{2} - \frac{5}{\gamma} \right)$$

where c_v = specific heat at constant pressure of a gram of gas. The agreement with experiment is generally good (Chapman and Cowling, p. 241). These relations enable us to estimate self-diffusion coefficients if either viscosity or thermal data are available. (It should be remarked that a similar set of relations is valid for transfer phenomena in eddy diffusion.)

The kinetic theory expression for the diffusion coefficient of a pair of gases at absolute temperature T is

$$(36) \quad D_{12} = (1 + \alpha_{12})^2 \sqrt{\frac{\pi}{8}} \frac{T}{n S_{12}} \left(\frac{n_1 + m_1}{m_1 m_2} T \right)^{1/2}$$

Here S_d is an equivalent mutual cross section of the two kinds of molecules for diffusion, m_1 and m_2 are the molecular masses, k is Boltzmann's constant = 1.38×10^{-16} in c.g.s. units, and σ_1 is a small correction term of the order of a few hundredths.

For hard spheres of diameters σ_1 and σ_2

$$(37) \quad S_d = \frac{\pi(\sigma_1 + \sigma_2)^2}{4}$$

It will be observed that (36) is of the same form as (27) which was derived for a constant speed gas, as $\frac{1}{\pi S_d}$ is a free path and

$\sqrt{\frac{m_1 + m_2}{m_1 m_2}} k T$ has units of velocity. The two expressions agree very closely when m_1 and m_2 are very much larger than m_1 and m_1 , which are conditions which give physical reality to section 3.

From (36), D_{12} varies inversely as the pressure, and since for constant pressure ν varies as $1/T$, D_{12} varies ostensibly as $T^{3/2}$. Actually S_d decreases slightly with the mean velocity of the molecular collisions, and thus D_{12} is found to vary as a slightly higher power of T , between 1.75 and 2.00.

D_{12} for a pair of light gases like nitrogen + oxygen is about 0.2 cm²/sec. at room temperature.

5 Diffusion in a Field of Force—We shall consider either a mixture of two gases, or a dilute solution or suspension of a high molecular weight compound in a low molecular weight solvent, such as water. Then if u_1, u_2 are the potential energies of the two kinds of molecules in the force field, the equilibrium distribution is given by Boltzmann's equations

$$(38) \quad \begin{aligned} n_1 &= n_{10} \exp -u_1/kT \\ n_2 &= n_{20} \exp -u_2/kT \end{aligned}$$

n_1, n_2 are the number densities, n_{10} and n_{20} are the number densities at some reference point at which the zero of energy is taken. This distribution is a dynamic equilibrium between the force acting on the molecules, which tends to move them in the direction of the force, and the process of diffusion, which tends to erase all concentration gradients and so creates a current opposite to the force. The diffusion current is always

$$-D \text{ grad } n_1$$

and at equilibrium is just balanced by the current created by the field which must therefore be

$$(39) \quad \begin{aligned} n_1 v_1 &= +D \text{ grad } n_1 \exp -u_1/kT \\ &= \frac{D n_1}{kT} F_1 \end{aligned}$$

where $F_1 = -\text{grad } u_1$ is the force on the molecule.

When the system is not in the equilibrium state the two contrary tendencies are still working, although no longer in balance. The equation of continuity is then (in the absence of other currents)

$$(40) \quad \frac{\partial n_1}{\partial t} + \text{div} [n_1 v_1 - D \text{ grad } n_1] = 0$$

and a similar equation holds for n_2 .

If we have the case of a dilute solution of a large molecule of mass m_1 in a solvent, Stokes' law tells us that

$$(41) \quad v_1 = \frac{F_1}{6\pi\eta a}$$

when η = viscosity of the liquid, and a the radius of the molecule. Thus

$$(42) \quad D = \frac{kT}{F_1} v_1 = \frac{kT}{6\pi\eta a}$$

a relation due to Albert Einstein

$$(43) \quad \text{In a gravitational field} \quad F_1 = (m_1 - \rho V_1)g$$

where ρ is the density of the solvent, V_1 the volume of the large molecule and g the gravitational acceleration.

If we make separate observations of v_1 (the sedimentation velocity) and D (see below, section 11), we can determine

$$(44) \quad F_1 = \frac{v_1 kT}{D}$$

a and hence V_1 , and so finally m_1 . This method of determining the molecular weight of large molecules is widely used in biochemistry. The gravitational field g is usually supplied by an ultracentrifuge, which gives fields strong enough to make the method useful on molecular weights down to 10,000.

Perth, in his classical investigation of Brownian movement, verified by direct observation almost all the theoretical relations used in this article. He used a suspension of particles which were visible to the ultramicroscope, yet so small that their velocity of thermal agitation was sufficient to give visible displacements in short periods of time. He verified successively the Boltzmann distribution law, the relation (23) which demands that the mean square displacement be proportional to time and the Gaussian distribution of displacements (12). Using the value of D calculated from (21) he used (42) where

T, η and a were known as a determining equation for the Boltzmann constant. The ratio of the gas constant R to k is the Avogadro number (number of molecules per gram mole) he found 6.8×10^{23} . (The best present value is 6.02×10^{23} .) The ensemble of experiments was a striking confirmation of the kinetic theory.

The two different distributions (38) obviously offer the possibility of separating a mixture of gases in a force field. The rate at which the field can transfer material is, according to (19), determined by the diffusion rate which therefore is the limiting factor in such separations. (See *Isotopes Separation of Isotopes*.)

6 Thermal Diffusion—A close study of the properties of fluid mixtures shows that if a temperature gradient exists, a gradient of composition will also be established. The concentration gradient thus set up is opposed by the ordinary process of diffusion, just as the concentration gradient set up in field of force is opposed. The steady state is characterized by the equation

$$(45) \quad D_{12} \text{ grad} \left(\frac{n_1}{n_1 + n_2} \right) = \frac{D_T}{T} \text{ grad } T$$

where D_T is defined as the coefficient of thermal diffusion.

This phenomenon, whose existence was unsuspected until 1911 and not demonstrated experimentally until 1916, aroused unusual interest after 1939 when Klaus Clusius and G. Dickel found a use for it as the basis of an exceptionally simple device for separating isotopes. Since then the effect has been observed on many isotopic mixtures, liquid as well as gaseous. One of the methods used for separating U^{235} from U^{238} for the release of atomic energy was thermal diffusion on liquid UF_6 . For further details on this interesting phenomenon, see references in the bibliography.

7 Diffusion in Liquids—Corresponding to our limited understanding of the liquid state, our knowledge of the process of diffusion in liquids is much less than in gases. Although diffusion in liquids is qualitatively the same, and the interpretation of the diffusion coefficient as proportional to the mean square displacement per unit time is unchanged, we have much less success in a priori quantitative estimation of D .

A suggestive interpretation of the process of diffusion in liquids, based on the theory of absolute reaction rates, was developed by Henry Eyring. He found the diffusion coefficient to be given by the equation

$$(46) \quad D = \lambda \frac{kT}{h} \exp -\Delta F/kT$$

In this equation λ is the distance between two successive lattice positions of the diffusing molecule, ΔF is the "activation energy" which must be acquired by a molecule to pass over the energy barrier between the two lattice points, and

$$\frac{kT}{h} \exp -\Delta F/kT$$

is the rate at which the molecule "reacts" in such a process (h = Planck's constant).

In terms of the viscosity η , by the same theory, the self-diffusion coefficient is found to be

$$(47) \quad D_{11} = \frac{kT}{\lambda \eta}$$

which may be compared with the Stokes-Einstein equation (42) for a very large molecule diffusing in a solvent of viscosity η . By qualitative arguments (47) is extended to diffusion in binary mixtures

$$(48) \quad D_{12} = \frac{kT}{2b\eta a}$$

Here η is the viscosity of the smaller molecules, a the radius of the larger molecules and b a factor which varies between 3/4 for very large spherical molecules diffusing in small molecules and 1 for self-diffusion (when $\lambda = 2a$).

Generally diffusion coefficients in a liquid are of the order of $1 \text{ cm}^2/\text{day}$, i.e. 10^{-6} times as small as in gases. The transport by diffusion across a unit distance, for a given concentration difference, is proportional to $D \times \text{density}$. Since the density of liquids is only 10³ times that of gases, it follows that molecular diffusion is between 10 and 100 times more efficient in the gas phase.

8 Diffusion in Solids—There are many types of diffusion in and through solids, including true solid-solid atomic diffusion (e.g. gold in lead), liquid-solid (water through semipermeable membranes or body tissues), gas-solid (hydrogen through platinum) and gas-porous solid (gases through clay pipes). In this section we shall consider only diffusion in nonporous solids, diffusion through porous solids is treated in the next section.

Two mechanisms are conceivable for diffusion of atoms A in a nonporous crystalline solid AB. The A atoms may diffuse individually through interstices in the lattice AB, or the diffusion may take place with the help of vacancies, the atoms moving into vacant adjacent sites. We have seen that $D = R^2/6t$, where R^2 is the mean square displacement of a diffusing atom in a time t . Now by symmetry R^2 is $3\lambda^2$ if λ^2 is the mean square displacement in a given direction. Hence $D = R^2/6t = \lambda^2 \nu$. Then if λ is the distance between atomic planes, and ν the frequency with which atoms jump from one plane to the next, it follows that

$$(49) \quad D = \frac{1}{2} \nu \lambda^2$$

ν equals the fraction of vacancies or interstitial atoms, times the probability that an atom will jump into a vacancy or from one interstitial position to another. Since both of these factors have the form $c \exp(-\epsilon/kT)$ we have finally

$$(50) \quad D = \nu \lambda^2 \exp(-\epsilon/kT)$$

much as in the case of liquids

ν is the jump frequency at temperatures so high that $kT \gg \epsilon$ in metals values of about 10^{13} per second are common. ϵ ranges from about $\frac{1}{2}$ to 2 electron volts. λ is of the order of a few angstroms. At ordinary temperatures kT is about $\frac{1}{40}$ electron volt. A typical value of D in a metal might be

$$(\epsilon = 1 \text{ ev}, T = 325^\circ \text{C})$$

$$D \sim 10^{13} \cdot 10^{-16} e^{-20} \sim 2 \times 10^{-11} \text{ cm}^2/\text{sec} \sim 6 \times 10^{-14} \text{ cm}^2/\text{year}$$

The 1000 mean square displacement in a year is about three-tenths of a millimeter

9 Diffusion of Gases Through Porous Solids—In the passage of gases through porous solids, the type of diffusion which occurs depends on the pressure of the gas and the pore size. At atmospheric pressure and with fairly large pores (e.g. coarse unglazed pottery) the principal function of the solid is to inhibit hydrodynamic flow, the diffusion that takes place is largely ordinary molecular diffusion of one gas through another. At pressures so low (or pore sizes so small) that the mean free path of a molecule is large compared with the pore size, a phenomenon known as free molecule diffusion takes place. A molecule in one of the pores now makes many collisions with the walls for one collision with another molecule. The mean free path in a long cylindrical pore is just the diameter of the tube (2a) and the diffusion coefficient for a molecule of mass m and mean speed \bar{v} is simply

$$(51) \quad D = \frac{2}{3} \bar{v} a$$

As \bar{v} is proportional to $1/\sqrt{m}$ by the law of equipartition of energy, it follows that the diffusion coefficients of different gases in free molecule flow are inversely proportional to the square roots of their molecular weights. This is Graham's law (1829-1861).

The flow (in grams/second) through a cylindrical capillary of length l , with a pressure difference Δp maintained across it, is similarly

$$(52) \quad \frac{D \Delta p}{\Delta x} \pi a^2 = \frac{4}{3} \sqrt{\frac{2 \pi m}{kT}} \frac{a^3}{l} \Delta p$$

on introducing (51) for D and $\bar{v} = 2 \sqrt{kT/m}$ for a Maxwellian gas. Equation (52) was first found by Martin Knudsen (1909).

On passing a mixture of two gases at low pressure through a porous solid, an alteration of the composition of the mixture occurs, as each gas flows through independently at a rate determined by its own diffusion coefficient. It is easy to show from (52) that if the ratio of partial pressures on the high pressure side of the porous barrier is p_1/p_2 , on the low pressure side the ratio is $p_1 \sqrt{m_2}/p_2 \sqrt{m_1}$, provided the pores are small compared with the mean free path on the high pressure side, and also that the low pressure is much smaller than the high.

This method of separating gases was employed by Baron Rayleigh and Sir William Ramsay in their classical work on the composition of the gases in the atmosphere. It was, however, little more than a laboratory curiosity until 1945 when the giant gas diffusion plant of

the United States Atomic Energy Commission was built at the University of Chicago. This plant was designed to separate the isotopes of uranium and plutonium. The diffusion of thermal neutrons through matter has been very intensively studied in connection with this process.

The theory of neutron diffusion presents many difficulties which are not shown in ordinary gas diffusion. Neutrons, because of their non-electrical nature, find matter largely empty. To be deflected they must collide with a nucleus, which is only a minute fraction of the volume of an atom. The mean free paths of neutrons diffusing through solid matter are consequently about 1,000,000 times greater than the mean free path in gases at ordinary pressures (λ cm as opposed to 10^{-8} cm). While boundary effects, which vanish a few mean free paths away from the boundary itself are usually negligible in gas diffusion, they are significant for neutrons. An even more

fundamental complication is that neutrons are captured on collision as well as scattered.

As a first approximation we may take account of the absorption of the medium by adding an extra term to the diffusion equation

$$(53) \quad \frac{\partial n}{\partial t} = D \nabla^2 n - \frac{\nu}{\lambda_a} n$$

In (53), n is the neutron density, v the speed, λ_a the mean free path for absorption and D the diffusion coefficient from (27). λ_a/v is the "lifetime" of a neutron the term $n/\lambda_a v$ is the number of neutrons per second per cc which are captured. Taking the steady state, $\frac{\partial n}{\partial t} = 0$, and a one dimensional problem, (53) reduces to

$$(54) \quad D \frac{d^2 n}{dx^2} - \frac{\nu n}{\lambda_a} = 0$$

which has solutions of the form $\exp \pm x/L$. L is known as the diffusion length and according to (54) and (27)

$$(55) \quad L = \frac{\lambda_a D}{\nu} = \frac{1}{3} \lambda_a \lambda_t$$

which is an expression due to Enrico Fermi

A more exact theory shows that equation (54) is correct provided D is interpreted as

$$(56) \quad D = \frac{v L^2}{\lambda_a} \frac{1}{1 - \cos \theta}$$

and the new fundamental quantity L is related to λ_a , the mean free path for scattering, and λ_t the mean free path for scattering and absorption

$$(57) \quad \frac{1}{\lambda} = \frac{1}{\lambda_a} + \frac{1}{\lambda_t}$$

by the equation

$$(58) \quad \frac{L}{\lambda} = \tanh \frac{\lambda_a}{L}$$

Diffusion lengths in paraffin, graphite, water and other common materials for slowing down fast neutrons run between 10 and 50 cm.

The boundary conditions to (54) are often expressed in terms of the reflection coefficient or *albedo*, which is the ratio of the number of neutrons reflected by an outside medium to the number of neutrons leaving the boundary outward bound.

The process of the slowing down of fast neutrons to thermal energies may also be expressed as a form of diffusion.

11 Measurement of Diffusion Coefficients—As we have seen in the preceding sections, the topic diffusion covers an extremely varied set of phenomena. Quantitatively, diffusion coefficients range from greater than 10^8 cm²/sec (neutrons) to less than 10^{-11} cm²/sec (atoms in metals). Corresponding to this diversity each measurement of diffusion offers its own particular problems and opportunities and requires its own special techniques. For example, in measurements of diffusion in liquids, convection is very troublesome, while in solids the problem is principally the minuteness of the effect over reasonable periods of time. The analytical methods whereby the concentration changes are measured are also most numerous. The concentration of neutrons is determined by the radioactivity which they induce in thin metal foils used as detectors. The concentration in gases or solutions may be found by a chemical analysis, by the refractometer, polarimetrically or by the mass spectrometer. The concentration in thin slices of metal may be determined spectrographically by X ray diffraction by radioactive indicators or by chemical analysis.

There are, however, some features which are common to all diffusion experiments. Measurements of diffusion coefficients are either based on the transport equation which defines D

$$(59) \quad q = -D \frac{\partial p}{\partial x}$$

where q is the flux in grams/sec/cm², or on an analysis of the concentration distribution which is a solution of the equation

$$(60) \quad \frac{\partial p}{\partial t} = \text{div } D \text{ grad } p$$

In a typical experiment of the first kind, a water solution of glucose is placed in a cell, one wall of which is a porous plate. Pure water is kept flowing on the other side of the plate. The porous plate serves to immobilize the water. Diffusion of glucose in water takes place within it. If A be the effective area of the plate (determined by an experiment with a reference substance) and l its thickness, c the concentration of the glucose solution and Q the loss of glucose in time t , then

$$(61) \quad D = \frac{Ql}{Atc}$$

Any convenient way of determining the glucose concentration may be used for example densimetric measurements. Obvious modifications of this method make it suitable for measuring diffusion of gases through solids.

An example of the measurement of a diffusion coefficient by analysis

ney through the alimentary canal, where it comes into contact with the digestive juices and thus undergoes chemical disintegration, the products being finally absorbed. The three chief functions of the digestive tract are (1) propulsion of food along the tract, (2) secretion of digestive juices by glands which are connected with the tract by means of ducts or situated in the walls of the tract, (3) absorption of the final products of digestion.

Salivary Secretion.—The food undergoes its first change while in the mouth, it is broken up into small pieces during the process of mastication, and is well mixed with the first digestive juice, the saliva. The normal secretion of saliva can best be studied in animals in which the natural opening of one of the salivary glands has been surgically transplanted from the inside skin of the mouth to the outside, so that the saliva flows from the gland through the diverted duct to the chin or cheek of the animal. As a result of this harmless operation, the saliva can easily be collected, measured and analyzed. This operation is known as the establishment of a salivary fistula. The results have been compared with observations on man obtained in cases where a fistula became established as the result of accidental injury. The salivary glands must be divided into two groups according to their structure and the composition of the secretion. The first group consists of the **mucous glands** (submaxillary and sublingual glands) which secrete viscid saliva, rich in the glucoprotein mucin. The second group comprise the **serous glands** (parotid gland), the juice of which contains no mucin and is therefore watery, it contains, however, some other proteins mainly of the globulin type. In man and certain other animals, both sets of glands secrete the enzyme ptyalin. Before and after the periods of intake of food, the glands are at rest, for the moisture of the mouth depends chiefly on the continuous secretion of small glands covering the mucous membrane, and not on the secretion of the salivary glands.

Function and Composition of Saliva.—On the administration of food, all the salivary glands begin to secrete, the amount of secretion being proportional to the length of time the food remains in the mouth. It is, however, not only food substances which evoke secretion. This power is also possessed by certain chemical substances which often are not swallowed but ejected from the mouth, as for instance acids, alkalis, salts and various irritants such as pepper, mustard, etc., secretion is even evoked by some substances whose irritant nature is due to purely mechanical properties, as is the case with fine sand and certain powders. It is obvious that many of these irritants play a considerable role in our daily menu, though they cannot be regarded as nutritive substances. The main function of saliva is to soften and lubricate, in order to make the food able to pass through the comparatively narrow oesophagus tube to the stomach. In the case of irritants, the purpose of saliva is to dilute them, and to protect the mucous membrane of the mouth by covering it with a layer of viscid mucin. The primary function of the saliva is therefore physical, but in man and those animals whose saliva contains ptyalin, there is the further function of assisting in the chemical decomposition of the higher carbohydrates.

The composition of saliva secreted on administration of the two classes of stimuli (food and irritants) is very different. When food is given, the mucous glands secrete a viscid saliva, rich in mucin, but when irritants are administered, the secretion contains hardly any mucin. This difference in viscosity can be demonstrated by observing the length of time taken by different samples of saliva to flow through a capillary tube, and comparing the rates with that of water. For instance, in one experiment, 1 cc of water took 6 seconds to pass through the viscosimeter,

1 cc of saliva obtained on introduction into the mouth of 0.5% HCl took 8 seconds, of an emulsion of mustard 9 seconds, of 2.5% NaCl 9 seconds, while 1 cc of saliva obtained on administration of bread took 95 seconds, of meat 175 seconds, of milk 231 seconds and of dried powdered meat 255 seconds. On determining the organic and inorganic constituents of the saliva, it was found that the "alimentary" saliva from the submaxillary gland contained about 0.99% of organic matter, and about 0.4% of inorganic, while that secreted after administration of irritants contained only about 0.1-0.2% of organic matter, and about the same percentage of inorganic matter, namely from 0.35-0.45%. These peculiar differences in the composition of saliva are exhibited only by the mucous glands. The parotid saliva varies little, and with both types of substance has approximately the same composition (0.9-1.0% of organic and 0.35-0.48% of inorganic matter). The organic substances are proteins and ptyalin, and the inorganic are chiefly potassium chloride, which appears in considerably larger quantities than in the blood, sodium chloride, sodium bicarbonate and potassium sulphocyanide.

Mechanism of Salivary Secretion.—The amount of saliva secreted depends on the length of time any particular substance remains in the mouth, and also on the extent to which the substance can mechanically or chemically stimulate the mucous membrane of the mouth. Dry substances always evoke a far more copious secretion than liquids. The results of an actual set of observations will serve as an illustration. The following substances were administered for one minute each. Dry bread and the same soaked in water, the resulting secretion measured 3.9 cc and 1.4 cc respectively, with dry meat powder and the same soaked in water, the secretions were 4.5 cc and 2.9 cc respectively, and with dry sand and the same soaked in water, 2.8 cc and 0.4 cc. It is obvious that the purely mechanical stimulation caused by the various substances is enough to bring about secretion. Pure water at body temperature evokes no secretion, but saliva is secreted on administration of both hot and cold water, and in each case the composition is the same as that obtained on administration of irritants. The concentration of the chemical stimulus is also of considerable importance. For instance, on administering HCl in concentrations of 0.1, 0.2, 0.3, 0.4 and 0.5% for one minute the total secretion was in one experiment 5.2, 7.4, 8.1, 9.2 and 9.5 cc respectively.

The movements of mastication do not evoke salivary secretion in the absence of the higher parts of the central nervous system, the well known effect of smell and sight of food is in this case also absent. The secretory effect of these stimuli is the result of association, and will be discussed in the section on conditioned reflexes. The mechanism of salivary secretion is based on a reflex act. Foodstuffs or irritants, in virtue of their chemical or mechanical nature, stimulate the peripheral nerve endings of the sensory nerves of the mouth and tongue, namely the lingual and the glossopharyngeal nerves. The nervous impulse passes along these nerves to the salivary centre in the medulla, and is there transmitted by the efferent (secretory) nerves to the corresponding salivary glands. The higher centres are not necessary for the normal reflex salivary secretion. In dogs in which the brain has been destroyed above the medulla, all the characteristics of the salivary secretion are preserved, moreover, the composition and amount of the secretion depend on the nature of the stimulus in the usual way. After injury to the medulla or after section of both sensory nerves of the mouth, secretion cannot be evoked either by the act of eating, or by irritants.

Nerve Connections.—The chief secretory fibres of the two mucous glands were discovered by Ludwig in 1851. They run in the chorda tympani, which is a branch of the facial nerve. The secretory fibres of the parotid gland pass along the glossopharyngeal nerve. Electrical stimulation of these nerves evokes an immediate and copious secretion from the corresponding glands, the rate of secretion being proportional to the strength of the stimulation. All the salivary glands also receive a nerve supply from the sympathetic system, via the cervical sympathetic nerve. The saliva obtained from the mucous glands after stimulation of the cerebral nerves of the dog is more copious and less viscid than

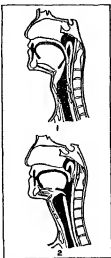


FIG. 1—DIAGRAM SHOWING POSITION OF SOFT PALATE (TIGERSTEDT)
2 During rest, 2 during the act of swallowing

that obtained after stimulation of the sympathetic nerve

Stimulation of the cerebral nerves produces a very considerable vasodilation and therefore increases the blood supply to the gland, while stimulation of the sympathetic nerves produces vasoconstriction to the point of almost arresting the circulation. The correlation formerly drawn was that the extent of secretion and the composition of the saliva were dependent on changes in the blood supply accompanying the stimulation of the corresponding nerves. But it is now generally accepted that the composition of the secretion depends little if at all on the blood flow. At any rate, the saliva does not become more concentrated if on stimulating the cerebral nerve the blood flow is reduced to its original level nor does it become more dilute if the blood flow is artificially increased. The differences in the composition of the saliva and the amount secreted in the normal animal during administration of various substances is certainly not dependent on changes in blood flow (as proved by direct measurements), neither is it dependent on the presence of the sympathetic fibres. After section of all the sympathetic connections, the secretion remains viscous in the case of food, and fluid in the case of irritants.

The part played by the sympathetic nerves in normal secretion is not definitely known. After section of the latter, the secretion hardly changes, while after section of the cerebral nerve it ceases. Artificial stimulation of the sympathetic nerve, however, produces a slight flow of saliva, and causes definite histological changes in the gland. Besides the secretory and vasomotor fibres, the sympathetic nerve contains fibres which stimulate some contractile elements around the secretory cells, and thus help to empty the gland of the viscid juice. The cerebral nerves have no such fibres. The secretory nerve endings of the cerebral salivary nerves are completely paralysed by atropine while the vasodilator nerves are left intact—a further proof that secretion is not due to vasodilation.

The Metabolism of the Gland.—The activity of the glands is accompanied by increased metabolism, and the consumption of oxygen and blood sugar may be increased during secretion tenfold. The organic substances and ptyalin which are secreted by the gland are derived from the stores laid down by the gland during the period of rest, and the inorganic substances are derived, together with the water, from the blood. In protracted secretion, as the stores are depleted, the saliva becomes progressively poorer in organic substances, and finally contains only inorganic substances and some urea. A gland can however excrete as much as one third of its total nitrogen, showing that the store of organic substances is considerable. As liquids water a gland may be able to secrete over 100 times its own weight in the course of a few hours. The rate of secretion from all the salivary glands in man may be roughly estimated at about one litre.

Secretion is not in relation of water from the blood through the gland with a certain amount of stored substances, but is an active process, the energy for which is derived from oxidations within the gland itself. This is most conclusively proved by the fact that secretion continues for some time after the gland has been removed from the body.

The secretion of saliva is under the control of the cerebral and sympathetic nerves, and is also influenced by local factors such as the presence of food in the mouth.

Deglutition.—The act of deglutition is the process by which food is taken into the stomach. It is a complex process involving the contraction of the muscles of the mouth, pharynx, and oesophagus. The food is first taken into the mouth, where it is chewed and mixed with saliva. The resulting bolus is then pushed into the pharynx, where it is swallowed. The muscles of the pharynx contract, forcing the food into the oesophagus. The oesophagus then contracts, forcing the food into the stomach. The process of deglutition is controlled by the vagus nerve and the sympathetic nervous system.

den and vigorous contraction of the tongue, assisted by the surrounding muscles (chiefly mylohyoid, also styloglossus, palato-glossus). The contraction of the palatoglossus closes the isthmus faucium, thus preventing the return of food towards the mouth.

In the pharynx, the food passes a region common to the respiratory and digestive system, but the respiratory passages are temporarily closed. The act of deglutition is impossible unless the larynx is free to move. The bolus is now shot rapidly into the region of the medium and lower constrictors of the pharynx, and then into the oesophagus. Liquids and semi-solids quickly pass down the oesophagus to its cardiac end. Here the passage becomes less rapid, the fluid escaping slowly in a narrow stream into the stomach. The average time for a complete act of deglutition is about 6 seconds for liquids and semi solids, but dry food substances may take as long as 15 minutes to reach the stomach. The propulsion of liquids is mainly due to the movement of the back of the tongue, but that of solids is due to the contraction of the constrictors of the pharynx and the oesophageal muscles, which slowly push the food towards the stomach.

The passage of food along the oesophagus is assisted by a reflex inhibition of the wall, which is succeeded by a contraction. In every complete act of deglutition there are thus two waves which pass along the oesophagus, one of relaxation and the other of contraction. If however several deglutitions follow one another at short intervals, the wave of contraction has no time to develop, and the succeeding waves of relaxation fuse with one another, thus causing a relaxation of the oesophagus along its whole length. The tube therefore becomes an open passage through which large amounts of liquid can pass into the stomach by mere force of gravity. When swallowing stops, a strong wave of contraction develops. These waves of relaxation and contraction are due to a reflex, and they are not arrested by complete transverse section of the oesophagus, but are stopped by section of its nerves.

There is an important interdependence between respiration and deglutition, for every act of deglutition inhibits a respiratory movement. In the absence of this correlation, food might easily slip through the open respiratory passages into the trachea, which may actually happen in cases of paralysis of the laryngeal muscles. The arrest of respiration may last as long as 6 seconds. That deglutition is impossible in the absence of a bolus is shown by the fact that a man with an empty mouth can perform only four or five swallowings in rapid succession, after which swallowing becomes impossible for a time. The first acts of deglutition were possible because of the presence of saliva in the mouth after rinsing the mouth with a weak solution of atropine even a single deglutition is impossible without taking some liquid.

Gastric Secretion.—Anatomically, the stomach is divided into the fundal or cardiac portion and the pylorus. Physiologically, the pylorus of the carnivorous animal resembles the intestinal tract proper rather than the rest of the stomach. As the result of an accidental wound in the stomach of a Canadian hunter, a permanent gastric fistula was established, and Beaumont was able, in 1834, to observe directly the movements and secretion of the stomach. The effects of administering food. In 1843, Bassov, on, established artificial gastric fistulae in dogs, and time various operations on the stomach have been performed in physiological experimentation.

The period of digestion, the gastric glands are at work being secreted by the superficial epithelial about 5 minutes of the intake of food, the gastric secretion. The secretion gradually increases in rate, and finally outlasts the actual period of eating.

Rate.—In order to determine whether it is the act of deglutition or the entry of food into the stomach that brings about the secretion, Pavlov performed the following operation. In a dog in which a gastric fistula had been established, he made a T-shaped incision in the skin of the neck, and sutured the ends of the oesophagus in the neck, and sutured the ends of the oesophagus and could be eaten again. The dog was of course to be fed either through the lower end of the oesophagus or through the gastric fistula. Animals operated on in this manner live as long as they would normally, and

experience no discomfort whatever. When these animals are fed through the mouth (sham feeding), the gastric glands begin to secrete, exactly in the same manner and after the same latent period as in the normal act of eating. The secretion lasts for hours so long as sham feeding is continued, and after its termination the secretion gradually declines, and finally ceases within 10-20 minutes. The conclusion from these experiments is that the onset and the maintenance of the secretion is a reflex which, like that of the salivary secretion, originates in the mouth. The afferent nerves for this reflex are the same as for the salivary secretion, while the secretory fibres run along the vagus nerve. The centre for gastric secretion lies in the medulla. This reflex secretion does not involve the co-operation of the higher nervous centres, and is readily obtained in dogs whose entire fore-brain has been removed. After section of both vagi, the reflex cannot be evoked, just as happens in the case of the salivary glands after section of their respective secretory nerves.

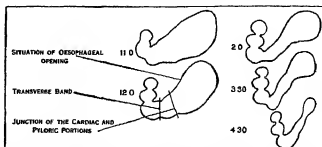
The rate of gastric secretion, the amount of juice secreted, and the composition of the juice (see NUTRITION) vary little with different food substances. The juice obtained after administration of fats is deficient in pepsin. The experiments with sham feeding were repeated and confirmed in the case of a man in whom a gastric fistula had to be established on account of stricture of the oesophagus. The amount of juice secreted by an average sized dog may be as much as 200 cc. after half an hour of sham feeding, but the secretion may vary considerably.

Part Played by the Higher Centres.—Like the amount of saliva, the amount of gastric juice secreted is largely dependent on appetite. A hungry animal may give, in the same period of time, 5 times more juice than an animal which recently has been fed. It is not only contact with the mucous membrane of the mouth that evokes the reflex, but also the sight and smell of food, and in fact all those stimuli which the animal associates with food. These effects are entirely dependent on conditioned reflexes (see on the higher centres), which in ordinary life play an extremely important part in regulating the activities of all the systems of animals and man, amongst these activities are those of the alimentary glands, which stand in close relation to the central nervous system. Administration of tasteless food, monotony in food, and gross irregularity in the time of feeding will all affect gastric secretion. If the intake of food is too rapid, the secretion will not have time to develop to its maximum, and the food will remain undigested for a considerable time. It is known that the amount of juice secreted, and therefore the digestive and nutritive properties of the food, depend in the long run not so much on the weight or caloric value of the food as on how we eat it, how it is prepared and served, and how we prepare ourselves and concentrate on its intake. However, if man's nutrition depended entirely on his wisdom, only a few would survive, and the organism has, in the case of gastric secretion, a mechanism which is controlled independently not only of the higher centres, but also of the medullary reflex mechanism.

The Chemical Mechanism.—This mechanism was also discovered by Pavlov. If certain food substances are introduced through a fistula directly into the stomach, secretion of the gastric juice ensues. This secretion is independent of the nervous system, and can be obtained in a stomach after section of all its nerves. The chemical mechanism of gastric secretion is independent of the nervous system, and can be obtained in a stomach after section of all its nerves. The chemical mechanism of gastric secretion is independent of the nervous system, and can be obtained in a stomach after section of all its nerves.

As regards the nature of the substances producing secretion on

entry into the stomach, it is known that unchanged food substances, whether carbohydrates, fats or proteins, are unable to produce this secretion. The secretion is however evoked by the presence of the products of the digestion of proteins (peptones, albuminoses) and of fats (fatty acids, soaps). Substances which may be extracted from meat and vegetables on boiling (probably the albumoses) also evoke the secretion if they are introduced directly into the stomach. A most illustrative example is provided



FROM STARRING: PRINCIPLES OF HUMAN PHYSIOLOGY (W. E. CARRON)

FIG. 2.—SHADOW SKETCHES OF THE OUTLINES OF A CAT'S STOMACH, OBTAINED BY MEANS OF X-RAY ILLUMINATION IMMEDIATELY AFTER A MEAL CONTAINING BISMUTH SALTS FED AT 11, 12, 0, 2, 0, 3, 30 AND 4, 30

by the following experiment. Direct introduction of raw meat into the main part of the stomach, after a latent period of about 15 minutes, brought about a considerable secretion from the isolated pouch, a similar introduction of an equal quantity of meat which had been boiled for several hours produced no secretion at all, but the water in which the meat had been boiled caused the same secretion as raw meat. Boiled meat which had been subjected to gastric digestion *in vitro* produced a very large secretion. The experiment is practically duplicated with vegetables, but on a smaller scale, except that the peptic digestion of the thoroughly boiled vegetables makes no appreciable difference.

There are however proteins which do not yield any extractive substances which are capable of stimulating gastric secretion (for instance egg white), though on digesting them with gastric juice they acquire strong stimulating properties. In general, we can say that extractive substances from proteins, the products of the digestion of proteins but not proteins themselves, and the products of the digestion of fats but not fats themselves bring about gastric secretion when introduced into the stomach, and this secretion is not under the control of the nervous system.

Two Phases.—The whole gastric secretion may thus be divided into two phases, the first reflex phase (through the vagus nerve), and the second or chemical phase. The first phase is by far the most important—it starts the digestion of proteins, and thus leads to the production of those chemical substances which will further stimulate the secretion of gastric juice. But how much more than mere custom there is in the taking of soup before a meal, in this way we administer to the stomach extractive substances derived from meat or vegetables, and thus ensure that, even in the absence of appetite, our food will meet with some gastric juice in the stomach.

The mechanism underlying the chemical phase of secretion is not yet clear. It is, however, known that the products of digestion of proteins, etc., need not come into contact with the fundal part of the stomach at all, they must, however, come into contact with the mucous membrane of the pylorus, and this is the way in which they produce their effect. There is much evidence for the view that, under the action of these stimulations, a substance (generally called gastrin [Edkins]) is liberated by the pylorus into the blood, the blood then brings this substance to the fundal glands and stimulates them to secrete the juice. That the stimulus is carried by the blood stream can be regarded as proved, at least in cases of transplantation of parts of the stomach to the thigh and chest of the animal, for extractive substances on introduction to the main stomach evoke secretion in the transplanted part.

Besides the two phases of gastric secretion, there are no other methods of evoking secretion, and in any given case the amount of gastric juice secreted, in a complete act of eating is equal to the

sum of the effects of the nervous phase and the chemical phase. Atropine, which paralyzes all secretory nerves, does not affect the second phase of secretion.

The Effect of Fats—Neutral fats have a peculiar effect on gastric secretion. On administration of fats, the amount and strength of the gastric juice are diminished. This effect is supposed to be due to a reflex originating in the duodenum. It is certainly not due to clogging of the orifices of the gastric glands, for substances with the same viscosity have no effect. Fats when administered to the mouth quickly enter the duodenum, and there augment the pancreatic secretion and diminish the gastric secretion. Fats become digested by the pancreatic juice, and the products of their digestion are regurgitated into the stomach, where they stimulate the gastric secretion by liberating the gastrin bodies from the pylorus. The effect of fats on the gastric secretion passes through three phases, the reflex, the inhibitory and the chemical.

It is obvious that in the case of complete feeding, the production of the gastric juice, depending on the two phases of secretion and on the inhibitory effect of fats, will be typical for each of the three main food substances. In the case of carbohydrate food, the secretion is very much like that in sham feeding—rapidly rising, then falling off within an hour or so, the nervous phase predominates, the chemical phase being negligible since the carbohydrates and their products have hardly any stimulating effect on gastric secretion. In the case of proteins, the chemical phase is well pronounced and superimposes itself on the nervous phase, and the secretion is prolonged at its maximum for over two hours. Then as the food leaves the stomach the secretion gradually diminishes. In the case of fats, the nervous phase is cut short as soon as food enters the duodenum, but the secretion is again favoured by the chemical phase setting in, the net result being a considerable prolongation of the period of gastric secretion. With mixed food, secretion will be the result of a summation of all these individual factors.

Gastric secretion is not evoked by the mechanical stimulation of the gastric mucous membrane, as was supposed before the true mechanism of gastric secretion was known. Water and alcohol both cause a slight secretion. The products of the digestion of carbohydrates do not seem to have any effect on gastric secretion, but carbohydrates themselves increase the strength of the gastric juice, and if they are present in the food in sufficient amount the concentration of pepsin may be actually doubled. The mechanism of this effect is not known.

The Pyloric Secretion—The secretion of the pylorus is strikingly different from that of the main part of the stomach. The pyloric secretion is never copious but is continuous, and is not increased by sham feeding. The pyloric juice does not contain HCl, and is very poor in pepsin. It is viscid on account of the presence of mucin. The secretion is not affected by section of all the nerves going to that part of the stomach, but it is greatly increased by local mechanical stimulation. It is immaterial whether the stimulation is caused by a food substance or something indigestible, provided that the texture is coarse, it will increase the production of the juice. Local stimulation with a glass rod may increase the secretion four or five-fold. Local application of chemical irritants, such as 0.5% HCl, a weak solution of carbolic suspension, of pepper, or an emulsion of mustard oil cut in water, increase secretion. But liquid and semi-liquid food substances, being devoid of mechanical stimulus, have no effect, either on local application or on introduction to the rest of the stomach. Even the extractive substances and the products of the digestion of food which serve as stimuli for the fundal secretion, have no effect on the pyloric secretion. The function of the pyloric juice is to lubricate the narrow passage connecting the stomach with the intestine, and to provide a small additional amount of pepsin which helps in the digestive digestion as a whole.

The Movements of the Stomach—The gastric movements can best be studied by Cannon's method of direct observation by means of Röntgen rays. Bismut subnitrate or oxychloride is mixed with the food, and the animal or man is then X-rayed at different intervals. The obtained shadow of the stomach gives a good idea of the movements. This method can be checked by

other experiments, such as the determination of the rate at which the food or various liquids pass from the stomach into the duodenum, which can be done in an animal with a gastric fistula. An alternative method is to introduce a small rubber balloon through the gastric fistula, the balloon is connected to some kind of registration apparatus, and in this way pressure changes occurring in the stomach at each contraction can be observed. The relaxation of the cardiac orifice, which accompanies swallowing, extends also over the whole fundus of the stomach. This relaxation lowers the pressure within the stomach and makes room for the incoming food. As soon as the gastric contents become acid the cardiac orifice closes.

When food is taken, it accumulates in the fundus and is separated from the pylorus by a strong contraction (the transverse band or the prepyloric sphincter). After a few minutes, waves of contraction begin to appear slightly on the fundal side of the transverse band, and travel slowly towards the pylorus. These waves gradually increase in strength so that the pylorus may present a series of contractions. The semi-digested food is thus brought into close contact with the pylorus mucous membrane. The pylorus, however, remains closed, and the food is therefore squeezed back, and forms a reflux stream towards the fundus. The food thus becomes thoroughly mixed with the gastric juice. The fundus of the stomach is now exercising a steady pressure by the contraction of its muscular walls, so that the digested food is forced to enter the pylorus. At varying intervals, the time depending on the nature of the food, the pylorus opens, and a little of the digested food enters the duodenum. As digestion proceeds, the fundus increases its pressure on the gastric contents while the pylorus opens at more frequent intervals. The stomach thus gradually empties itself, and the whole organ acquires the shape of a curved tube. At the end of digestion, the pylorus may even open to allow the passage of undigested material.

The contractions of the stomach, and its method of emptying, are very similar in man and the carnivorous animals. The foregoing description applies to the events which succeed the taking of a considerable mixed meal. If water alone is taken, the pylorus opens within a very short time, and the fluid reaches the duodenum within a few minutes. The importance of this becomes obvious when it is remembered that practically no absorption of water takes place in the stomach, but only in the intestine.

Pylorus and Duodenum—The movements of the two portions of the stomach can be observed also on anaesthetised animals, and even on a stomach which has been excised and placed in warm salt solution. They must therefore have their origin in the walls of the stomach itself. The vagus nerve supplies the muscles with fibres, the stimulation of which increases the contractions. The opening of the pylorus is more dependent on the nervous mechanism. If both vagi are cut, the emptying of the stomach becomes difficult on account of the diminution in the strength of the contractions, and also because the opening of the pylorus is not easily brought about. The food thus remains in a semi-digested form (since the secretion of the juice is also diminished) for a long time in the stomach, it undergoes putrefaction and the animal may die of autointoxication. The opening of the pylorus does not only depend on the intragastric events but also, as shown by Pavlov, on the condition of the duodenum. The pylorus remains firmly closed so long as the contents of the duodenum remain acid. If alkaline fluid or water is introduced into the stomach, and at the same time some weak acid is injected into the duodenum by means of a duodenal fistula, no fluid passes out of the stomach until the acid is neutralised by the secretion of the pancreatic juice.

When the pylorus is open, not only do the contents of the stomach enter the duodenum, but also the contents of the duodenum regurgitate into the pyloric cavity. Such regurgitation is a normal occurrence, and takes place in the digestion of any food, but is especially conspicuous in the digestion of fats. Fats are not digested in the stomach, they pass on to the duodenum where they are converted into glycerol and fatty acids which, in the alkaline medium, form soaps. While in the duodenum, fats cause (a) an inhibitory effect on gastric secretion and (b) a contraction

of the pylorus. As soon as the fats are digested, the pyloric sphincter opens, and large amounts of the products of the digestion together with bile and pancreatic juice regurgitate into the pylorus, where they increase gastric secretion by chemical stimulation. We must consider the action of the sphincter as dependent on the central nervous system and on the "acid control." Cannon's experiments have shown that "hunger pangs" are associated with and probably due to the rhythmic contractions of the stomach which occur about meal times, especially if they are delayed.

Vomiting—Vomiting may occur as a result of overdistension of the stomach, or the presence of irritating material, or from abnormal conditions of the brain. The first indication of vomiting is the feeling of nausea, accompanied by a profuse secretion of saliva. After a deep inspiration, the glottis is closed, and this is followed by a strong contraction of the diaphragm and of the abdominal muscles. At the same time the cardiac orifice is relaxed, and the gastric contents are passed out. The part played by the stomach itself is negligible. Vomiting is a reflex which can be excited by stimulation of the base of the pharynx, irritation of the stomach and from almost every abdominal organ. It is also evoked reflexly through the labyrinth or the eye, as in sea sickness, and is a conspicuous symptom of various diseases of the cerebrum and cerebellum. The nerve centre of vomiting is located in the medulla, and can be excited directly by various drugs such as tartar emetic, apomorphine, etc.

Pancreatic Secretion—The pancreas is the main digestive gland. It is the only gland which secretes a juice that contains enzymes capable of digesting all the three classes of foodstuffs. The carbohydrate-splitting enzyme (amylase or diastase) is secreted in a fully active form. The fat splitting enzyme (lipase) is partially active when secreted, and is rendered fully active by the action of the bile salts. But when the protein splitting enzyme (Trypsinogen) is secreted, it is completely inactive, it is converted into the active form (trypsin) by the co enzyme enterokinase of the intestinal juice.

The secretion of pancreatic juice has been studied in animals in which a fistula of the pancreatic duct has been established (the operation is similar to that of establishing a salivary fistula). Like the salivary glands and the glands of the stomach, the pancreatic gland is at rest except during the periods of digestion. The secretion begins soon after administration of food but it lags behind the gastric secretion, the maximum of which precedes the maximum of the pancreatic secretion by about an hour. The rate of pancreatic secretion, after a meal of proteins or carbohydrates, is on the whole very similar to that of the gastric secretion, but in the case of fats it is somewhat different. The similarity in the histological structure of the pancreas and the salivary glands has led physiologists to believe that the mechanism of secretion of these glands is the same, that is to say that the pancreatic secretion is controlled by a secretory nerve.

The Secretory Innervation of the Pancreas—The secretory fibres were discovered by Pavlov to run in the vagus nerve. However, stimulation of the vagus never produces anything like the normal quantity of the juice, and the whole secretion is rather peculiar. The vagus nerve has to be stimulated for a very long time before the secretion will appear. The vagus produces a strong contraction of the larger ducts of the gland, and thus prevents the juice from leaving the gland. But even independently of this contraction of the ducts, the amount of juice secreted is very small (about 10cc during a period of stimulation of 5-6 hours, as against a normal secretion of over 150cc after entry of $\frac{1}{2}$ pound of meat).

Furthermore, the composition of the juice so obtained is not like that which is secreted under normal conditions. It is over 10 times more concentrated, both in its protein and enzyme content. When boiled, it coagulates in a lump like egg white, while the normal juice becomes only slightly flocculent, it is also less alkaline than the normal juice, and therefore the trypsinogen of the "vagus juice" is apt to undergo spontaneous activation, and is more easily activated by enterokinase than the normal juice (the rate of activation is slower the more alkaline the juice). Nevertheless, the vagus nerve is a true secretory nerve, on stimu-

lation, it produces very considerable histological changes in the gland, far greater changes than in the case of normal secretion, and the nerves are completely paralysed by atropine. It may be concluded that, so far as causing the output of solids and enzymes is concerned, the vagus stimulation does the same or more than the taking of food, but as regards the passage of water from the blood into the ducts it is much less effective.

We also owe to Pavlov the discovery that introduction of acid into the duodenum of animals or anaesthetised animals is followed by a profuse pancreatic secretion, which lasts as long as the acid is being absorbed. The similarity between this effect and the secretion of saliva (on administration of acid into the mouth) led Pavlov to believe that the pancreatic secretion is also based on a reflex mechanism, the efferent path from which follows the vagi. He soon found, however, that section of the vagi, or in fact destruction of the entire nervous system, does not prevent the secretion of the pancreatic juice on administration of acid into the small intestine. Administration of acid into the stomach, into the large intestine or anywhere else has no effect whatever.

Gastric Juice—The discovery of the effect of acids is far more important than could be imagined at first sight. Pure gastric juice contains about 0.5% HCl but usually, on account of dilution with saliva and food, the acidity of the gastric contents is reduced to about 0.2-0.3%. The acid enters the duodenum and causes the pancreatic gland to begin to secrete. The first phase of gastric secretion becomes of outstanding importance, for it not only causes a further stimulation of gastric secretion, by giving rise to the products of digestion, but it also indirectly causes the continuation of digestion, for the acidity of the whole gastric contents leads to the secretion of the pancreatic juice.

Appetite, in that it augments the nervous phase of gastric digestion, is the trigger that sets the whole digestive tract into activity. This fact so much impressed Pavlov that he organized, next to his laboratory, a special department where the gastric juice of dogs was (and still is) obtained by sham feeding in large quantities. This material was sterilized and sold at a low price to the general public at the rate of several thousands of bottles a year. The improvement of digestion and nutrition in cases of dyspepsia, cancer, achlorhydria, loss of appetite and chronic gastritis was immense.

The Chemical Phase of Pancreatic Secretion—The mechanism of the secretory effect of acid was discovered by Bayliss and Starling in 1902. They found that, on pounding up some scrapings of the intestinal mucous membrane with dilute ac. and filtering, they obtained a filtrate that produced a copious flow of pancreatic juice when it was injected into the blood. This discovery was not only of great value in elucidating the mechanism of pancreatic secretion, but it was also of general importance in physiology, for it was the first time it could be shown that a chemical substance, manufactured under definite conditions by one organ, could be liberated into the blood stream and conveyed to another organ, which it would excite to activity. Since this discovery, a number of other substances of the same nature have become known. Bayliss and Starling described them as chemical messengers, and gave them the name of *hormones* (*q.v.*). The hormone of the small intestine was called secretin, or pancreatic secretin, to distinguish it from other members of the same class.

Secretin can be extracted from the small intestine by various solvents, e.g., water, alcohol, salt solutions, etc. It is not an enzyme, and is not destroyed by boiling. That secretin is normally transported by the blood stream is most convincingly shown by experiments with crossed circulation, and perfusion of the isolated pancreatic gland. If two arteries of two dogs are connected in such a manner that the blood of one animal freely mixes with that of the other, and if acid is injected into the duodenum of one of the animals, the pancreatic glands of both dogs begin to secrete. Also, if a pancreas is cut out of the body and perfused with blood under pressure so as to keep it alive, and if a solution of secretin is injected into the blood, the isolated pancreas immediately responds by secretion of the juice. In this secretory mechanism, we have a very striking example of a correlation between the activities of two different parts of the body, effected

by chemical means. When the acid chyme enters the intestine, a certain amount of secretin is liberated into the blood stream. The resulting secretion of the alkaline pancreatic juice neutralizes the acid chyme, and the liberation of secretin (and therefore of pancreatic juice) comes to an end. So long as the duodenal contents are acid, the pylorus remains closed, but as soon as they are neutralised, the pylorus opens to allow another portion of the acid gastric contents to pass. In this way, the pancreatic secretion is maintained throughout the whole period of digestion.

Secretin—The chemical composition of secretin is not known, and secretin has not yet been obtained in a pure form. The usual extracts of the mucous membrane of the small intestine contain, besides secretin, a large number of impurities, especially a substance named histamine, which has a considerable vasodilator effect on the capillaries of all organs. Thus after the injection of crude preparations of secretin, the blood pressure falls, sometimes very considerably. It has been proved that the induced pancreatic secretion is not caused by the fall of blood pressure itself. The proof rests on the following observations. The vasodilatory substances can be extracted from almost every organ, but secretin is only present in the small intestine. With certain solvents, it is possible to extract a depressor free secretin. In slightly alkaline medium, secretin is destroyed while the vasodilatory substances remain intact. The action of secretin is not paralysed by atropine, showing that secretin acts directly on the pancreatic cells, and not on the nerve endings of the secretory nerves. The composition of the secretion and the chemical mechanism of pancreatic secretion are apparently the same in all animals, at least, secretin extracted from the intestine of any animal will cause pancreatic secretion in any other animal. In the foetus, secretin is found in a very early stage of development.

The question now arises as to the correlation between the nervous and the chemical mechanisms of pancreatic secretion. The correlation is not yet clear, but we know of one instance in which the secretion, or rather the composition of the juice, is determined by the cooperation of the vagus nerve—that is in the case of injection of fats. Injection of neutral fats or of soaps into the duodenum evokes a secretion of very concentrated juice that is rich in enzymes. After section of the vagi, or after injection of atropine, the quantity of the secreted juice is unaltered, but it is now poor in enzymes. In many cases also sham feeding, when the entry of the gastric juice into the duodenum is prevented, will evoke a small secretion of very concentrated juice, some time before the appearance of gastric secretion, this secretion is absent after section of the vagi.

Stimulation of the vagi, superimposed upon the pancreatic secretion which has been evoked by injection of secretin, does not modify the rate of secretion but greatly enriches the juice in enzymes. It seems that the nervous mechanism is chiefly concerned with the removal from the cells of the pre-stored enzymes, while the chemical mechanism regulates the passage of water and alkali from the blood through the gland into its system of ducts. Histological observations support this point of view since, after the considerable secretion of pancreatic juice evoked by chemical means, the pancreas looks only lightly exhausted while after the small secretion evoked by stimulation of the vagus the gland becomes a picture of maximal exhaustion.

The Secretion of Bile—The liver is the largest gland in the body, but its digestive function is only of secondary importance, as compared with the rôle it plays in the chemical alteration of substances after they have been absorbed into the blood and its function as an excretory organ of various substances amongst which the products of the decomposition of haemoglobin are the chief. The production of bile by the liver cells is continuous, but the entry of the bile into the digestive tract is intermittent, and is only to some extent related to the periods of digestion. The secreted bile accumulates in the gall bladder and in the large bile duct, the entry into the intestine being prevented by a small sphincter at the end of the common bile duct. While the bile remains in the gall bladder, it undergoes concentration on account of absorption of water and secretion of mucin by the walls of the bladder.

From the point of view of digestion, the only important constituents of bile are the bile salts (sodium taurocholate and glycocholate). The digestive functions of bile are—

- (1) Activating the lipase of the pancreatic juice
- (2) Increasing the emulsification of fats by lowering the surface tension
- (3) Dissolving fatty acids and soaps
- (4) Increasing the peristaltic movements of the intestinal tract
- (5) Increasing the bile production on reabsorption of bile salts into the blood

During the periods of digestion, the flow of bile is increased. This is due to two factors—(a) the emptying of the gall bladder, and (b) an increased formation of bile.

The muscular wall of the gall bladder is under a nervous control, the vagus conveying motor, and the sympathetic inhibitory fibres. The entry of the products of gastric digestion and of the acid chyme into the duodenum sets the reflex in operation. The actual secretion of bile, however, is independent of the nervous system, and continues even after all the nerve connections of the liver have been severed. It is mainly dependent on the blood supply to the liver and, if other conditions are the same, the bile flow increases with increase of blood flow. Absorption of food substances, of acid, and especially of fats increases the production of bile. This is ascribed by some to the liberation of the pancreatic secretin.

The bile salts are reabsorbed in the intestine and conveyed via the portal vein back to the liver, which removes them from the blood, thus preventing their entry into the general circulation where they would be intensely poisonous (see JAUNDICE and ICTERUS). The bile salts increase the production of bile, and thus a comparatively small amount of bile salts undergoes repeated resecretion during a comparatively short time. The entry of bile into the digestive tract, and therefore the stimulating effect of bile salts upon bile production, is stopped at the end of digestion by the closure of the sphincter of the common bile duct.

The Intestinal Juice (Succus Entericus)—The secretion of the intestinal juice, like that of the pyloric juice, is continuous. The secretion is studied in animals in which one or another part of the intestinal tract is transplanted so as to open to the outside of the abdominal cavity. Since the intestine hangs on the loose mesentery, the blood vessels and nerves of the transplanted part remain intact. The continuity of the rest of the tract is re-established. Animals operated on in this manner live as long as normal animals, and do not suffer in their digestion or general condition.

The intestinal juice on standing divides itself into 2 fractions, a sediment which is chiefly composed of the mucus secreted by the goblet cells of the digestive tract and desquamated epithelium, and a liquid part containing enzymes (the enzymes are enterokinase, erepsin, nuclease, amylase, invertase, lactase and lipase maltase, the Brunner's glands of the duodenum secrete an enzyme similar to pepsin). The lower down the tract, the larger is the sedimentation, until the secretion in the large intestine is composed of mucus and is devoid of enzymes (See VITRITION).

There are no definite indications of any nervous control of intestinal secretion. Section of the nerves produces a great increase in the flow, but this is usually accompanied by the hyperaemia ensuing after section of the nerves which can in a large amount of vasoconstrictor fibres. Some physiologists regard this secretion as due to section or special inhibitory nerves.

Intestinal stimulations increase the secretion of intestinal juice and by this regard the mechanism of intestinal secretion as identical with that of pancreatic secretion, namely, that in both cases, the stimulus is due to the liberation of the same agent, secretin. However, experiments on animals with a transplanted loop of the intestinal tract (kept under normal conditions) make this view untenable. On feeding such an animal the secretion of the transplanted part is not increased as it would have been if the hormone mechanism were the operative factor. Pavlov's experiments show that the stimulus for intestinal secretion is, like that of pyloric secretion, local mechanical stimulation of the mucous membrane.

Some Experiments.—The following experiments may serve to illustrate this point. The secretion of the intestinal juice from the small isolated portion was measured before and after feeding the animal with various food substances. The juice was collected by means of a small tube inserted in the isolated loop. Before feeding, the spontaneous secretion varied between 2.0 and 2.8 cc, after intake of meat, it was 2.5 cc, after bread 3.0 cc, after milk 1.7 cc, and after mixed food 1.6 cc. Only in the case of feeding with fats

did the secretion of the isolated portion slightly but definitely increase (from 3.0 to 5.0 cc). With these results should be compared the experiments with local mechanical and chemical stimulation of the transplanted part. The spontaneous secretion was 0.0–0.5 cc per hour, when a rubber tube was introduced into the intestinal loop, the secretion increased to 4 cc, when glass beads were placed in the intestines, it increased to 8.7 cc, when 0.5% HCl was injected into the intestine and then removed, the hourly secretion increased to 20 cc. The stimulation by either of the above methods of some part of the intestine has no effect on the rest of the tract, showing that the effect is mainly if not entirely local. These local stimuli have hardly any effect on the secretion of the sediment, they only increase the production of the enzyme-containing liquid part of the juice.

Some observers have found that stimulation of the vagus nerve increases the secretion of the juice after a very long latent period. It is possible, however, that the increased flow is due to a more vigorous contraction of the intestines, for the vagus is the motor nerve of the intestinal muscles.

A very interesting correlation has been discovered as regards the concentration of enterokinase in the intestinal juice and the pancreatic juice. The transplanted loop of the intestine secretes a juice which becomes progressively poorer in enterokinase, so that a few months after the operation it almost entirely loses the power to activate trypsinogen (*see ENZYMES*). If however the mucous membrane is brought for a short time (2–3 minutes) into contact with the pancreatic juice (the juice may be diluted to as much as one in 1000), the concentration of enterokinase increases. Alkali and boiled pancreatic juice have no such effect. The concentration of other enzymes of the intestinal juice is not affected by such treatment of the intestine with pancreatic juice.

The Movements of the Small Intestine.—It is known that the intestinal tract is in a state of constant movement, the analysis of which presents great difficulties because several types of contraction may occur simultaneously or in rapid succession, either at the same point or at neighbouring positions. Different authors have given different descriptions of these movements, and have used different nomenclatures but in spite of this confusion it may be said that the small intestine exhibits three kinds of contractions. These are as follows:—(a) the rhythmic segmentation (also known as pendular movements or swaying movements), (b) the peristaltic contraction (also known as the myenteric reflex), and (c) the tonic contractions.

Rhythmic Contractions.—Direct observations of an exposed part of the intestine show that slight waves of contraction pass over its surface. Records by means of instruments show that both the circular and the longitudinal muscular coats take part in these contractions, which recur at the rate of 10–15 a minute. These contractions involve only short stretches of the intestine. They easily can be produced artificially by stimulating the gut either electrically or mechanically. On application of such a stimulus, the part immediately stimulated quickly contracts, the contraction spreading one or two centimetres along the intestine. These rhythmic contractions may originate spontaneously in any part of the intestinal tract, especially at those parts which are subjected

to some tension. The propagation of this contraction goes from muscle fibre to muscle fibre at an average rate of about 5 cm per second.

These rhythmic contractions are unaffected by section of all the nerves of the intestine, in fact they are entirely myogenic in origin. They are even independent of the local nervous network of the intestinal wall, for strips removed from the longitudinal coat of the small intestine entirely free from any remains of the nerve plexus continue their rhythmic contraction. (The nervous network of the intestine is made up of Auerbach's plexus and Meissner's plexus.)

In order to observe the rhythmical contractions, isolated portions of the intestine can be removed from an animal after its death, these portions should be kept at body temperature, surrounded with a solution containing salts in the same proportion as those in blood (Ringer's fluid), and richly supplied with oxygen. In the normal animal, the rhythmic contractions cause a thorough mixing of the contents of the gut with the secretions of the various glands, but they do not help to pass the food along the intestinal tract, for each contraction squeezes the food in both directions. A column of food may thus remain at the same level in the gut for a considerable time.

Peristaltic Contractions.—The onward progress of the food is caused by true peristaltic contractions which involve contraction of the intestine above the food mass, and relaxation below. This contraction and relaxation travels down the intestinal tract in the form of two waves, and in this way the food is slowly propelled towards the large intestine. The peristaltic contractions involve the co-operation of the local nervous system of the intestine, and they are absolutely abolished by painting the intestine with drugs which paralyse nerves (e.g., nicotine, cocaine), but still continue after severing the nervous connection between the intestine and the brain and spinal cord. The direct irritating effect of food, or the application of an experimental stimulus, evokes an immediate contraction above and relaxation below (sometimes described as "the law of the intestines"). Anti peristalsis is not observed in the small intestine.

Tonic Contractions.—The third type of movement, which is known as the tonic contraction, is common to all plan muscles, and is determined by a state of sustained partial contraction of the muscle. Neither during the wave of relaxation observed as the forerunner of the wave of contraction in peristalsis, nor during the periods in between the rhythmic segmentation, is the intestine completely relaxed, it always maintains a certain tone, which may be greater or less. Thus the two forms of contraction (already described) are superimposed upon the tonically contracted state of muscles. In some cases, the intestinal tone may be intense. It is claimed that colic pains are due to this form of contraction.

Although the mechanism of all these three forms of contraction is entirely peripheral, they can be increased or decreased by impulses from the central nervous system. The vagus nerve carries nerve fibres to the intestine which stimulate its movements, while the splanchnic nerves diminish or even abolish them. The lowest 2 cms of the small intestine exhibits a thickening of the circular muscular coat, the ileocolic sphincter (valve), which relaxes in front of a peristaltic wave and contracts if there is any regurgitation from the large intestine. This sphincter presents a marked contrast to the rest of the small intestine in that its innervation is reversed, the vagus being the inhibitory and the splanchnic the excitatory nerve.

The Movements of the Large Intestine.—The contents of the small intestine are gradually transferred into the large intestine. In carnivora, the digestion and absorption are both nearly completed at the ileocolic valve, but in herbivora a large part of the processes of digestion and absorption occur in the large intestine and in the caecum. As regards his large intestine, man takes an intermediate position between these two groups of animals.

The movements of the large intestine can best be observed by means of the X-ray method, after feeding a meal containing some bismuth. The food first fills the proximal part of the large intestine. The distension brings about a wave of contraction which starts at the end portion of the ascending colon, and slowly travels

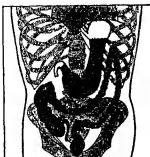


FIG. 3.—DIAGRAM OF NORMAL POSITION OF COLON OR LARGE INTESTINE IN MAN SHOWING THE TIME IN HOURS OF ARRIVAL OF FOOD AT VARIOUS LEVELS.

in a backward direction, passing the food toward the caecum, the ileocolic valve prevents its escape into the small intestine. These contractions are not preceded by a wave of relaxation and therefore should not be regarded as antiperistaltic waves. As the whole contents cannot escape into the caecum, certain portions slip back. These movements thus have the same effect as those of the pylorus, they bring the food into closer contact with the walls of the alimentary canal. In this way the intestinal movements favour the absorption of substances that escaped absorption in the small intestine.

The distension of the caecum occasionally excites a true peristaltic wave which travels in a forward direction and drives the semi-solid residue of the food toward the distal part of the colon. The intensity of the peristaltic waves and of the backward contraction vary greatly in different kinds of animals, and even in different individuals of the same species. In man they are not well pronounced, and the caecum and the ascending colon seem to be more or less passive.

About 400 g. of semiliquid material pass the ileocolic valve daily, of this amount, about 250 g. is water with some nutrient material, which is absorbed in the large intestine, the remaining 150 g. form the faeces.

The large intestine, like the small, is a nervous system of its own in the form of a network of nerve cells and fibres lying in between the muscular layers. The movements of the large intestine are primarily dependent on this network, but they can be increased under the influence of the pelvic visceral nerve, or diminished by the inferior mesenteric nerves which belong to the sympathetic nervous system.

A distinguishing feature of the distal colon is its complete subordination to the spinal centres. It remains inactive until, on account of distension, it is reflexly excited through the pelvic visceral nerve, it is then completely emptied.

In man, the emptying of the rectum is largely assisted by contractions of voluntary muscles of the pelvis and of the abdominal wall.

In herbivora, the large intestine plays an important part in the digestion of cellulose, not because of the secretion of some special enzyme which could effect this digestion, but because of the rich bacterial flora of the large intestine.

The splitting of cellulose is caused by the action of bacteria, and it results in the formation of simpler carbohydrates, viz, sugars. Thus the cellulose which forms vegetable cell walls can be utilized by the animal.

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DIGESTIVE ORGANS. The digestive system is made up of the gastrointestinal tract, consisting of the mouth, throat, oesophagus, stomach and intestines, and of glands such as the salivary glands, the pancreas and the liver which pour the secretions into the tract in order to accomplish the digestion of the food. (See ALIMENTARY CANAL, ALIMENTARY SYSTEM, DISEASES OF THE, DIGESTION, etc.)

DIGG'S LLODARD

SIR DUDLEY DIGGES (1583-1639), the son of Thomas, was a judge and diplomat. Graduated with the degree of B.A. from University College, Oxford in 1601, he became an early shareholder in the East India Company and served as a member of parliament at various times. In 1618 he represented the king, James I., in Russia and in 1620 went to Holland where he unsuccessfully attempted to settle by negotiation the disagreements between the East India companies of the two countries. In 1636 he became master of the rolls. Sir Dudley and his father jointly wrote *Four Paradoxes or Politique Discourses* (1604).

DUDLEY DIGGES (1613-1643), son of Sir Dudley Digges was a staunch supporter of Charles I., whom he defended in a number of political works such as *A Review of the Observations upon some of His Majesty's late Answers and Expresses* (1643) and *The Unlawfulness of Subjects taking up arms against their Sovereign in what case soever* (1643).

DIGGES, WEST (1720-1786), English actor, made his first stage appearance in Dublin in 1749 as Japhet in *Venice Preserved*, and both there and in Edinburgh until 1764 he acted in many tragic roles with success. He was the original "young Norval" in Home's *Douglas* (1756). His first London appearance was as Cato in the Haymarket in 1777, and he afterward played Lear, Macbeth, Shylock and Wolsey. In 1781 he returned to Dublin and retired in 1784. He died in Cork on Nov. 10, 1786.

DIGIT, literally a finger or toe (Lat. *digitus*, finger), and so from counting on the fingers a single numeral or, from measuring, a finger's breadth. In astronomy a digit is the 12th part of the diameter of the sun or moon, it is used to express the magnitude of an eclipse.

DIGITALIS In pharmacy, the dried leaf of the common foxglove (*g.*), *Digitalis purpurea* Linné. It was first introduced into medicine as a diuretic (stimulant of urine secretion) in dropsy in 1775 by William Withering of Birmingham, Eng., who recognized it as the active ingredient of an old woman's secret formula.

Three cardiac glucosides have been isolated in crystalline form from *Digitalis purpurea*, digitoxin, gitoxin and gitalin. All three have essentially similar pharmacological actions although they differ in the rate in which they are absorbed and eliminated in the body and also in their solubilities in various solvents. In addition, digitalis also contains a number of saponins which probably modify the effect of the cardiac glucosides without producing cardiac effects themselves.

The beneficial actions of the cardiac glucosides in heart disease include a tonic effect on the heart, with diminution of the volume of the organ and increased cardiac output, a slowing of the pulse, and a slowing of the conduction of impulses throughout the heart. These effects are produced at near toxic doses and are frequently accompanied by gastrointestinal upsets, caused probably by a stimulation of the vomiting centre by reflexes set up by the cardiac effects. The diuretic effect of digitalis is secondary to its improvement of the circulation and is not due to any specific action on the kidney.

Digitalis is indicated in congestive heart failure from any cause, being most effective in cases of auricular fibrillation. It leads to cumulation of the drug in the body because of excretion and destruction. Because of this cumulation use of the small margin between therapeutic and toxic toward effects are not uncommon and may consist of gastrointestinal upsets and visual disturbances or more alarming irregularities. It is usually administered by mouth in the form of tablets of the dried leaf. The purified principles may be given orally, though this is seldom necessary or desirable.

(F. O. K.)

DIGNE, the chief town of the department of the Basses Alpes, southeast France, 14 mi. by a branch line from the main way line between Grenoble and Avignon. Population 10,000 (1936), 5,689, in 1946, 6,845. The *Duma* of the Romans was the capital of the Bodionti. From the early 6th century at least it has been an episcopal see, which till 1790 was in the ecclesiastical province of Embrun, but since 1802 in that of the Provence. It suffered much during the religious wars of the

16th and 17th centuries. The Ville Haute is built on a mountain spur on the left bank of the Bléone river, and above its narrow, winding streets towers the present cathedral church (late 15th cent.), largely reconstructed in modern times, and the former bishop's palace (now the prison). The fine Boulevard Gassendi separates the Ville Haute from the Ville Basse, which is of modern date. The old cathedral (Notre Dame du Bourg) (13th cent.) is now disused except for funerals. The neighbourhood of Dijne is rich in orchards, which have long made the town famous in France for its preserved fruits and confections, honey and yellow wax.

DIJON, a town of east central France, in the department of Saône-et-Loire, on the right bank of the Loire, 55 mi WNW of Mâcon on the Paris Lyon railway. Pop. (1936) 5,668. It is situated at the meeting places of the Loire, the Lateral canal of the Loire and the Canal du Centre, which here crosses the Loire by a fine aqueduct. The town carries on considerable manufactures of faience, pottery and porcelain. The port on the Canal du Centre trades in timber, sand, iron, coal and stone.

DIJON, a town of eastern France, capital of the department of Côte d'Or and formerly capital of Burgundy, 195 mi S.E. of Paris on the Paris Lyon railway. Pop. (1936) 93,929.

Under the Romans Dijon (*Divonense castrum*) was a *vicus* in the *civitas* of Langres. In the 2nd century it was the scene of the martyrdom of St. Benignus (Benigne, *vulg.* Berlin, Bernin), the apostle of Burgundy. About 274 the emperor Aurelian surrounded it with ramparts. Gregory of Tours, in the 6th century, comments on the strength and pleasant situation of the place, expressing surprise that it does not rank as a *civitas*. The dukes of Burgundy acquired Dijon early in the 11th century. The communal privileges, conferred on the town in 1182 by Hugh III, duke of Burgundy, were confirmed by Philip Augustus in 1183, and in the 13th century the dukes took up their residence there. For the decoration of the palace and other monuments built by them, eminent artists were gathered from northern France and Flanders, and during this period the town became one of the great intellectual centres of France. The union of the duchy with the crown in 1477 deprived Dijon of the splendour of the ducal court, but to counterbalance this loss it was made the capital of the province and seat of a *parlement*. Its fidelity to the monarchy was tested in 1513, when the citizens were besieged by 50,000 Swiss and Germans, and forced to agree to a treaty so disadvantageous that Louis XII refused to ratify it. In the wars of religion Dijon sided with the League, and opened its gates to Henry IV only in 1595. The 18th century was a brilliant period for the city, it became the seat of a bishopric, its streets were improved, its commerce developed, and an academy of science and letters founded, while its literary salons were hardly less celebrated than those of Paris. The neighbourhood was the scene of considerable fighting during the Franco-Prussian War, which was, however, indirectly of some advantage to the city owing to the impetus given to its industries by the immigrants from Alsace.

Dijon stands on the western border of the fertile plain of Burgundy, at the foot of Mont Afrique, the north-eastern summit of the Côte d'Or range, and at the confluence of the Ouche and the Suzon, it also has a port on the canal of Burgundy. The great strategic importance of Dijon as a centre of railways and roads, and its position with reference to an invasion of France from the Rhine, led to the creation of a fortress forming part of the Langes group. There is no *enceinte*, but on the east side detached forts, 3 to 4 m distant from the centre, command all the great roads, while the hilly ground to the west is protected by Fort Hauteville to the NW and the "groups" of Motte Garon and Mont Afrique to the SW. Including a fort near Saussy (about 8 m to the NW) protecting the water-supply of Dijon, there are eight forts, besides the groups above mentioned. The old churches and historic buildings of Dijon are to be found in the irregular streets of the old town, but industrial and commercial activity has been transferred to the new quarters beyond its limits.

The cathedral of St. Bénigne, originally an abbey church, was built in the latter half of the 13th century on the site of a

Romanesque basilica, of which the crypt remains. The west front is flanked by two towers and the crossing is surmounted by a slender timber spire. The plan consists of three naves, short transepts and a small choir, without ambulatory, terminating in three apses. In the interior there is a fine organ and a quantity of statuary, and the vaults contain the remains of Philip the Bold, duke of Burgundy, and Anne of Burgundy, daughter of John the Fearless. The site of the abbey buildings is occupied by the bishop's palace and an ecclesiastical seminary. The church of Notre Dame, typical Burgundian Gothic (1252-1334) is distinguished for the grace of its interior and the beauty of the western façade. The portal consists of three arched openings, above which are two stages of arcades, open to the light and supported on slender columns. A row of gargoyles surmounts each storey of the façade, which is also ornamented by sculptured friezes. A turret to the right of the portal carries a clock called the *Jaquemart*, on which the hours are struck by two figures. The church of St. Michel belongs to the 15th century. The west façade, the most remarkable feature of the church, is, however, Renaissance. The vaulting of the three portals is of exceptional depth owing to the projection of the lower storey of the façade. Above this storey rise two towers of five stages, the fifth stage being formed by an octagonal cupola. The columns decorating the façade represent all the four orders. The design of this façade is wrongly attributed to Hugues Sambin (fl. c. 1540), a native of Dijon, and pupil of Leonardo da Vinci, but the sculpture of the portals, including "The Last Judgment" on the tympanum of the main portal, is probably his work. St. Jean (15th century) and St. Étienne (15th, 16th and 17th centuries), now used as the exchange, are the other chief churches. Of the ancient palace of the dukes of Burgundy there remain two towers, the Tour de la Terrasse and the Tour de Bar, the guard room and the kitchens, these now form part of the *hôtel de ville*, the rest of which belongs to the 17th and 18th centuries. This building contains an archaeological museum, the archives of the town, and the principal museum, which, besides paintings and other works of art, contains the magnificent tombs of Philip the Bold and John the Fearless, dukes of Burgundy. These were transferred from the Chartreuse of Dijon (or of Champmol), built by Philip the Bold as a mausoleum, now replaced by a lunatic asylum. Relics of it survive in the old Gothic entrance, the portal of the church, a tower and the well of Moses, which is adorned with statues of Moses and the prophets by Claus Sluter (fl. end of 14th century), the Dutch sculptor who also designed the tomb of Philip the Bold. The Palais de Justice, which belongs to the reign of Louis XII, is of interest as the former seat of the *parlement* of Burgundy. Dijon possesses several houses of the 15th, 16th and 17th centuries, notably the Maison Richier in the Gothic, and the Hotel Vogué in the Renaissance style.

The town is important as the seat of a prefecture, a bishopric, a court of appeal and a court of assizes, and as centre of an academy (educational district). There are tribunals of first instance and of commerce, a board of trade-arbitrators, a chamber of commerce, an exchange and an important branch of the Bank of France. Its educational establishments include faculties of law, of science and of letters, a preparatory school of medicine and pharmacy, a higher school of commerce, a school of fine art and a conservatoire of music.

Dijon is well known for its mustard, and for the black-currant liqueur called *cassis de Dijon*, its industries include the manufacture of machinery, automobiles, bicycles, soap, biscuits, brandy, leather, boots and shoes and hosiery. There are also flour mills, important printing works (vinegar works and, in the vicinity, nursery gardens). The state has a large tobacco manufactory in the town. Dijon has considerable trade in cereals and wool, and is the second market for the wines of Burgundy.

DIKE or DYKE, a trench dug out of the earth for defensive and other purposes (*cf.* Dutch *dijk*, Ger. *Teich*). Water naturally collects in such trenches, and hence the word is applied to natural and artificial channels filled with water, as appears in the names of many narrow waterways in East Anglia. "Dike"

is also used of the bank of earth thrown up out of the ditch, and so of any embankment, dam or causeway, particularly the defensive works in Holland, the Fen district of England, and other low-lying districts which are liable to flooding by the sea or rivers (See *HOLLAND and FENS*). In Scotland any wall, fence or even hedge, used as a boundary, is called a dyke. In geology the term is applied to wall like masses of rock (sometimes projecting beyond the surrounding surface) which fill up vertical or highly inclined fissures in the strata.

DIKKA, in architecture, a raised tribune or platform in a Mohammedan mosque, from which the service is directed and the Koran read.

DILAPIDATION, a term meaning in general a falling into decay, but more particularly used in the plural in English law for (1) the waste committed by the incumbent of an ecclesiastical living, (2) the disrepair for which a tenant is usually liable when he has agreed to give up his premises in good repair (see *EASEMENT, FLAT, LANDLORD and TENANT*, as to limited owners, see *WASTE*).

In the eye of the law an incumbent of a living is a tenant for life of his benefice, and any waste, voluntary or permissive, on his part must be made good. Under the old law, proceedings might be taken against the dilapidating incumbent in the ecclesiastical court, or an action in the courts of common law could be brought by the successor upon the custom of England against the previous incumbent or his personal representatives if he were dead. And if such a thing should happen, this law might still have to be applied in the case of bishops or cathedral dignitaries or officers. But for parochial incumbents provision was made in 1873 by the Ecclesiastical Dilapidations Act of that year, which Act however has now been superseded by the Ecclesiastical Dilapidations Measure 1923 which covers the whole ground.

By this measure, diocesan dilapidation boards are appointed who are to cause first inspections to be made of the buildings of every benefice. These first inspections are to be made within seven years of the passing of the Measure or earlier if the benefice becomes vacant or is put under sequestration. The surveyor is to report whether any and if so what repairs are needed, and to divide them into ordinary repairs and structural repairs, and to subdivide the latter into those which do not or do admit of delay, and if there has been any mischief due to deliberate action or gross neglect, he is to state the cost of these separately and call them "wilful dilapidations." For these latter the incumbent is to be liable at once. Opportunity is given to any party interested to object to the report of the surveyor on any point, and the board is finally to determine.

If the inspection is on a vacancy, and the late incumbent is not protected by a certificate under the old Act, he or his personal representatives must pay to Queen Anne's Bounty the cost of ordinary and immediate structural repairs, as determined by the Board. If the first inspection is not on a vacancy and the incumbent or the sequestrator is not protected by a certificate under the old Act he is similarly liable, but in case of personal poverty or the benefice being less than £250 a year, there are provisions for his relief.

As to the future, Queen Anne's Bounty is to make an assessment first for a "repair rate" to cover the execution of repairs required by an order of the dilapidation board, except those already provided for and those for which the cost is spread over more than five years, secondly for an "insurance rate" to provide for reinstating the buildings in case of fire, and thirdly for an "administration rate" to cover office expenses and surveyor's fees. For repairs, the cost of which is to be spread over a longer period than five years, there is to be a "long assessment" in lieu of an ordinary assessment.

There are numerous provisions directing the application of the moneys raised and the execution of repairs and giving power to Queen Anne's Bounty to advance loans and to make grants in the case of poor livings, and concerning timber growing on the glebe. The broad effect of the Measure is to substitute annual payments in the nature of premiums of insurance in lieu of a capital liability.

In the United States, the term means the neglect of necessary repairs of a building, the suffering of it to fall into a state of decay or the unauthorized pulling down of the building or any part of it (See *LANDLORD and TENANT*).

DILATATION, a term used in medicine to denote the widening or enlarging of a cavity, orifice or hollow viscus beyond its normal dimensions. It may arise pathologically from obstructions in hollow viscera such as the gastrointestinal tract and the urinary and biliary tracts. Fluid accumulates above the obstruction, leading to a dilatation of the viscus. This usually leads to an increased muscular activity above the obstruction which produces a sensation of pain and may ultimately lead to a thickening of the muscular wall. Following the removal of the obstruction the viscus may or may not assume its original dimensions depending on the elasticity of its muscular layers. In dilatation of the ventricles of the brain, expansion of the brain is limited by the rigidity of the skull, hence hydrocephalus (*qv*) results. Digital dilatation, dilatation of a cavity or orifice by means of a finger is a method commonly employed in physical diagnosis.

The term is used in connection with heart disease when the muscle is weakened and one or more cavities dilated, thus causing interference with normal circulation.

The term is also used to describe certain operative procedures when an orifice or passage is dilated with various types of instruments (F L A).

DILATORY, delaying, or slow, in law a "dilatory plea" is one made merely to delay the suit.

DILEMMA is the name of a special type of reasoning. In its commonest form its conclusion presents one with two alternatives. When employed in debate the usual aim is to present alternatives both of which are unpalatable to the opponent. Thus, *e.g.* in answer to the contention of a protectionist that protective import duties both increase revenue and stimulate home industry, it has been argued: "If protective duties increase revenue, they cannot also stimulate home industry, and if they stimulate home industry, they cannot also increase revenue."

"But they do either the one or the other."
"Therefore they either cannot stimulate home industry, or they cannot increase revenue." (That is they cannot do both at once.) The unpalatable alternatives are called the "horns" of the dilemma. This familiar use of the dilemma has led to an extension of its meaning, and the term is applied popularly to any kind of situation in which one is confronted with unsatisfactory alternatives, as, *e.g.*, when a country, exhausted by war, finds itself in the dilemma of either impoverishing its people or repudiating its debts.

Valid arguments in the form of the dilemma are not very common, hence few situations can be adequately summed up in two alternatives. The dilemma is consequently used frequently in a rather loose manner by plausible orators. Hence there is an impression abroad that dilemmas are merely sophistical tricks. But this is a mistake. Dilemmas can be, and sometimes are, quite sound. Their association with political discussions or merely captious argumentations is accidental, and the alternatives which their conclusions present need not be unpalatable. (See *LOGIC*).

DILETTANTE, an Italian word for one who delights in the fine arts, especially in music and painting. Properly the word refers to an "amateur" as opposed to a "professional" cultivation of the arts, but is often used in a depreciatory sense of one who is only a dabbler. The Dilettanti Society, founded in 1733-34, still exists in England. A history of the society, by Lionel Cust, was published in 1898.

DILIGENCE, in common law, a term which is substantially equivalent to "care." In Scots law it is a general term for the process by which persons, lands or effects are attached on execution, or in security for debt (See *NEGLECTANCE*).

DILKE, CHARLES WENTWORTH (1780-1864), an English critic and antiquarian, was born on Dec. 8, 1789. After studying at Cambridge, he entered the navy pay office. From 1814 to 1816 he edited *Old English Plays* (6 vols.), from 1830 to 1846 the *Athenaeum*, and from 1846 to 1849 was manager of the *Daily News*. He then became a regular contributor to the

Athenaeum, his valuable essays for it on Elizabethan drama, on the literary history of the 17th and 18th centuries, and especially on Pope, being collected as *Papers of a Critic* (2 vols, 1875) Dilke died in Hampshire on Aug. 10, 1864.

DILKE, SIR CHARLES WENTWORTH, BART (1810-1869), English politician, son of Charles Wentworth Dilke, proprietor and editor of *The Athenaeum*, was born in London on Feb. 18, 1810, and was educated at Westminster school and Trinity Hall, Cambridge. He studied law, and in 1834 took his degree of LL.B., but did not practise. He assisted his father in his literary work, and was for some years chairman of the council of the Society of Arts. He took a prominent part in the affairs of the Royal Horticultural Society and other bodies, including the executive committee of the Great exhibition. In 1853 Dilke was one of the English commissioners at the New York Industrial Exhibition, and in 1862 one of the five royal commissioners for the second Great Exhibition. Soon after the death of the prince consort he was created a baronet. In 1865 he entered parliament as member for Wallingford. In 1869 he was sent to Russia as representative of England at the horticultural exhibition held at St. Petersburg (Leningrad). His health, however, had been for some time failing, and he died suddenly in that city on May 10, 1869.

DILKE, SIR CHARLES WENTWORTH, BART (1843-1911), son of the preceding, was born in London in 1843, and educated at Trinity Hall, Cambridge, where he achieved the triple distinction of being senior lawist in the law tripos, president of the Union and stroke of the boat which was head of the river. In 1866 he made a voyage round the world, beginning with the United States, and visiting New Zealand, Australia, Ceylon, India and Egypt. The impressions gained on these travels left him, he said, "with a conception, however imperfect, of the grandeur of our race, already girdling the world, which it is destined, perhaps, to overspread." The book in which he described his travels, *Greater Britain* (1868), gave a great impulse to a sane and reformed imperialism. All his life Dilke was a true imperialist. For him there was no incompatibility between imperialism and extreme radicalism. He became a prominent Liberal politician, as M.P. for Chelsea (1868-86), under-secretary for foreign affairs (1880-82), and president of the local government board (1882-85). In 1871-72 Dilke represented the extreme radical party in England. There was no great love for the Crown, for the Queen's retirement of ten years was a cause of discontent, and he attacked the expense of royalty, in particular the dowries voted for the Queen's children. He was a theoretical republican, and on various occasions in public speeches put the case for republicanism. His own attitude was the reverse of revolutionary. As he said himself, "To think and even to say that monarchy in western Europe is a somewhat cumbersome fiction is not to declare oneself ready to fight against it on a barricade." During these years he says himself he was nearly subjected to physical and really subjected to moral martyrdom, and it is a fact that on one occasion at least nothing but his own imperturbable courage saved his life. Nevertheless, within a few years Disraeli could express the opinion that Sir Charles Dilke was the most powerful and influential member among quite young men that he had ever known.

During his first years in the House of Commons he maintained an independent position. Between 1876 and 1880 he became a close ally of Joseph Chamberlain. Gradually, however, he became a force within the Liberal party, and during the Beaconsfield government with Lord Hartington as leader, the task of presenting the case for the opposition fell more and more into his hands. As a result of the Liberal victory of 1880 he and Chamberlain became members of the Gladstone ministry. In 1885 Dilke was chairman at a conference on industrial remuneration attended by all the prominent trade unionists of the day and women representatives of the Protective and Provident League, afterwards to become the Women's Trade Union League. This was symptomatic of his whole attitude towards labour problems. Throughout his life he was an ardent supporter of better conditions for the workers. While he was at the Local Government Board he called attention to the problem of housing, with the result that a Royal Commission sat in 1884 to study the housing of the working

classes. He was associated with the acts legalizing the position of the Trades Unions and limiting the hours of work. He was in favour of legislation to secure a minimum wage and he wished for the representation of labour in the House of Commons. When the Independent Labour Party emerged in 1894 he was asked to be its leader, but refused on the ground that he differed on certain radical points with its views. He therefore remained its candid friend and critic to the end of his life. He was largely instrumental in 1884 in bringing about the party treaty enabling the Franchise Bill to become law. It was at first rejected by the Lords unless accompanied by a redistribution of seats, a principle for which Dilke had long contended. It was eventually passed at the end of 1884, and the Redistribution Bill early in 1885.

"I never knew a man of his age, hardly ever a man of any age, more powerful and admired than was Dilke during his management of the Redistribution Bill in 1885." Such was Sir George Trevelyan's verdict of a man who combined radical principles with an extraordinary authority on foreign affairs and a capacity for working with men of the most varied views when great questions were at stake. Nevertheless, when Dilke left the Local Government Board on June 24, 1885, on the defeat of the Gladstone ministry, he left official life for ever. At this point he was cited as co-respondent in a divorce suit brought by Donald Crawford, Liberal M.P. for Lanark. Mrs. Crawford was the sister-in-law of Dilke's brother Ashton and the proceedings caused great scandal. The case against Dilke was dismissed, but he determined to retire from public life. In 1884 he had become privately engaged to Emilia Frances Pattison (née Strong), the widow of Mark Pattison, herself an accomplished art critic and collector. She was in India when the blow fell. Her reply to the accusation was the publication of her engagement to Sir Charles Dilke in the *Times*, and she married him on October 3, 1885; she died in 1904. Later, Chamberlain overruled his determination to retire from politics, and he was returned for the Forest of Dean in 1892 and for Chelsea once more in 1905. Although his knowledge of foreign affairs and his powers as a critic and writer on military and naval questions were admittedly of the highest order, his official position in public life could not again be recovered. He was marked out in 1885 as the future leader of the Liberal Party in the House of Commons, and there is little doubt that he might have become one of the great foreign ministers of Europe. He possessed a knowledge of the needs and aspirations of foreign countries rare among his contemporaries, and a definite policy to be pursued irrespective of party politics and the rise and fall of ministries. His military writings are *The British Army* (1888), *Army Reform* (1898) and, with Spenser Wilkinson, *Imperial Defence* (1892). On colonial questions he wrote with equal authority. His *Greater Britain* (2 vols., 1866-67) reached a fourth edition in 1868, and was followed by *The Present Position of European Politics* (1887), *Problems of Greater Britain* (2 vols., 1890) and *The British Empire* (1899).

Emilia Frances, Lady Dilke, his second wife, was the author of a number of books, the most important being the studies on *French Painters of the Eighteenth Century* (1899) and three subsequent volumes on the architects and sculptors, furniture and decoration, engravings and draughtsmen of the same period, the last of which appeared in 1902. A posthumous volume, *The Book of the Spiritual Life* (1905), contains a memoir of her by Sir Charles Dilke. (E.F.M.-S.)

S. Gwynn and G. M. Tuckwell, *Life of Sir Charles Dilke* (2 vols., 1917). Also published in abridged form by G. M. Tuckwell (1925).

DILL (*Anethum graveolens*), an annual or biennial herb of the family Umbelliferae, native to the south of Europe, Egypt and the Cape of Good Hope. It resembles fennel in appearance. The leaves are used in soups and sauces and, as well as the umbels, for flavouring pickles. The fruits are employed for the preparation of dill water and oil of dill, they are largely consumed in the manufacture of gin and when ground are eaten in the East as a condiment. Aqua Anethi or dill-water (dose 1-2 oz.) and the Oleum Anethi, almost identical in composition with caraway oil, and given in doses of 1-3 minims, are sometimes used as a carminative and as a vehicle

for the exhibition of nauseous drugs

DILLEN (DILENIUS) **JOHANN JAKOB** (1687-1747), English botanist, was born at Darmstadt and educated at the university of Giessen, where he printed in 1719 his *Catalogus plantarum sponte circa Gissam nascentium*. In 1721 he came to England, and in 1724 published a new edition of Ray's *Synopsis stirpium Britannicarum*. In 1732 appeared *Hortus Dillmanensis*, a catalogue of the rare plants growing at Eltham, Kent, for which Dillen himself executed 417 plates, and it was described by Linnaeus as *opus botanicum quo absolutius mundus non vidit*. In 1734 he became professor of botany at Oxford. Dillen, who wrote *Historia muscorum* (1741), died at Oxford on April 2, 1747.

For an account of his collection preserved at Oxford, see *The Dillenian Herbaria*, by G. Clardge Druce (Oxford 1907).

DILLENBURG, a town of Hesse Nassau, Prussia, Germany, in wooded country, on the Dill, 25 mi NW from Giessen on the railway to Troisdorf. Population 6,470. On an eminence above it lie the ruins of the castle of Dillenburg, founded by Count Henry the Rich of Nassau, about the year 1255, and the birthplace of Prince William of Orange (1533). It has a chamber of commerce. Its industries embrace iron works, bronze works, colour works, tanneries and the manufacture of cigars. Owing to its beautiful surroundings Dillenburg has become a favourite summer resort.

DILLENACEAE, a family of dicotyledonous plants, chiefly ligneous species and mostly trees, shrubs or vines. The group is largely tropical, 11 genera and about 300 species being recognized. The large genera are *Tetracera* with 30 or more species, *Davilla* of tropical America, with about 35 species, *Dolichocarpus* also of tropical America, 20 species, *Hibbertia*, largely Australian, with at least 120 species, *Wormea* with 35 or more species and *Dilena* with 20 species, both with very large showy flowers and characteristic of the Indo-Malaysian region.

For a treatment of the genera see E. Gilg and E. Weidemann, "Dilleniaceae," in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, ed. 2, vol. 21, pp. 7-35, fig. 1-20 (1925).

DILLENS, JULIEN (1849-1904), Belgian sculptor, was born at Antwerp June 8, 1849, son of a painter, and died at St. Gilles, near Brussels, Dec. 24, 1904. He studied under Eugène Simonis at the Brussels Academy of Fine Arts. In 1877 he received the *prix de Rome* for "A Gaulish Chief taken Prisoner by the Romans," and from this time he executed a number of important sculptures for the principal towns of Belgium and for the Belgian Government. Perhaps the most famous of these is the group "La justice entre la démocratie et le droit," in the Palais de Justice at Brussels.

DILLINGEN, a town of Germany in the *Land* of Bavaria, on the left bank of the Danube, 25 mi NF from Ulm by rail. Population 6,220. Dillingen has been the residence of the bishops of Augsburg, was taken by the Swedes in 1642 and 1648, by the Austrians in 1702 and on June 17, 1800 by the French. In 1800, it passed to Bavaria. Its principal buildings are an old palace of the bishops of Augsburg, now government offices, a royal gymnasium, a Capuchin monastery and a Franciscan convent. The university, founded in 1549, was abolished in 1804. The inhabitants are engaged chiefly in cattle rearing and the cultivation of corn, hops and fruit. In the vicinity is the Karolinen canal which cuts off a bend in the Danube between Lauingen and Dillingen.

DILLMANN, CHRISTIAN FRIEDRICH AUGUST (1823-1894) German orientalist and biblical scholar was born at Illingen on April 25, 1823. In 1853 he became professor extraordinarius at Tübingen, and subsequently professor of philoso-

phy at Kiel (1854), of theology at Giessen (1864) and Berlin (1869). He died on July 4, 1894. Dillmann's chief works are the *Book of Enoch* in Ethiopic (1851, German, 1853), the first part of the Ethiopic bible, *Octateuchus Aethiopicus* (1853-55), *Grammatik der aethiopischen Sprache* (1857, Eng. trans., 1907), the *Book of Jubilees* (1859), another part of the Ethiopic bible, *Libri Regum* (1861 and 1871), *Lexicon linguae aethiopicae* (1865), *Chrestomathia aethiopica* (1866). His *Commentar zum Hiob* (1866) stamped him as one of the foremost Old Testament exegetes. His renown as a theologian was mainly founded by the series of commentaries on other Old Testament books including *Genesis*, *Exodus* and *Leviticus*, *Numeri*, *Deuteronomium* and *Josua*, and *Jesaja*. In 1877 he published the *Ascension of Isaiah* in Ethiopic and Latin, and in 1895 *Vorlesungen über Theologie des Alten Testaments* appeared.

See W. Baudissin, *A. Dillmann* (Leipzig, 1895).

DILLON, ARTHUR RICHARD (1721-1807), French archbishop, was the son of Arthur Dillon (1670-1733), an Irish general in the French service. He was born at St. Germain, held many important preferments and in 1763 became archbishop of Narbonne, and in that capacity, president of the estates of Languedoc. He carried out many works of public utility, bridges, canals, roads, harbours, etc., had chairs of chemistry and of physics created at Montpellier and at Toulouse, and tried to reduce poverty. In 1787 and 1788 he was a member of the Assembly of Notables called by Louis XVI, and in 1788 presided over the assembly of the clergy. Refusing to accept the civil constitution of the clergy, Dillon emigrated to Coblenz in 1791. He lived in London until his death in 1807, never accepting the Concordat.

See L. Audibert, *Le Dernier Président des États du Languedoc, Mgr Arthur Richard Dillon, archevêque de Narbonne* (Bordeaux, 1868), L. de Lavergne, *Les Assemblées provinciales sous Louis XVI* (Paris, 1864).

DILLON, JOHN (1851-1927), Irish nationalist politician, was the son of John Blake Dillon (1816-1866), who sat in parliament for Tipperary, and was one of the leaders of "Young Ireland." John Dillon was educated at University college, Dublin, and afterwards qualified as a surgeon. He entered parliament in 1880 as member for Tipperary, and was at first an ardent supporter of C. S. Parnell, whom he accompanied in his tour of the United States in that year. In August he delivered a bitter speech on the Land League at Kildare, he advocated boycotting, and was arrested in May 1881 under the Coercion act, and again after two months of freedom in October. In 1883 he resigned his seat for reasons of health, but was returned unopposed in 1885 for East Mayo, which he continued to represent. He was one of the prime movers in the famous agrarian "plan of campaign" (see *IRELAND, History*). Dillon was compelled by the court of queen's bench on Dec. 14, 1886, to find securities for good behaviour, and in June 1888 under the provisions of the new Criminal Law Procedure bill he was condemned to six months' imprisonment. He was released in September, and in the spring of 1889 sailed for Australia and New Zealand, where he collected funds for the Nationalist party. On his return he was again arrested, but, being allowed bail, sailed for France in a fishing-boat with W. O'Brien, and thence to America. He returned to Ireland by way of Boulogne, where he and W. O'Brien held long and intensive conferences with Parnell. They surrendered to the police in February and on their release from Galway gaol in July declared their opposition to Parnell. After the expulsion of T. M. Healy and others from the Irish National Federation Dillon became the champion (Feb. 1896) of his early friendship with O'Brien gave place to disagreement but the various sections of the party were ostensibly reconciled in 1900 under Redmond's leadership. In the autumn of 1906 he arranged a convention of the Irish race, which included 200 delegates from various parts of the world. In 1907 Dillon opposed in the house the diamond jubilee address to Queen Victoria on the ground that her reign had not been a blessing to Ireland. He was suspended on March 20 for violent language addressed to Joseph Chamberlain.

In 1907 he advised Irishmen in England to vote Liberal at the general election and began to support the Liberal government.



DILL (*ANETHUM GRAVEOLENS*) AN AROMATIC PLANT VALUED FOR FLAVOURING AND FOR ITS MEDICINAL PROPERTIES.

At left is an enlarged drawing of fruit of Dill.

in its Irish measures, notably the Land bill, although in his earlier days he had opposed ameliorative measures as likely to defer Home rule. In the crisis of 1912 over the Better Government of Ireland bill Dillon urged that Nationalists should concentrate on the attack against the house of lords. In July 1914 he was invited by King George V to accompany Redmond to the Buckingham Palace conference which attempted to settle the Irish controversy, when his attitude is said to have been stiffer than Redmond's.

When war broke out, he immediately placed his whole influence behind the British government, speaking in this sense at the meeting in the Dublin Mansion House on Sept. 25, 1914. He took an active part in recruiting but steadily opposed the extension of conscription to Ireland which would, he was convinced, merely strengthen the Sinn Féin movement. He succeeded Redmond as leader of the Nationalist party, and at the General Election of Dec. 1918 he shared the general obliteration which overwhelmed the party. He died in London on Aug. 4, 1927, and was buried in Glasnevin cemetery, Dublin, by the side of his wife (d. 1907), a daughter of Justice Mathew.

DILLON, a city of southwestern Montana, U.S., on the Beaverhead river, the Union Pacific railroad and federal highway 91, the county seat of Beaverhead county. The population in 1950 was 3,079, in 1940 it was 3,014 by the federal census. It has a picturesque location on a plateau 5,200 ft above sea level, surrounded by mountain peaks. It is the hub of an extensive live stock, agricultural and mining (gold, silver, lead and copper) region. Dillon was settled about 1880 and incorporated in 1885, and is the seat of the Western Montana College of Education, which was established in 1893.

DILTHEY, WILHELM (1833–1911), German philosopher, was born on Nov. 19, 1833, at Biebrich and died on Oct. 1, 1911, at Seis, near Bolzano. He was successively professor in Basle (1866), in Kiel (1868), in Breslau (1871), and in 1882 succeeded Lotze in Berlin. As a supporter of positive Idealism, Dilthey regards the external world as a representation arising out of pure experience, will as well as thought being a factor of knowing and of self consciousness. His empirical tendency also appears in his historical approach to philosophy. His chief writings are *Leben Schleiermachers* (1870), *Einführung in die Geisteswissenschaften* (1883), *Das Erlebnis und die Dichtung* (1905), *Die Jugendgeschichte Hegels* (1905), *Systematische Philosophie* (1907), *Der Aufbau der geschichtlichen Methode in den Geisteswissenschaften* (1910), *Weltanschauung u. Analyse des Menschen seit Renaissance und Reformation*, 2 vols. (1921). See E. Spranger, *Wilhelm Dilthey* (1912).

DILUVIUM, a term in geology for superficial deposits formed by floodlike operations of water, and so contrasted with alluvium (*q.v.*) or alluvial deposits formed by slow and steady aqueous agencies. The term (Lat. for "deluge," from *diluere*, to wash away) was formerly given to the "boulder clay" deposits, supposed to have been caused by the Noachian deluge. In this sense it still lingers on the continent of Europe, but it has disappeared from British geological literature.

DIME, the tenth part, the tithe paid as church dues, or as tribute to a temporal power. In this sense it is obsolete, but is found in Wyclif's translation of the Bible—"He gave him dynes of alle things" (Gen. xiv, 20). A dime is a silver coin of the United States, in value 10 cents (English equivalent about 5d), or one-tenth of a dollar, hence "dime-novel," a cheap sensational novel, a "penny dreadful", also "dime-museum" and "dime-store."

DIMENSION, a term used in geometry to denote a magnitude measured in a specified direction, as, for instance, along a diameter or a principal axis or an edge. A point is said to be without dimension, a line has the one dimension of length, a surface has the two dimensions of length and breadth, while a solid has the three dimensions of length, breadth and thickness. Since the lengths of lines, the areas of surfaces and the volumes of solids are represented respectively by linear, quadratic and cubic algebraic expressions, the term dimension has been carried over into algebra. Thus quadratic, cubic, bi-quadratic algebraic expressions or equations are said to be respectively of two, three, four dimen-

sions. Similarly, the term dimensions is used in mechanics with reference to the units of time, length and mass and various derived units (see DIMENSIONAL ANALYSIS), and it occurs likewise in many other parts of physics, notably in the theory of electricity and magnetism (see PHYSICAL UNITS).

The fundamental descriptive proposition concerning space, as we are accustomed to it in experience is that space is a continuum (a continuous or unbroken distribution of points) having three dimensions. The intuitive basis of this proposition may be elucidated as follows. If on a curve (or line) we mark certain points (elements without dimension) we separate the curve into parts bounded by the points in such a way that we cannot pass along the curve from one part to another without encountering and passing over one of these marked points. Since the curve may be separated into parts by elements without dimensions it is itself said to be a figure having one dimension. But a surface cannot be thus separated into parts by marking isolated points on it, for, in going from one place to another on the surface, we can always avoid passing over these marked points by going around them. If we draw in the surface a suitable closed curve (a figure of one dimension) then the surface is separated into parts in such a way that we cannot move over the surface from one part to another without encountering and passing over a point on the curve. Since a surface can not be separated into parts by points (figures without dimension) but can be separated into parts by a suitable figure of one dimension, we say that a surface itself has two dimensions. Similarly space cannot be separated into parts by isolated points or curves or both taken together, while it can be so separated into parts by means of a closed surface (a figure of two dimensions). For this reason we say that space has three dimensions. Thus, according to Henri Poincaré (*Dernières Pensées*, Flammarion, Paris, 1917, pp. 61 ff.), is the fundamental qualitative ground for ascribing three dimensions to the usual space of experience.

The mathematician introduces three co ordinates to represent the points of ordinary space and much of his analysis of its properties is carried out algebraically. Now the algebraic analysis is competent to deal with sets of any number n of co ordinates. Thus algebraic geometry leads readily to the conception of spaces of any number n of dimensions, and these have been extensively treated, though no one has a lively mental picture of spaces having more than three dimensions. Popular interest in these higher spaces (as opposed to the interest of mathematicians in them) has been centred principally around the concept of the "fourth dimension." But the number of dimensions of these higher spaces is unlimited, and, in fact, several kinds of space with an infinite number of dimensions have been investigated.

That the higher spaces may be given a concrete representation in terms of experience is shown by the fact that the totality of straight lines in our usual space of three dimensions constitutes a veritable space of four dimensions (see PROJECTIVE GEOMETRY). This arises from the fact that four independent co ordinates are necessary to define completely the position in space of a line of unlimited extent. Therefore a geometry in which the elements are the lines of ordinary space is a geometry of four dimensions. (R. D. CA.)

DIMENSIONAL ANALYSIS The principal use of dimensional analysis is to deduce from a study of the dimensions of the variables in any physical system certain necessary limitations on the form of any possible relationship between those variables. The method is of great generality and mathematical simplicity. The name dimensional analysis is comparatively new, Lord Rayleigh, one of the earliest and principal exponents of the method, called it the principle of similitude. In earlier editions of this *Encyclopædia* it was treated under the heading UNITS, DIMENSIONS OF.

This method is not capable of completely determining the unknown functional relationship. In the simplest cases it can give everything except a numerical factor of proportionality, for example, it can show that the time of swing of a simple pendulum is independent of its mass and proportional to the square root of its length but cannot determine the constant of proportionality.

In more complicated cases, where there are a larger number of variables, it can show that the variables must enter the function in certain definite combinations, thus reducing the number of the undetermined functional relations. Perhaps its most important use is in connection with problems so complicated that not only may an exact solution by purely mathematical methods be impossible, but also it may be impossible even to give a precise and detailed formulation of the fundamental equations from which the solution is to be found. Many problems of aeroplane or ship design are of this nature. In these cases a knowledge of the necessary limitations on any possible functional relationship makes it possible to cover completely the range of all possible experimental relationships with a much smaller number of experiments than would be necessary otherwise. In this capacity it now receives the widest application in engineering. Other uses of dimensional analysis are as a simple check, against error in writing out equations or their solutions, in changing units from one system to another, and in theoretical investigations in making preliminary orienting surveys to explore promising lines of attack.

The methods of dimensional analysis depend to an important extent on the properties of the systems of measurement in ordinary scientific use and presuppose the use of such systems. These systems are subject to certain definite limitations. It is a matter of extensive past experience that all the physical systems ordinarily encountered can be completely described in terms of measurements of the restricted and conventional scientific sort. It is this past experience, the mere existence of which is not always obvious to an uncritical glance, that is capitalized in obtaining the results of dimensional analysis. For, since the system of measurement is subject to limitations and has definite properties, the fact that it can be applied to such a wide variety of situations implies the possession of certain properties by those situations, it is these properties which are brought explicitly to light by dimensional analysis. In respect to this degree of dependence on past experience dimensional analysis differs from no other scientific enterprise, for it is never possible to obtain factual information about any concrete physical situation by pure ratiocination, but any factual information which emerges in the final mathematical formula had to be explicitly inserted into the mathematics at an earlier stage.

Since it is basic to everything that follows, we begin our detailed argument with an examination of such properties of the systems of scientific measurement as are necessary for our purpose. Many different systems of measurement are in general possible, the desirability of any particular system depending on the purpose in hand and on the physical system to which the measurement is applied.

The primary purpose of a system of measurement may be taken to be precise description. In practice one method of securing precision has proved to be so overwhelmingly superior to any other that it alone survives in serious scientific usage, this is by the specification of numbers. Measurement, then, in a very broad sense means description by the assigning of numbers. Given a concrete physical system, it is possible to assign various numbers to it by performing various sorts of physical operation upon it. The number obtained by any particular kind of physical operation constitutes a particular kind of measurement. Different aspects of the system are dealt with by employing different sorts of measuring operation. If one were dealing with only a single isolated physical system a high degree of arbitrariness would be permissible in the measuring operations by which the system is described. In practice, however, a large part of this arbitrariness disappears because of the fact that we desire to deal with large numbers of physical systems. This leads to the requirement not only that the physical operations back of the measurements be easily applicable to the widest variety of systems, but also that they be such that it is possible to express in relatively simple mathematical terms correlations between the results of measurements on different systems. The discovery of measuring operations which satisfy these requirements came only after hundreds of years of experience and experimenting, and demanded a wide acquaintance with the factual content of our environment.

The requirements of convenient application to many systems

and of adaptability to mathematical correlation are not sufficient, however, to determine uniquely the measuring operations but a great deal of flexibility remains. As a matter of fact, a wide variety of systems and methods of measurement are in scientific use today.

We now consider in some detail the properties of the systems of measurement in actual physical use, starting from the general point of view that a physical measurement is a number obtained by a particular kind of physical operation. The sort of measurement that it is, is determined by the sort of operation that it is. **Length, Weight and Time**—Consider, for example, length. We may define this as the number obtained by the operation of applying a metre stick to successive positions on a body, counting the number of applications, and reading the fractional part from the divisions inscribed on the metre stick. This procedure is applicable to a wide variety of physical systems. From the point of view of maximum precision, once having defined length by this single definite procedure, the name length should be applied only to numbers obtained by this one procedure. In practice, however, there prove to be whole families of operations giving numbers which are either undistinguishable from the numbers given by the defining operation or else are related to them by a constant of proportionality so that in practice the term length is given the extended meaning of a number obtained by any one of the family of operations.

The family of operations which is at present accepted as defining length may be divided into various subfamilies. Some of these subfamilies involve drastic physical changes in the measuring operations such, for example, as measuring lengths by optical methods of triangulation, or by counting interference fringes. It is particularly necessary to subject the equivalence of widely different types of operation to fresh experimental check whenever the field of application is extended. Other subfamilies of operations, however, may be specified with very slight verbal changes. By far the most important of these involve the use of some fundamental measuring stick other than the one of the fundamental definition. For example, instead of specifying the metre stick as basic to the operations of measuring length, we may substitute a foot rule, keeping all the other verbal instructions the same. Strictly, it requires experimental confirmation to show that the verbally specified operations are still physically performable when foot rule is substituted in the specifications for metre stick. The recognition that the operations are performable with either is so deeply ingrained in all our experience that we usually do not realize, unless we stop to think about it, that we are saying something about the structure of the world when we say that a length may be measured either with a metre stick or with a foot rule. Dimensional analysis involves some of the consequences of the world being constructed in this way.

We designate the results of operating according to the specifications for measuring length as length in metres or length in feet. An inspection of what we do now shows that there is a simple invariant relation between the two sorts of length. The metre stick itself is an object whose length in feet can be determined, and similarly the length of the foot rule may be measured in metres. We express this by saying so many feet make a metre or a certain fraction of a metre makes a foot. Due consideration of this, together with an examination of the details of any concrete measuring operation, shows that the ratio of the length of any concrete object in metres to its length in feet is a constant, independent of the object, and equal to the number of metres in a foot or the length of the foot in metres. A generalization of this consideration evidently applies to measurement of length with any other primary standard of length, parasang, verst or what not. An immediate mathematical consequence of this application is that the ratio of the lengths, that is, the ratio of the length numbers, of any two concrete objects, both measured with the same primary standards, is the same, independent of what primary standard is used. We may express this by saying that relative length has absolute significance. This is only a special case of a general requirement exacted of any method of making any sort of physical measurement which is to be accept-

able for scientific use, namely the requirement of the absolute significance of relative magnitude

The possibility of maintaining the requirement of the absolute significance of relative magnitude has to be determined by fresh examination of the details of the measuring process for each new kind of measurement with which we are concerned. For instance, the measurement of weight is obviously an entirely different sort of measurement from the measurement of length. The operations for weighing may be specified in terms of an equal arm balance. It is not the place here to expand the details of the weighing process. It is evident, however, that certain of the same general results hold for measuring weights as for measuring lengths. We may measure weights in terms of different standards of weight. The weights of the same object in terms of different standards bear a fixed ratio depending on the relative magnitude of the standards, and the ratio of the weights of two different concrete objects is independent of the standard of weight. The requirement of the absolute significance of relative weight is satisfied. Detailed examination shows that the fact that it is satisfied involves the physical law of the conservation of weight—the total weight of all the little weights into which we cut up a standard in order to make a new standard is the same as before it was cut up. There is no immediate, obvious connection between the physical property of conservation of weight and the geometrical properties of lengths placed end to end. We could not have predicted the possibility of the absolute significance of relative weight from the known absolute significance of relative length, but a fresh appeal to experiment is necessary.

Equally fundamental with length and weight is the measurement of time. The physical operations are again basically different: time does not recur, but we pass over it only once. We cannot ask whether two intervals of time are equal by placing one interval in juxtaposition with another and comparing them, as we do two lengths or two weights. The operations are different: they are performed with clocks, according to rules which we shall not attempt to formulate in detail. However, the same results that we have found previously carry over to the new situation. In particular, we can specify operations by which the same interval may be measured in terms of different standard intervals. The ratio of the time numbers obtained for any specified time interval by operating with different standard intervals is always the same and depends only on the standards. Furthermore, the relative value of any two different concrete intervals is independent of the interval adopted as fundamental, or in other words, the requirement of absolute significance of relative magnitude is still met. A proof of this can be given by observation of the details of the measuring process with clocks, and involves the properties of the angles swept over by the hands of the clock. There is no immediate connection with the physical situation involved in the absolute significance of relative length or of relative weight.

The measurements of length, weight (or mass) and time are similar in that the operations make direct reference by one physical process or another to standards of length, mass or time. This involves the existence of different physical operations for mass, length and time analogous to the mathematical operation of addition for numbers. Furthermore, other properties of these physical operations are involved, for the resulting mass numbers, or length numbers, or time numbers are combinable according to the commutative or associative rules for mathematical addition. These requirements are obviously definitely restrictive, not every sort of simple physical operation satisfies them, for example, successive rotations through a finite angle about different axes. It required long experience to find such operations. There are still other sorts of physical operations which may be made the basis of other sorts of physical measurement which have similar properties. For example, forces may be measured by direct comparison with a standard force given by a definite deflection on a spring balance, and the physical operation for the addition of forces exists and consists in simply applying two spring balances in parallel to produce twice the force.

Secondary Measurements—When we make a measurement in this way by direct reference to some concrete standard by means of a physical addition law, we may be said to be making a primary measurement. Most physical measurements are, however, more complicated, and are compounded of simple primary measurements. Such may be called secondary measurements. A simple example is velocity, which is ordinarily defined as the quotient of distance by time, or more exactly the quotient of a distance number by a time number. To measure the velocity of any concrete moving object, we measure the time required by it to traverse a known measured distance, and divide the distance by the time. The distinction between primary and secondary measurement is not absolute, in some cases either method may be used. An example is force. We have indicated above how to measure force as a primary quantity by reference to a spring balance. If we wish to define it as a secondary quantity, we may utilize Isaac Newton's first law of motion, defining force as equal to mass times acceleration. In this case we obtain the force on any body by measuring the mass of the body and its acceleration, which in turn is obtained by measuring the change of velocity in a known time interval, the velocities themselves being obtained from measurements of distance and time. That is, when force is defined as a secondary quantity it is measured by making certain primary measurements (mass, length and time), which are then combined by mathematical rules. Other instances may be given of the possibility of either a primary or a secondary definition. Thus, velocity may be measured as a primary quantity by methods which have been described in detail. Or density, which ordinarily is treated as a secondary quantity and defined as mass divided by volume, may be treated as a primary quantity. In this latter case the difficulties of the necessary physical manipulations would obviously be prohibitively great except when dealing with gases at comparatively low pressures. Whether a given quantity is to be treated as primary or secondary is to a certain extent a matter of convenience, depending on the particular situation. In certain problems, for example, force is best treated as secondary, while in others more information is obtained by treating it as primary.

A certain aspect of the measurement of secondary quantities, which is significant for our purposes is singled out and specified by giving the dimensional formulas of these quantities. Since the numerical magnitude of any primary quantity changes when the size of the corresponding primary standard is altered, the numerical magnitude of secondary quantities also changes when the size of the primary standards is changed. It is with this aspect that we are chiefly concerned in setting up dimensional formulas. Thus, the dimensional formula of velocity, defined as above, is LT^{-1} , or $[V] = [LT^{-1}]$, where the square brackets denote "dimensions of," and the equation stands for the verbal expression "the dimensions of velocity are the dimensions of length divided by time. This is merely a shorthand statement for the number which, in the given system of measurement, measures the velocity of any concrete object, is obtained by multiplying the number which measures some distance associated with the object by the reciprocal of another number which measures some time associated with the object. In future applications the square brackets will usually be omitted as unnecessary. In the formula, T^{-1} indicates the reciprocal of a number obtained by the process for measuring T , the exponent -1 is to be associated with the number, not with the T , that is, the existence of another physical operation, the analogue of the mathematical operation of taking the reciprocal, is not involved or implied by this notation. The dimensional formula is obviously only a partial statement; it does not, for example, contain the detailed specifications for associating the measurements of length and time. The dimensional formulas apply to the primary quantities as well as secondary quantities. For instance, we denote the dimensions of length by L . The significance of this is that the number which measures a length is obtained by a definite physical procedure and the L recalls this procedure. Whenever L occurs in a dimensional formula, the connotation is that a number was obtained by the procedure specified for measuring length. By recalling this pro-

cedure we are in a position to find how the numerical magnitude changes when the size of the standard changes.

Dimensional Formulas—Let us examine other examples of dimensional formulas. What is the dimensional formula for acceleration? By what procedure do we obtain the number which measures acceleration? This is given by definition: acceleration is change of velocity in a given time so that the first result would be, $[\text{Acceleration}] = [(V_2 - V_1)T^{-1}]$, where V_1 and V_2 apply to the final and initial velocities. In use this expanded dimensional formula is at once contracted: the first contraction is to write $[\text{Acc}] = [VT^{-1}]$. That is, our purpose does not demand that we continually remind ourselves that a certain number was obtained by taking the difference of two velocities, but it is sufficient to remember only that the procedure for obtaining velocity entered our operations. This contraction obviously implies a very important restriction, which indeed is contained in the definition, we must measure the initial and final velocity in the same system of units. The reason that the contraction of the dimensional formula is permissible is that under the conditions the difference of two concrete velocities changes by the same factor as do each of the velocities separately when the fundamental units are changed. The dimensional formula for acceleration may now be contracted further by writing $[\text{Acc}] = [LT^{-2}]$. Here we have expressed the fact that the number measuring a velocity is obtained by dividing a length number by a time number. A further contraction at once suggests itself: to combine the two T^{-1} 's into a single term, writing $[\text{Acc}] = [LT^{-2}]$. But this contraction obviously involves another implication: that the unit of time used in measuring velocity is the same as the unit of time used in measuring change of velocity. If this is not the case, we have left out a factor which determines how the number changes when we change the fundamental units. In practice, hybrid units are not uncommon. The performance of the brakes of an automobile might be described by saying that the car is brought to rest from a velocity of 30 mi per hr in 5 sec. Acceleration measured in this way is not covered by the dimensional formula above.

In all our analysis it is expressly supposed that all measurements of secondary quantities are such that the same primary units are consistently used at all stages of the measuring process. Under these restrictions we are justified in contracting $T^{-1}T^{-1}$ to T^{-2} because the number obtained by multiplying the reciprocal of a number obtained by measuring a concrete time interval by the reciprocal of another number measuring another concrete time interval, changes by the same factor as the product of the two numbers. The number measuring a concrete time interval when the fundamental unit of time is changed appears, in general, that addition or subtraction of simple dimensional symbols is without significance for our purposes. It may be ignored (as in the formulas for acceleration), and products may be combined by the simple algebraic rules for exponents.

The dimensional formulas of the simple secondary quantities, velocity and acceleration, exemplify thus far are of the same simple type: that is, products or powers of the primary quantities. This is true of a number of other such quantities, too. Given illustration. The dimensions of force, defined as mass times acceleration, are MLT^{-2} ; the dimensions of momentum, defined as mass times velocity, are MLT^{-1} ; the dimensions of work or energy, defined as the product of force and distance (parallel to the force), are MLT^{-2} ; the dimensions of moment of force, defined as the product of force and distance (perpendicular to force), are also MLT^{-2} ; and the dimensions of viscosity, defined as force per unit area per unit velocity gradient, are MLT^{-1} . All these secondary quantities are seen by inspection to have the same important property which, as we have seen, is enjoyed by the primary quantities—that is, the property of absolute significance of relative magnitude. This property follows at once from the construction of the dimensional formulas as products of powers

The Property of Absolute Significance of Relative Magnitude—It is easy to give a formal proof that any quantity whose dimensional formula is composed of products of powers

has the property of absolute significance of relative magnitude. It will be sufficient to consider systems in which the fundamental quantities are taken as mass, length and time—the extension to other systems involving only trivial modifications.

Consider any secondary quantity of the specified type, the dimensional formula of which may be written as $M^a L^b T^c$. Consider two concrete examples measured in a certain system of concrete units, and denote by $M_1^a L_1^b T_1^c$ and $M_2^a L_2^b T_2^c$ the numbers obtained by combining the component measures of mass, length and time in the way specified by the definition of the secondary quantity. Then the ratio of the two magnitudes is $M_1^a L_1^b T_1^c / M_2^a L_2^b T_2^c$. Now consider a second system of measurement in which the unit of mass is smaller in the ratio μ than in the first system, the unit of length is smaller in the ratio λ , and the unit of time is smaller in the ratio τ . Then the number which measures any concrete mass will be larger by the factor μ in the second system than in the first, and similarly for the numbers which measure length and time. Hence, the numerical magnitude of the secondary quantity for the first concrete example will now be $(\mu M_1)^a (\lambda L_1)^b (\tau T_1)^c$, and for the second concrete example $(\mu M_2)^a (\lambda L_2)^b (\tau T_2)^c$. On taking the ratio of these, the μ , λ , and τ cancel, leaving the same result as at first. That is, the ratio of the numerical measures of any two concrete examples is independent of the size of the fundamental units for secondary quantities constructed on the scheme of products of powers of the primary quantities: this is what is meant by absolute significance of relative magnitude. The converse is also true, the dimensional formula of any quantity which satisfies the principle of the absolute significance of relative magnitude is constructed of products of powers of the primary quantities (the proof will not be given here).

The property of absolute significance of relative magnitude has proved to be of such very great convenience in application that no secondary quantities are in present scientific use which do not satisfy this principle, and whose dimensional formulas therefore are not products of powers. It is an express presupposition of all the following discussion that the dimensional formulas of all quantities have the form of products of powers. The formulas of primary quantities already have this form identically.

The Formula as Definition—The dimensional formula may serve as a signpost suggesting the underlying definition. There is obviously no rigorous and exact correspondence between the dimensional formula and the definition, as shown by the example above in which energy and moment of force have the same dimensions. However, in a great many practical cases the dimensional formula permits a decision between conceivable alternatives and is therefore useful as a mnemonic device. In fact it is not uncommon for the system of measurement to be specified by listing the dimensional formulas of various quantities. This method is much used with reference to the various systems of electrical units. Such a listing of dimensional formulas is often entirely adequate, but obviously it presupposes an initial specification more formal and more precise.

Assume that we have developed a system of physical measurement, with measuring procedures and fundamental units specified, secondary quantities defined and all dimensional formulas written out. We address ourselves to apply this system of measurement to some physical system or set of systems. Our problem is to find relationships between various measurable quantities. We proceed at first on a purely empirical basis; by plotting certain quantities or combinations of quantities against others to find whether the points lie on curves or surfaces. The existence of such curves or surfaces means a relationship, having found such, we then try to find a mathematical equation which shall reproduce the curve or surface within experimental error. Having found this we believe that we have acquired the power to predict the results of any new experiment or measurement on the system, because if we substitute into the equation (or plot on the graph) an independent variable as yet not realized experimentally, the corresponding dependent variable as determined by the equation or the graph will correspond to what we will find when we make the experiment. Of course there is no

logical necessity in this. The assumption is made in virtue of our past experience that interpolation is usually smooth.

Consider a very simple example. We use for our fundamental primary units the pound, the foot and the second, and make application to all systems of weights falling freely from rest under the action of gravity near the surface of the earth. We collect data for the widest range of conditions and find that all our observations satisfy certain equations, namely

$$\text{Distance of free fall} = 16 \times (\text{square of time of fall})$$

$$\text{Velocity of fall} = 32 \times (\text{time of fall})$$

These equations are a complete and adequate description in the sense that given the time or distance or velocity we can predict what the other two quantities will be for any new experiment in the future or recall what they were at any time in the past. But this may not satisfy us, we notice that there has been an element of arbitrariness in our procedure in that we chose the pound, foot and second as fundamental units. We might have chosen the gram, centimetre and minute as fundamental. If we had, would we have to make our physical measurements all over again? We suspect that we would not, and that there must be some relation between measurements in the two systems, because each system is constructed on the same pattern, and the principle of absolute significance of relative magnitude holds for measurements in the two systems. In fact, substitution of the concrete values for two examples shows that for any other such system satisfying the principle of absolute significance of relative magnitude we must have

$$\text{Distance of free fall is proportional to square of time of fall}$$

$$\text{Velocity of free fall is proportional to time of fall}$$

The factors of proportionality obviously depend on the system of measurement. We now have the answer to our question given a relationship between quantities in any scientific system of measurement, we can at once find corresponding relationships in any other system for which the principle of absolute significance of relative magnitude holds. The change from one system to the other is to be made by changing certain factors of proportionality. Precisely how shall we change the factor of proportionality? We have seen how to change the numerical value of a physical quantity given its dimensional formula. Can we perhaps assign dimensional formulas to our factors of proportionality in our present problem? Inspection shows at once that if we assign to the factor in the first equation the dimensions of LT^{-2} and to the factor in the second equation the dimensions of VT^{-1} our problem is solved, because through the compensatory action of the factor of proportionality the numbers which we substitute into the equation when we measure in pounds, feet and seconds combine so as to give identically the same final result as when we measure in grams, centimetres and minutes.

The Dimensional Constant.—We see then that we may pass back and forth between equations for different systems of measurement, provided the systems satisfy the principle of absolute significance of relative magnitude, by the device of assigning suitable dimensions to various factors of proportionality. A factor of proportionality which varies when the units change according to a scheme which can be specified by giving to it a dimensional formula is called a dimensional constant.

The equations for the falling body, written with the appropriate dimensional constants, obviously hold for any system of units in which mass, length and time are taken as fundamental. An equation of this sort, which holds without formal change when the size of the fundamental units changes, is called a complete equation. In the problem of the falling body there are two dimensional constants, one for the first and one for the second equation. We notice, however, that the dimensions of the second constant, VT^{-1} reduce to those of the first constant, when we substitute for V its dimensions LT^{-1} . That is, in this problem we have essentially only one dimensional constant, instead of the two which are given formally by the two equations. What is the significance of this?

The problem of the falling body is a problem over which we have adequate theoretical mastery, it is a problem in mechanics, and the motion of the body can be obtained by an integration

of the equations of motion. We should, therefore, be able to obtain the relations between distance and velocity and time of fall by purely mathematical operations performed on the fundamental equations of motion. An inspection of the nature of any purely mathematical process, such as is involved in solving the equations of motion, shows that if the initial equation is complete the final equation resulting from the mathematical manipulation is also complete. Furthermore, no new dimensional constants can be introduced by any mathematical manipulation. Any dimensional constants in the final result must have been present in the original equations from which the final result was deduced. The equation of motion for a falling body is

$$\text{Acceleration of falling body} = \text{constant}$$

The constant acceleration is usually denoted by g , and it is obviously a dimensional constant because its numerical magnitude changes with the size of the fundamental units. In other words, the fundamental equation of motion contains only one dimensional constant, and any relationships implicit in the equation and deducible by mathematical manipulations can contain only the same constant. Of necessity the dimensional constant in the two empirical equations first written must be the same. In fact, the explicit relations are

$$S = \frac{1}{2}gt^2, \text{ and } v = gt$$

It is obvious that any empirical equation whatsoever expressing a relation between various physical parameters can be written as a complete equation by the device of introducing dimensional constants as factors multiplying each parameter, the numerical values of the constants being so adjusted as to be unity in the original system of units. This device demands as many constants as parameters. However, if the relationship can be deduced theoretically, that is by mathematical manipulation of fundamental equations, which by construction are always complete equations, then the relationship will be complete and will involve only those dimensional constants which enter the fundamental equations. The number of such constants, in general, will be smaller than the number of physical parameters, so that an advantage has been gained as compared with the purely empirical method of treatment.

Scientific achievement has now reached such a state of progress that the nature of the fundamental governing equations is known for practically all situations of ordinary occurrence, so that in these situations we know that there are relationships which can be expressed in the form of complete equations between the physical parameters of the system and certain specifiable dimensional constants, that is, the constants which appear in the fundamental equations.

The II Theorem and Dimensional Homogeneity.—Any mathematical relationship between parameters x_1, x_2, x_3, \dots can be written by a rearrangement in the form of an equation $f(x_1, x_2, x_3, \dots) = 0$. If the physical system to which this equation applies is one of the very large number in which the nature of the fundamental governing equations is understood, then this equation can be so rearranged as to appear to be a complete equation, because it might have been deduced by mathematical manipulation. There are important restrictions on the mathematical form of any complete equation. Dimensional analysis is essentially a study of the restrictions on the form imposed by the requirement of completeness. There is a fundamental theorem here, the so called II theorem, apparently first explicitly enunciated by E. Buckingham, although used implicitly ever since the time of Baron Jean Baptiste Fourier, who was the first to apply dimensional considerations. All the parameters which enter into the functional relationship are given. These will include both physical parameters and dimensional constants, and both physical parameters and dimensional constants are similar in that they have dimensional formulas expressible as products of powers of the fundamental units.

The II theorem states that, subject to an important restriction, the functional relationship must be expressible in such a form that it contains as arguments only such products of powers of the physical parameters and dimensional constants as have zero dimensions in all the fundamental quantities. The restric-

tion is that there be not more than one independent functional relationship between the quantities. The II theorem may be rephrased to express the principle of dimensional homogeneity, which is often taken as the fundamental theorem of dimensional analysis. Let us express the function which satisfies the II theorem, as

$$F(\Pi_1, \Pi_2, \dots) = 0,$$

where the Π 's are the dimensionless products formed from all the parameters. We may solve the equation for one of the arguments, say Π_1 , and express Π_1 in terms of the component parameters, say as $p_1^a p_2^b p_3^c$, and then solve for the first, writing the equation as

$$p_1^a p_2^b p_3^c f(\Pi_1, \Pi_2, \dots) = 0$$

The function f , having only dimensionless arguments, contains only dimensionless terms. By construction of Π_1 , the dimensions of p_1^a (which stands on the left hand side of the equation) are the same as the dimensions of $p_2^b p_3^c$, which multiplies the f on the right, all the terms of which are dimensionless. Hence, every term on the right hand side has the same dimensions as the single term on the left, or, in other words, the equation expressing the relationship is dimensionally homogeneous.

Attempts have often been made to prove the principle of dimensional homogeneity by vague intuitive arguments. The following is an example. "Every equation which expresses an 'essential' physical relation must be independent of the size of the fundamental units, and in such an equation every term must have the same dimensions because it is meaningless to add together terms with different physical dimensions, as for example a length and a time." That such an argument is not valid in general can be seen by considering such equations, for example, as the equation for a falling body $(v - gt) + (s - \frac{1}{2}gt^2) = 0$. This is a true equation, since it is always satisfied whenever the simultaneous values of v , s and t for any falling body are substituted into it, furthermore, it is a complete equation, because it holds without change no matter what the size of the units of length and time. It is, however, obviously not dimensionally homogeneous.

The restriction that there is only one functional relationship is essential to the II theorem and to the principle of dimensional homogeneity. The equation just given obviously falls apart into two equations $v = gt$ and $s = \frac{1}{2}gt^2$. In practice the requirement of only one functional relationship is no essential restriction because we are always interested in reducing the relationships until only one remains. If there should be two relationships, one of the arguments may be eliminated between the two, leaving a single relation between a smaller number of arguments.

The functional relation as it first comes from the pen of the mathematical analyst may not obviously satisfy the II theorem, but some rearrangement may be necessary. The II theorem states that such rearrangement is always possible. This has particular application to the so-called logarithmic constants which often present themselves in thermodynamic analysis.

The II theorem places no restrictions whatever on the form of the functional relationship, the restriction is only on the arguments. The importance of the restriction consists in the fact that the number of possible independent dimensionless arguments is in general less than the full number of physical parameters. The number of experiments necessary to find the form of an unknown function is obviously less if we are dealing, for example, with a function of only one argument instead of with one of three.

Consider a system of measurement in which there are m kinds of fundamental units whose magnitude may be changed and in terms of which any equation of relationship must be a complete equation. Suppose this system of measurement is being applied to a physical system in which there are n parameters, including all dimensional constants. Then in general, unless there is some special relationship, the n parameters can be combined into only $n-m$ independent dimensionless products, and any possible functional connection is a function of only $n-m$ arguments instead of the full n . If there are special relationships between the exponents in the dimensional formulas of the parameters, the

number of independent dimensionless arguments may be either greater or smaller than $n-m$. It is possible to include these special exceptional cases in a general formulation, but in practice they are usually immediately obvious to inspection, so that we shall avoid here the complication of a perfectly general formulation.

Since products of powers of dimensionless products are themselves dimensionless products, there is no unique way of writing the $n-m$ dimensionless products—it is only the number which is determined. The precise form in which these products are to be written must be chosen with discretion, to suit the purposes of the application.

Making the Dimensional Analysis.—The steps in a dimensional analysis of any concrete problem are as follows. We first have to decide what sort of physical system we are dealing with in the sense that we have to decide what is the nature of the fundamental governing equations. For example, it may be a mechanical system governed by the equations of mechanics, or it may be an electromagnetic system governed by the equations of electrodynamics. We then have to decide on the system of measurement, which involves fixing the sort of quantities that are to be treated as primary and setting up the definitions of the secondary quantities. This will involve setting up the dimensional formulas, in cases of doubt it will pay to write out the definitions explicitly. We then imagine the fundamental equations written for this system of measurement, paying special attention to any dimensional constants that may be used in writing the equations. We then make a list of all the parameters entering the particular problem, including both so-called physical quantities and dimensional constants. We write the dimensional formulas of all these parameters. We next form all the independent dimensionless products of these parameters, this is to be done by a method of solution of simple algebraic equations in the unknown exponents, as will appear from a study of the detailed examples. If necessary, the dimensionless products which first present themselves are to be rearranged so as to be more convenient for the particular problem. An arbitrary function of these dimensionless products is then to be set equal to zero, and this function is to be rearranged to suit the special exigencies. This is as far as dimensional analysis proper can go. An additional step is often taken by further restricting the form of the function by applying any special information that one may have as, the effect of a certain parameter on the function disappears if the parameter is very small (or very large). Lord Rayleigh was especially successful in supplementing the dimensional analysis proper with other sorts of general physical information.

It is especially to be noticed that no detailed solution of the governing equations is assumed—in fact, if we were in a position to give the detailed solution we could get the complete relationship, and dimensional analysis to that extent would be superfluous. All we need to know about the fundamental equations is what goes into them—in particular, what dimensional constants. It follows that we can apply the method to situations so complicated that it would be hopeless to attempt a detailed writing out of the equations, much less to obtain a solution, and in fact the most important applications of dimensional analysis are precisely to such complicated situations.

It is important to notice that a great deal of flexibility is possible in the form in which the governing equation is written, both in the system of measurement and in the definitions for the secondary quantities. The governing equations do not have to be written in any unique canonical form, but may be specially adapted to the particular problem. This flexibility is to be utilized so as to reduce the number of independent dimensionless products to a minimum. The larger the m , other things being equal the smaller the number of dimensionless products. Special problems often permit an increase in m . For example a problem in mechanics or hydraulics will ordinarily be set up with conventional mechanical units, mass, length and time as primary. But if the physical situation is of such a special character that the connection between force, mass and acceleration does not enter, as in a problem of steady motion like the Sir

George Gabriel Stokes problem of the fall of a sphere in a viscous medium where accelerations are zero, then force may be used as an independent primary unit, and the problem may be set up with four independent primary units force, mass, length and time, instead of three. The result is a reduction in the number of dimensionless arguments, and hence more highly specialized information. If one chooses, any problem in mechanics may be set up in these four primary units, but in most problems the equation connecting force, mass and acceleration will be necessary, and this equation, written in four primary quantities, demands a new dimensional constant, the factor of proportionality between force and mass times acceleration. In general, then, the gain in increasing the number of primary quantities is nullified by an increase in the number of dimensional constants, so that the number of independent dimensionless products is unchanged.

It obviously requires experience and insight to know when the special situations arise, dimensional analysis yields an amount of information dependent on the skill and experience of the analyst. Positive errors are never introduced by failure to recognize these special situations—it is only that less than the maximum information is obtained. In the limiting case, where one has nothing whatever to contribute to a knowledge of the nature of the physical system, dimensional analysis does not give incorrect results, but only trivial results.

We have seen that any empirical connection whatever can be thrown into complete form by introducing an appropriate dimensional constant as a factor multiplying each physical parameter. If there are n' physical parameters, in this case there will be m' dimensional parameters altogether, including the dimensional constants, and hence $2n' - m'$ dimensionless products. The result is some undetermined function of $2n' - m'$ arguments. But in general $n' > m'$, so that $2n' - m' > n'$, and we know less by applying the analysis than before, because we knew in the beginning that there was some functional connection between the n' parameters. Although positive errors are not introduced by using an unnecessarily large number of independent quantities, it is obviously fatal to omit from the analysis any parameter which should actually enter the results. Experience and understanding are required of the analyst in order to ensure this. Consider now several typical applications.

(1) *The Simple Pendulum*—This is the conventional introductory problem. The physical parameters defining the simple pendulum may be taken to be the mass of the bob and the length of the suspending rod. The problem is obviously one in mechanics, and we may take as the fundamental units, mass, length and time. A detailed solution of the equations of motion will give the time of any complete oscillation, and this oscillation may be characterized by its angular amplitude. Our physical command of the situation is sufficient to show that the time of oscillation for any particular amplitude must be uniquely determined, since the bob starts from rest at the extreme point of the oscillation and the boundary conditions and the equation of motion determine a unique solution. The equations of motion will involve the force on the bob, and this will involve the acceleration of gravity, that is, in the equations of motion will appear the dimensional constant g . The detailed solution should therefore give a relationship between mass of bob, m , length of pendulum, l , angular amplitude of oscillation, θ , acceleration of gravity, g , and the period of oscillation, τ . This is a complete relationship, being deduced by mathematical manipulations from a complete equation, and therefore the II theorem applies. We write the parameters which enter

| Parameter | Dimensional formula |
|-----------|---------------------|
| m | M |
| l | L |
| θ | \circ |
| g | LT^{-2} |
| τ | T |

The II theorem instructs us to form all the independent dimensionless products. There will in general be 2, because n , the number of parameters, is here 5, and m , the number of primary units,

is here 3. One of these products, θ , is obvious on inspection. We then must form one dimensionless product from the four remaining parameters. The exponents in the dimensionless product are unknowns which we write as $\alpha, \beta, \gamma, \delta$. We must now find these four quantities so that $m^\alpha l^\beta (LT^{-2})^\gamma T^\delta$ is dimensionless. Substitute the dimensional formulas for the parameters $M^\alpha L^\beta (LT^{-2})^\gamma T^\delta$ must be dimensionless, or the total exponents of M, L and T must vanish. This condition gives three algebraic equations

$$\begin{cases} \alpha = 0 \\ \beta + \gamma = 0 \\ -2\gamma + \delta = 0 \end{cases}$$

There are three equations and four unknowns, which means that one unknown may be assumed arbitrarily. Take δ as the arbitrary one. Then the solution is $\alpha = 0, \gamma = \frac{\delta}{2}, \beta = -\frac{\delta}{2}$. The dimensionless product is $l^{-\frac{\delta}{2}} g^{\frac{\delta}{2}} T^\delta$. The II theorem states that the solution is some functional relationship between the two independent products, or

$$F[(l^{-\frac{\delta}{2}} g^{\frac{\delta}{2}} T^\delta), \theta] = 0,$$

where F is completely undetermined.

This equation may be rearranged by solving for the quantity in parenthesis, giving

$$l^{-\frac{\delta}{2}} g^{\frac{\delta}{2}} T^\delta = f(\theta),$$

where f is completely undetermined. This again may be rearranged as

$$\tau = \frac{1}{\sqrt{g}} f(\theta)$$

That is, the time of swing is independent of the mass, proportional to the square root of the length, and inversely proportional to the square root of the acceleration of gravity. As far as this analysis goes it may be any function of the amplitude. The detailed solution would show that for small amplitudes f has approximately the constant value 2π .

Even in this simplest of all problems we have had to make approximations and utilize special knowledge. For example, friction has not entered our result, yet every actual pendulum experiences friction, both from the resistance of the air and from imperfect elasticity of the supports. A precise formulation of the equations of motion would have involved the coefficient of viscosity of the air and an internal damping coefficient for the material of the supports. There would have been two more parameters, and the final result would have involved an arbitrary function of three arguments instead of one. Furthermore, we would have lost the information that we now have that time varies as the square root of the length. Suppose, for example, that we consider the effect only of the damping of the air. We would have had one more parameter, the viscosity of air, μ , of dimensions $ML^{-1}T^{-1}$, and one more argument of the function. Our result would have had the form

$$F[(l^{-\frac{\delta}{2}} g^{\frac{\delta}{2}} T^\delta), (\mu l^{-\frac{\delta}{2}} g^{\frac{\delta}{2}} T^\delta), \theta] = 0$$

In this solution l cannot be isolated, and the dependence on l is tied up with that of the other parameters. Our original simplified analysis can be justified only by the additional knowledge, acquired either by experiment or by other considerations, that the effect of viscosity of the air on the period is vanishingly small. This sort of supplemental information is almost always necessary to make dimensional analysis yield useful results.

(2) *The problem of the resistance experienced by some body of definite shape moving at constant velocity through a body of fluid of dimensions indefinitely large compared with those of the moving body*. Special cases of this problem are the resistance encountered by a projectile, by a submarine in deep water, by an aeroplane, or by a falling raindrop. The case of the ship is not included because for a ship, part of the resistance to motion arises from the creation of surface waves against gravity. The converse problem obviously is covered also, that is, the problem of the force exerted on a stationary obstacle by an infinite mass

(3) *The Problem of Heat Transfer*—A body of given shape is surrounded by an infinite stream of liquid flowing past it at uniform velocity. The body is maintained at a given temperature higher than that of the remote parts of the stream. It is required to find the rate of heat interchange between body and stream. A complete solution of this problem would be excessively complicated, so we shall make several essential simplifications. The heat convected away by the stream is known if we know the velocity distribution in the liquid and know the rate of heat transfer into each element of its volume. We assume that the velocity is so low that the flow is non-turbulent, in this region the distribution of flow velocity is independent of the viscosity of the fluid, although the forces are not. Further, the preceding problem shows that in this range the density of the fluid does not affect the velocity distribution. At the surface of separation of liquid and body there is no surface slip. The rate of heat transfer into the liquid at the surface depends on the temperature gradient in the liquid at the surface, and this will depend on the thermal conductivity of the liquid, its thermal capacity, and the rate at which new liquid is brought up by the motion, that is, on the velocity of the liquid. We suppose that the thermal conductivity of the solid body is so much higher than that of the liquid that the thermal conductivity of the solid offers no restriction on the rate of heat transfer from solid to liquid, and therefore the heat conductivity of the solid will not enter.

The conditions in this problem are sufficiently special so that it is advantageous to use a special set of primary units. We have the following table of parameters and dimensions

| Name of Quantity | Symbol | Dimensional formula |
|---|------------|--------------------------|
| Rate of heat transfer | h | HT^{-1} |
| Velocity of fluid | v | LT^{-1} |
| Temperature difference | τ | τ |
| Thermal conductivity of liquid | k | $HL^{-1}T^{-1}\tau^{-1}$ |
| Heat capacity of liquid per unit volume | c | $HL^{-1}\tau^{-1}$ |
| Linear dimensions of body | l | L |
| Shape factors | r_1, r_2 | 0 |

Here we use new kinds of fundamental unit, quantity of heat, H , and temperature, τ , while mass does not appear. The justification is in the details, as outlined above. This is a problem in static flow, that is, as far as the velocity of flow is concerned it is a problem in statics and masses do not enter. The equations deal directly with the flow of heat as such, and, since there is no transformation of heat into mechanical work, we are not concerned with the fact that in other kinds of systems heat and mechanical energy are mutually transformable. It is therefore sufficient to treat heat as a primary unit. Furthermore, temperature enters only through temperature differences and through those properties of the body which determine the behaviour when there are temperature gradients. Temperature may, therefore, be treated as a primary unit, in spite of the fact that there are other kinds of physical systems whose behaviour involves the fact that absolute temperature is proportional to kinetic energy per degree of freedom.

Disregarding the shape factors, we have six parameters expressed in terms of four primary units. Unless there is something exceptional in this situation the II theorem leads us to expect two dimensionless products. Since we are interested in h , we choose one of the products without h . Detailed carrying through of the solution shows that there is nothing exceptional here, and the two independent dimensionless products are found to be h/klv and lvc/k . The solution is

$$F[h/klv, lvc/k; r_1, r_2] = 0,$$

where F is arbitrary. The solution may be rearranged and solved for h , giving

$$h = klvf[lvc/k; r_1, r_2],$$

where f is arbitrary. The rate of heat transfer is therefore pro-

portional to the temperature difference. In a model experiment, identical values of the function f can be kept only by increasing the velocity in proportion as the linear dimension of the body is decreased. In the range in which the transfer is proportional to the velocity, it is also proportional to the square of the linear dimensions, that is, to the area and independent of the thermal conductivity of the liquid. This means that under these conditions the transfer is entirely a convective phenomenon. In this range the effect of increasing the velocity of flow is the same as decreasing the heat capacity by the same factor.

The importance of a judicious choice of units adapted to the particular problem is particularly apparent here. If we had taken temperature to be a secondary quantity, and defined it as proportional to the kinetic energy of the atoms (as we might in perfect consistency with kinetic theory), the dimensional formulas and all the parameters would have been expressed in terms of three instead of four primary units, we would have had one more dimensionless product, the arbitrary function would have involved one more argument, and the relationships that we could have deduced would have been correspondingly less restricted, although not actually incorrect. The point is that the phenomena of kinetic theory do not enter this problem, and we are only handicapping ourselves unnecessarily if we try to bring them in by way of the definitions. A problem in which the connection between temperature and energy has to be brought in by way of the units is, for example, the very simple problem of the pressure volume temperature relation for a perfect gas.

(4) *Electromagnetic Problems*—In dealing with problems in electrodynamics the question of the most suitable system of primary units is likely to prove more troublesome than in mechanical problems, because of the much larger number of alternative systems which have been proposed and which are in actual use. From the point of view of dimensional analysis the only requirement is that the system is consistent and adapted to the particular problem in hand. This requirement does not fix the system of measurement uniquely, and alternative definitions and corresponding alternative sets of dimensional formulas are possible in dealing with most of the problems of electrodynamics. There has been much controversy and misunderstanding in this connection, at one time an engineering society tried to determine the correct point of view by majority vote. The view has been very common that a dimensional formula expresses the essential physical nature of a quantity. From this point of view the present indeterminateness in dimensional formulas is an expression of our present incomplete knowledge of the complete physical mechanism, and the time is anticipated when we shall be able to write the correct dimensional formula for the dielectric constant and the magnetic permeability of empty space. The thesis is often defended that when this occurs all fractional exponents will disappear from all dimensional formulas. This attitude has a partial explanation as a historical survival from the time when the displacement current of Maxwell's equations was thought to indicate a movement of an electrical fluid which pervaded all space and which was everywhere elastically tethered to a second all-pervading rigid framework. This point of view has outlived any usefulness it may ever have had in suggesting experiment, it appears not to be unusual for a point of view to survive in its effect on philosophical attitude after it is dead in its original significance.

As an illustration of the application of dimensional analysis to a problem of electrodynamics, consider the classical problem of the electromagnetic mass of the electron. The electron is conventionalized by specifying its total charge, e , and its equivalent radius, a . To find the electromagnetic mass the electron may be placed in a constant electric field, and the resultant acceleration determined. If this acceleration should prove to be constant, independent of the velocity of the electron, then its behaviour is similar to that of a mechanical particle with ordinary mechanical mass, and it is proper to speak of electromagnetic mass. However, until the solution has been carried through one cannot say whether the electron has an electromagnetic mass or not. In carrying through the solution the field equations of

electrodynamics will be used, and into them will be substituted the parameters characterizing the electron. For the solution of theoretical problems of this nature the Gaussian system of units is often regarded as most convenient, and we shall suppose this to be the system used. In the field equations written in this system one dimensional constant occurs, c , of the dimensions of velocity, and numerically equal (by experiment) to the velocity of light. Our problem is then to build up a quantity of the dimensions of mass from the three quantities: electronic charge, e , electronic radius, a , and c . In the Gaussian system e^2 has the dimensions ML^2T^{-2} . Inspection shows that ae^2/c^2 is of the dimensions of mass, so that the point of view which anticipated an electromagnetic mass is to this extent justified and the mass is proportional to ae^2/c^2 . The constant of proportionality can be found only by a detailed solution and will depend on the manner of distribution of the charge.

Applications to Theoretical Physics.—The general scheme of applying dimensional analysis to theoretical physics is not different from that in the applications already considered, provided the underlying mechanisms of the system are sufficiently understood. The method may, however, be applied as a tool of preliminary exploration in situations which are not yet completely understood, in order to find whether certain lines of attack are sufficiently promising to justify more detailed and elaborate development. A well known example is the application by Albert Einstein to a discussion of the infra-red characteristic frequency of solids. Before Einstein, no connection had been envisaged between the mechanism responsible for the ordinary elastic behaviour of a solid and that controlling its optical behaviour. Einstein suspected that the forces resisting the ordinary elastic deformations in a solid were the same in character as those responsible for the characteristic optical frequency in the infra-red. An exact working out of the point of view would obviously have demanded detailed and laborious calculations, which one would not lightly enter upon. A preliminary dimensional analysis was therefore made. A connection is sought between characteristic frequency, ν , compressibility, K , the mass of the atom, m , and the number of atoms per cm^3 , N . The dimensions of these quantities in ordinary mechanical units are respectively T^{-1} , $M^{-1}L^2T^2$, M , and L^{-3} .

There is in general one dimensionless product, and the result is obtained that

$$\bar{K} = \text{numerical const} \times \nu^{-2} N^{-1} m^{-1}$$

A connection of the suspected sort is therefore possible. However, in its present form very little significance can be attached to this result, because in general a dimensionless product may be formed with any four quantities chosen at random. If the exponents in the dimensional formulas of the parameters had provided such a special relationship that the dimensionless product was impossible, then the result would have been of immediate significance, but it would have been negative, and the line of inquiry would have been dropped as impossible. However, in the actual situation further argument is required to find whether the existence of this dimensional relation is significant, and this further argument was supplied by Einstein from an examination of the numerical value of the constant of proportionality.

Substituting actual numerical values for the physical parameters of a representative solid, copper,

$$1 \times 10^{23} \text{ for } \bar{K}, \quad 7.5 \times 10^{23} \text{ for } \nu,$$

$$7.5 \times 10^{22} \text{ for } N,$$

$$1.06 \times 10^{-25} \text{ for } m,$$

and gives the value 0.18 for the numerical constant, a value neither very large nor very small. Einstein's argument is based on the empirical observation that any very large or very small numbers which appear in equations of physics derived theoretically have their origin in physical parameters, such as the charge on the electron or the number of atoms per cm^3 . On the other hand, any numbers which are the result of purely mathematical calculations are likely to be neither very large nor very small.

In the analysis above a number was found, 0.18, neither very large nor very small, so that it might have been the result of mathematical operations on certain fundamental equations containing the physical parameters. The point of view therefore appears to be worth further investigation. It is well known that detailed analysis did justify the general point of view, and the whole modern theory of specific heats at low temperatures has come out of it. The method is admittedly far from rigorous, nor can it be made rigorous, it is intended only to be suggestive, as a tool for preliminary exploration.

Use in Checking Equations.—Another use of dimensional analysis, which often saves much time, is in checking the correctness of a theoretical derivation of a formula. An equation derived from theoretical considerations should in general be a complete equation, the terms should then all have the same dimensions. Simple errors in manipulation are often discoverable by observation of a failure of dimensional homogeneity, and the place of origin of the error may be quickly traced. Consider, for example, a formula in thermodynamics for the adiabatic thermal expansion in terms of the isothermal expansion and other quantities, which might appear as

$$\left(\frac{\partial v}{\partial \tau}\right)_s = \left(\frac{\partial v}{\partial \tau}\right)_p + C_p \left(\frac{\partial v}{\partial p}\right)_\tau / \left(\frac{\partial v}{\partial \tau}\right)_p$$

We ask whether this expression is dimensionally homogeneous? The dimensions of thermodynamic quantities are often expressed most conveniently in terms of pressure (p), volume (v), and temperature (τ) taken as primary. The dimensions of $\left(\frac{\partial v}{\partial \tau}\right)_s$

in the formula are $\nu\tau^{-1}$, as also are those of $\left(\frac{\partial v}{\partial \tau}\right)_p$. The dimensions of C_p , defined in this case as the heat required to raise the temperature one degree, are $p\nu\tau^{-1}$, $p\nu$ having the dimensions of heat or energy. Substitution gives ν for the dimensions of

$$C_p \left(\frac{\partial v}{\partial p}\right)_\tau / \left(\frac{\partial v}{\partial \tau}\right)_p$$

This differs by τ^{-1} from the dimensions of the other terms, so that there must be some error. Consideration would show that a factor τ^{-1} had been lost, and the correct formula is

$$\left(\frac{\partial v}{\partial \tau}\right)_s = \left(\frac{\partial v}{\partial \tau}\right)_p + C_p \left(\frac{\partial v}{\partial p}\right)_\tau / \tau \left(\frac{\partial v}{\partial \tau}\right)_p$$

Use in Changing Units.—By writing out the dimensional formulas of various quantities a method is afforded of finding how the numerical magnitudes of any concrete examples change when the size of the primary units of measurement change. The method is so simple that no elaborate or formal exposition is necessary, it will be sufficient to give several illustrative examples. The method has already been applied in an earlier discussion in this article.

Suppose that a given body is moving with a velocity of 60 mi per hr and we wish to find what its velocity would be in feet per second. Since 1 mi contains 5,280 ft and 1 hr contains 60×60 sec, we may write

$$60 \frac{\text{mile}}{\text{hour}} = 60 \frac{5,280 \text{ ft}}{3,600 \text{ sec}} = 88 \frac{\text{ft}}{\text{sec}}$$

Or, what is the pressure of the atmosphere, which we may take as 15 lb per sq in, expressed in kilograms per square centimetre? One pound is equal to 0.4536 kg, and 1 in equals 2.54

$$\text{cm. Hence, } 15 \frac{\text{lb}}{\text{in}^2} = 15 \frac{0.4536 \text{ kg}}{(2.54 \text{ cm})^2} = 15 \frac{0.1536 \text{ kg}}{(2.54)^2 \text{ cm}^2} = 1.054 \text{ kg/cm}^2$$

The method illustrated is obviously general. In fact it may be extended to much more complicated sorts of examples in which the conversion is between systems of units different in general nature, as from a system with mass, length and time as fundamental to one with force, velocity and energy as fundamental.

In applying the method the symbolic and abbreviated character of the notation is especially not to be lost sight of. We do

not, for example, divide a mile by an hour, but we divide a number obtained by the physical operation for measuring a distance in miles by a number obtained by the physical operations for measuring a time interval in hours. Our question is, what number would we have obtained if we had operated on the same physical system with the operation for measuring a length in feet and the operation for measuring a time in seconds?

Critical Comments—While there is general agreement as to the details of the application of dimensional analysis to any concrete problem, and also with regard to the specific form of the results, there has not by any means been agreement with regard to the philosophy of the subject, and many questions are still controversial. The view presented here is one which apparently is increasingly accepted in the U S. The crux of this point of view is that dimensional analysis is an analysis of an analysis; that is, an analysis of the implications of the fact that methods of analyzing experience have been found profitable which employ certain types of measuring process and certain methods of mathematical treatment of the results of the measurements. There is nothing absolute here, but a great deal of flexibility.

On the other hand, there has been a view, widely held by British authors and also on the continent, that the dimensions of a physical quantity have a much more esoteric significance, that dimensions refer to its essential physical nature, and that the correct dimensions are unique and sometime perhaps may be discovered. Examples of this point of view have been given in the text, this opinion leads, for example, to an intuitive proof of the necessary dimensional homogeneity of all physical equations, and also to an aversion for fractional exponents in dimensional formulas, the occurrence of which is supposed to indicate that certain essential dimensions have been suppressed. Something connected with this point of view is the feeling, held by many contemporary writers, that it is necessary to distinguish two different sorts of operation in our handling of physical situations: that is, ordinary mathematical or arithmetical operations with numbers, and corresponding operations with physical quantities. Thus, according to this view, a velocity is the quotient of a physical length by a physical time.

Contrasted with these points of view, the point of view of this article may be characterized as a minimum point of view. The thesis is whether or not it is possible to give satisfactory meaning to operations with physical quantities, or whether or not there is reason for thinking that things have an ultimate essential physical nature. For present purposes it is not necessary to settle these questions, but everything that we actually need or use in applying dimensional analysis is contained in the considerations set forth in this article. In particular, the various symbols in a dimensional formula perform the function of indicating the different sorts of physical operation that give rise to certain numbers that we use in our calculations. (See PHYSICAL UNITS.)

BIBLIOGRAPHY—The bibliography is very extensive, particularly that of applications to model experiments and other problems of engineering. Only a few of the references to more fundamental aspects will be indicated here.

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DIMINISHING RETURNS, in economics, represents the special application to land of the more generalized "law of diminishing productivity." This latter law may be stated as follows: "The size of the product obtained in a given productive process varies greatly according to the way in which the various agents of production are combined. If the supply of all other agents is kept constant, while the supply of one specific agent is increased, the average product per unit of this specific agent may increase to a maximum point, but, thereafter will, as a rule, diminish continuously, though often irregularly." This law is applicable to all types of production. Economists early noted the application of this law to land and called it "the law of diminishing returns." They observed that, beyond a certain point, as a greater value of labour and other agents of production are applied to a given area of land, the physical product obtained per additional unit of value invested on the land tends to diminish continually. Experience everywhere confirms the existence of this principle.

Any farmer knows that it is unprofitable to increase the intensity of use or cultivation of land beyond a certain point. It is a generally accepted fact that, when population density in a nation increases beyond an optimum point, average productivity per capita diminishes, and hence poverty increases.

(See ECONOMICS) (W I K)
DIMINUENDO (It), diminishing, *se*, as used in music (abbr *dim.*), in loudness, otherwise getting softer *Decrescendo* and the sign — have the same meaning.

DIMINUTION, a term in music applying when a given theme or passage is played in a "diminished" form, *se*, in notes of shorter duration, "augmentation" signifying the converse procedure.

DIMITRIEVIĆ, DRAGUTIN (1876-1917) COLONEL, Serbian soldier and conspirator, was born on Aug 17, 1876, and was the principal organizer of the conspiracy which ended in the murder (1903) of King Alexander (q v) Obrenovich of Serbia and his wife Draga. He was at first treated with great consideration by King Peter Karageorgević, and advanced rapidly in his profession. He became lecturer in tactics at the Military Academy of Belgrade, and contributed largely to the reorganization of the Serbian army. In time, however, he became estranged from the dynasty, and as the semi-official "Narodna Obrana" was too lukewarm, in his opinion, he founded (May 1911) the secret society "Ujedinjenje ili Smrt" (Union or Death), a league composed mainly of officers, and known generally as "the Black Hand," which aimed at uniting all southern Slav districts, by no matter what means. This league, and Dimitrievič himself, took an active part in the comitadj warfare in Macedonia, and also in the anti-Austrian propaganda in Bosnia.

In June 1913 Dimitrievič was appointed chief of intelligence of the Serbian general staff. He was the prime author and organizer of the murder of Sarajevo. The "Black Hand" had quarrelled with the civilian administration and Radical party over the latter's administration in Macedonia. On Dec 15, 1916, Dimitrievič and his principal partisans were arrested at Salonika on a charge of conspiring to deliver the Serb front to the enemy, he was condemned to death for inciting to mutiny and conspiring to assassinate the crown prince (later king) Alexander of Serbia, and shot June 1917.

Dimitrievič (commonly known as "Apis") was a man of great courage, intelligence, patriotism and energy, but ruthless and utterly unscrupulous in his methods. Personal details are given most fully in Boghichevich, *Le Procès de Salomon* (1927), while the evidence regarding the Sarajevo crime is best given in R W Seton-Watson, *Sarajevo* (1927).

DIMITY, derived from the Gr *διωτος* "double thread," through the Ital *dimito*, "a kind of coarse linzie wolzie" (Florio, 1611), a cloth commonly employed for bed upholstery and curtains, and usually white, though sometimes a pattern is printed on it in colours. It is stout in texture, and woven in raised patterns.

DIMORPHISM, the property of assuming two forms. In crystallography (*qv*), two substances which are identical in chemical composition but different in crystalline form, and consequently in others of their physical properties, are *dimorphous*.

In biology the word is used when there are two distinct varieties of an organism which freely interbreed, thus, in plants, the pin eyed and thrum eyed varieties of primrose (*Primula*) are examples of dimorphism, among animals, some female mimetic butterflies show dimorphism, changing their appearance to resemble a different model (*see* MIMICRY), some birds, *e.g.*, certain owls, also exhibit dimorphism. In addition, many animals exhibit sexual dimorphism (*see* SEX) in which the two sexes are sharply differentiated from one another, *e.g.*, deer, birds of paradise, many butterflies, etc.

DINAJPUR, a town and district of British India, in the Rajshah division of Bengal. The population of the town in 1941 was 28,190. The district has an area of 3,953 sq mi and a pop (1941) of 1,926,833. It is a flat alluvial plain broken in the south by a slightly elevated tract known as the Barind, and in the north-west by low hills, along the banks of the Kuli river. The principal rivers are the Atrai and Jamuna and the Karatoya, which forms the eastern boundary for 50 mi. Rice is the staple agricultural product. The district is partly traversed by the main line of the Eastern Bengal State railway and by the line to Bihar, which takes off at Farhatpur. Pillars and copperplate inscriptions have yielded numerous records of the Pala kings of Bengal. Interesting ruins exist at Denkot and Ghoraghat which were military stations under the early Mohammedan rulers of Bengal.

DINAN, a town of northwestern France, capital of an arrondissement in the department of Côtes du Nord, 37 mi E of St. Brieuc on the Ouest-État railway. Pop (1936) 11,711. Dinan, a stronghold of the dukes of Brittany was besieged by the English under the duke of Lancaster in 1359, during which siege Du Guesclin and an English knight called Thomas of Canterbury engaged in single combat.

Dinan stands on a height on the left bank of the Rance (here canalized), some 17 mi above St. Malo, with which it communicates by means of small steamers. It is united to the village of Lannvilly on the right bank of the river by a granite viaduct 130 ft. in height. The town is almost entirely encircled by the mediaeval ramparts, strengthened with towers and, on the south, a castle of the late 14th century, now a prison. Three old gateways also remain. The church of St. Malo is late Gothic, that of St. Sauveur, Romanesque and Gothic intermingled. In the latter church a granite monument contains the heart of Bertrand Du Guesclin. The quaint winding streets of Dinan are often bordered by mediaeval houses. It is a tourist centre. Near the town are the ruins of the château and the Benedictine abbey at Léhon, and not far off is the now dismantled château of La Garaye. Dinan is the seat of a subprefect. There is trade in grain, cider, wax, honey, butter and other agricultural products. Leather is manufactured.

DINANT, an ancient town in the province of Namur, Belgium, on the Meuse, with the station and the suburb of St. Medard. Pop (1930) 6,943. As early as the 7th century it was a dependency of the bishopric of Tongres. From the 10th century to the French revolution it was a fief of the prince bishopric of Liège. In 1040 a castle was built on a rock dominating the town. In the 13th century, with a population of 60,000, and 8,000 workers in copper, Dinant was one of the most flourishing cities in Walloon Belgium until it incurred the wrath of Charles the Bold. In 1466 Charles, in his father's name, laid siege to Dinant, and carried the place by storm, killing most of the combatants. In 1675 Dinant was taken by Louis XIV, and remained in French hands for nearly 30 years. The citadel on the cliff, 300 ft or 408 steps above the town, was fortified by the Dutch in 1818, but was dismantled later. Half way up the cliff is the grotto of Montfat, 13th century.

The church of Notre Dame (13th century) stood immediately under the citadel, flanking the bridge, and was a remarkably complete illustration of Gothic architecture with a curious slate-covered spire shaped like a long pumpkin.

Dinant was practically destroyed in August 1914 during the German invasion, and 670 of its inhabitants were shot, but after 1918 it was largely restored. It again suffered heavily in the May 1940 campaign.

Dinant is a summer resort and also a convenient central point for excursions into the Ardennes.

DINAPORE, a subdivisional town and cantonment of British India, in the Patna district of Bihar, on the right bank of the Ganges. Pop (1941) 40,057. In 1857 the sepoy regiments here who had been allowed to retain their arms broke into open mutiny when an attempt was made to disarm them. The majority crossed over the Son into Shahabad where they joined the rebels under Kuar Singh and laid siege to Arrah.

DINAR, The monetary unit of Serbia, and since World War I, of Yugoslavia, divided into 100 paras. At par, the dinar is equivalent to 2 082 cents in the currency of the United States.

Gold coins are of 20 and 10 dinars in denomination, and silver is coined into pieces of 5, 2, 1 and $\frac{1}{2}$ dinars, respectively. Nickel coins circulate, in the form of 20, 10 and 5 paras, while bronze is struck into coins of 2 paras. With the dinar equivalent to 1 76 cents or about three farthings, 2 paras would be only 1/100th of a penny.

National bank notes circulate in Yugoslavia. In 1920, 3,344,000,000 dinars were outstanding, and by 1924 the volume had risen to 6,000,000,000. Concurrently, the dollar exchange fell from 2 95 to 1 49 cents.

The world depression of the 1930s and the outbreak of World War II in 1939 caused further violent fluctuations in the exchange value of this and other currencies.

(*See also* CURRENCY)

DINARD, a seaside town of northwestern France in the department of Ile-et-Vilaine. Pop (1936) 6,541. The town, the chief watering place of Brittany, stands on a rocky promontory at the mouth of the Rance opposite St. Malo, which is about 1 mi distant. It is a favourite resort of English and Americans, as well as of the French, its attractions being the beauty of its situation, the mildness of the climate and the good bathing. It has two casinos and numerous luxurious hotels and elegant villas. The adjoining watering places of St. Enogat, St. Lunaire and St. Brac are increasing in importance.

DINDIGUL, a town of British India, in the Madura district of Madras, 880 ft above the sea, 40 mi from Madura by rail. Pop (1941) 56,275. Dindigul is a trade centre, and has a considerable manufacture of tobacco, a large cotton ginning and pressing factory, and tanneries. The town has manufactures of cloth and safe locks and an export trade in cotton, coffee, grain and cardamoms. Approximately one ninth of the population is Christian. There is an industrial school. The ancient fort, well preserved, stands 350 ft above the town, this was formerly a position of great strategic importance, commanding passes into Madura from Combarote, and figured prominently in the military operations of the Mahrattas in the 17th and 18th centuries, and of Hyder Ali in 1755 and the years which followed. After being thrice captured by the British it was eventually ceded to the East India Company.

DINDORE, KARL WILHELM (1802-1883), German classical scholar, was born at Leipzig. After completing F. Inverniz's edition of Aristophanes (1826), and editing several grammarians and rhetoricians, he was, in 1828, appointed extra ordinary professor at Leipzig, a post which he resigned in 1833. He edited Athenaeus (1837) and the Greek dramatists, both separately and combined in his *Poetae scenici Graeci* (1830 and later editions). He also wrote a work on the metres of the Greek dramatic poets, and compiled special lexicons to Aeschylus and Sophocles. He edited Procopius for Nicbuhr's *Corpus* of the Byzantine writers, and between 1846 and 1851 brought out at Oxford an important edition of Demosthenes, he also edited Lucian and Josephus for the Didot classics. His last important editorial labour was his *Eusebius of Caesarea* (1867-71). Much of his attention was occupied by the republication of Stephanus's *Thesaurus* (Paris, 1831-65), chiefly executed by him and his brother Ludwig, a work of prodigious labour and utility.

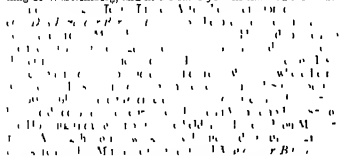
His brother LUDWIG (1805-1871) led so secluded a life that many doubted his existence, and declared that he was a mere pseudonym. The important share which he took in the edition of the *Thesaurus* is nevertheless authenticated by his own signature to his contributions. He also published valuable editions of Polybius, Dio Cassius and other Greek historians.

D'INDY, PAUL - MARIE - THEODORE - VINCENT (1851-1931), French musical composer, was born in Paris on March 27, 1851. He studied composition and the organ at the Paris Conservatoire under Cesar Franck, and obtained the grand prize offered by the city of Paris in 1885 with *La Chant de la Cloche*, a dramatic legend after Schiller. His principal works include the symphonic trilogy *Wallenstein*, the symphonic works entitled *Sauvefleure*, *La Forest enchantee*, *Ishtar*, *Symphonie sur un air montagnard français*, overture to *Anthony and Cleopatra*, *St. Marie Magdeleine*, a cantata, *Attendez moi sous l'orme*, a one act opera, *Fervaa*, a music drama in three acts, and *La Legende de Saint-Christophe*, a hybrid work, part oratorio, part opera, part symphony, containing some of his finest music. Vincent d'Indy was perhaps the most prominent among the disciples of Cesar Franck. He was guided by the loftiest ideals and few musicians laboured more strenuously or disinterestedly in the service of art. His opera *Fervaa*, which is styled "action musicale," is constructed upon the leading motive system. Its legendary subject recalls both *Parsifal* and *Tristan*, and the music is also suggestive of Wagnerian influences. As founder and director of the Schola Cantorum d'Indy did magnificent work as a teacher, and the briefest record of his activities would be incomplete which omitted reference to his indefatigable propagandist labours on behalf of his master, Cesar Franck.

DINER, also **DINAR** or **GEYIKLER**, a *kaza* in the vilayet of Afion Qarahisar in Turkey, built amid the ruins of Celasnae-Apamea, near the sources of the Maeander. Population, 36,117. It lies on the Smyrna-Egirdir railway (see **APAMEA**).

DINGAAN, see **ZULULAND**.

DINGELSTEDT, FRANZ VON (1814-1881), German poet and dramatist, was born at Haldorf, in Hesse Cassel, on June 30, 1814. He studied at Marburg, became schoolmaster at Cassel (1836) and at Fulda (1838). In 1839 he produced a novel, *Unter der Erde*, and in 1841 the book by which he is best remembered, the *Lieder eines kosmopolitischen Nachtwachters*. These poems, which expressed the liberal aspirations of his time, determined his career, and in 1841 he joined the staff of the *Augsburger allgemeine Zeitung*. In 1843 the satirist of German princes accepted, to the general surprise, the appointment of private librarian to the king of Wurtemberg, and in the same year he married the Bohe-



(1879), *Die Amazone*, a society novel (1809), translations of several of Shakespeare's comedies, and several writings dealing with questions of practical dramaturgy. He was ennobled in 1867 by the king of Bavaria, and in 1876 was created *Freiherr* by the emperor of Austria. Dingelstedt was one of the founders of the German Shakespeare Society.

Dingelstedt's *Samtliche Werke* (12 vols., 1877-78), is incomplete. On his life, see, besides the autobiography mentioned above, J. Rodenberg, *Heimaterinnerungen an F. Dingelstedt* (1882), and F. Dingelstedt, *Blätter aus seinem Nachlass* (2 vols., 1891).

DINGHY, a boat of greatly varying size and shape, used on the rivers of India, the term is applied also, in certain districts, to a larger boat used for coasting purposes. The name was adopted by the merchantmen trading with India, and is now generally used to designate the small extra boat kept for gen-

eral purposes on a man of war or merchant vessel, and also, on the Thames, for small pleasure boats built for one or two pairs of skulls.

DINGLE, a seaport and market town of Co. Kerry, Eire on the fine natural harbour of Dingle bay. Pop. (1936) 1,800.



FROM FAUNA (ZOOLOGICAL SOCIETY OF PHILADELPHIA).

DINGO (**CANIS DINGO**) THE WILD AUSTRALIAN DOG.

of tail and feet. Cranially, it resembles the oldest domestic dogs of Europe. After white settlers went to Australia, domestic dogs crossed with the dingoo, and few pure dingoes are to be found in certain regions. The dingo was without doubt brought to Australia by the Australian Blacks when they first settled the continent.

Owing to the introduction of the rabbit, which affords it a staple food supply, the dingo has recently increased in numbers to such an extent as to become a serious menace to the sheep-farmers in many parts of Australia. It hunts singly or in pairs, more rarely in small packs of five or six.

Fossil remains of the dingo are found in the Australian Pleistocene mixed with bones of giant marsupials (J. E. HL.).

DINGWALL, royal and small burgh and the county town of the shire of Ross and Cromarty, Scotland. Pop. (1938) 2,828. It is near the head of Cromarty Firth where the valley of the Pefferly unites with the alluvial lands at the mouth of the Conon, 18½ mi. NW of Inverness by the LMSR. Its name, derived from the Scandinavian *Thingvallr*, "field or meetingplace of the thing," or local assembly, preserves the Norse origin of the town, its Gaelic designation is Inverpefferon, "the mouth of the Pefferly." The 18th century town house (largely rebuilt in 1905) and some remains of the ancient mansion of the once powerful earls of Ross still exist. A tower has been built on Mitchell hill to the south of the town in memory of Brig General Sir Hector Macdonald, who was born near Dingwall. The town has an important corn market and auction marts, and a distillery. Some shipping is carried on at the harbour at the mouth of the Pefferly, about a mile below the burgh. Branch railways run to Strathpeffer and to Strone Ferry and Kyle of Lochalsh (for Skye). Alexander II created Dingwall a royal burgh in 1226, and its charter was renewed by James IV. On the top of Knockfarrel, a hill about 3 mi. to the west, is a large and very complete vitrified fort with ramparts.

DINIZ DA CRUZ E SILVA see **CRUZ E SILVA**, ANTONIO

DINIZ DA

DINIZULU see **CETUYAWO** and **SU ZULULAND**

DINKA see **NILOTES**

DINKELSBUEHL, a town of Germany, in the *Land* of Bavaria, on the Wornitz, 16 mi. N from Nördlingen by rail. Population 5,180. Fortified by the emperor Henry I, Dinkelsbühl received in 1305 the same municipal rights as Ulm, and obtained in 1351 the position of a free imperial city, which it retained till 1802, when it passed to Bavaria. Its municipal code, the *Dinkelsbühler Recht*, published in 1536, and revised in 1738, contained a very extensive collection of public and private laws. It is still surrounded by old walls and towers. The *Deutsches Haus*, the ancestral home of the counts of Drechsel-Deufletten, is of the German renaissance style of wooden architecture. Brushes, gloves, stockings and gingerbread are the chief manufactures.

DINNER, the chief meal of the day, eaten either in the middle

of the day or in the evening. The word "dine" comes through Fr from Med Lat *dinare*, for *disjungere*, to break one's fast (*jejunium*), it is, therefore, the same word as Fr *déjeuner*, to breakfast, in modern France, to take the midday meal, *dîner* being used for the later repast.

DINOFLAGELLATA, small celled organisms (class Flagellate), with plant like metabolism, which are present as part of the floating fauna (plankton) of pools, lakes and the sea. They form a certain part of the food supply of other animals (e.g., of fish larvae) (See PROTISTA).

DINORNITHIDAE, See MOA

DINOSAURIA, the dominant land animals of the Mesozoic era, they form two orders of reptiles related to the crocodilians and the ancestors of the birds. Although certain of the earlier or more primitive forms were of small size, the dinosaurs as a whole tended to be of gigantic proportions, some members of the group were the largest animals that ever walked the earth. A fair number of dinosaurs were flesh-eaters, but a majority abandoned this mode of life for an herbivorous diet. The primitive dinosaurs were bipeds, and various types remained bipedal throughout the history of the group, in both orders, however, many herbivorous forms reverted to a four footed gait.

The two dinosaur orders are termed the Saurischia and the Ornithischia, the names referring to the fact that in the first order the structure of the characteristic hip bones was fairly comparable to that of other reptiles, whereas in the second order these elements were more bird-like. The oldest saurischians were common reptiles of the late Triassic, most were small, lightly-built, carnivorous bipeds of which *Podokesaurus* (fig. 6) is typical. Some of the saurischians remained relatively small throughout the Mesozoic. *Ornitholestes* of the Jurassic (fig. 1) probably weighed little more than a turkey, and a European contemporary, *Compsognathus*, was no larger than a chicken. In the Cretaceous *Spinosaurus*, although as large as an ostrich, was a bipedal and presumably primitive descendant of these older forms.

From such primitive forms evolved the great flesh-eating bipeds. By the end of the Triassic there were already 10 or 15 of considerable size, and in the Jurassic, *Tyrannosaurus* (fig. 2) is representative of a group of predators able to cope with any animal of its day. Still larger carnivores evolved in the Cretaceous. *Tyrannosaurus* (fig. 3) stood nearly 20 ft high, in the hind legs, the hind legs are massively built in contrast with the tiny useless "arms." The skull, 4 ft in length, was armed with daggerlike teeth 6 in or more in length.

These bipedal carnivores are generally considered to constitute a suborder Theropoda of the saurischians. In strong contrast to them are the members of the suborder Sauropoda, the amphibious dinosaurs, which reached their peak in the late Jurassic. Some large late Triassic sauropods tended to change from flesh eating to plant feeding. In the Jurassic their descendants had reverted to a four-footed life and appear to have spent much of their time as inhabitants of lagoonal areas rich in soft vegetation. *Brontosaurus* (fig. 7), the "thunder lizard," is a characteristic sauropod. Reaching a length of 67 ft in one mounted specimen this animal is estimated to have weighed perhaps 35 tons. The small head bore but a few simple peg teeth, the food material must have been a very soft type of vegetation. The limbs are massively built in elephantlike columnar fashion, a construction necessary for an animal of such great weight. Even so, it seems doubtful if sauropods could have emerged onto land to any extent, they presumably spent most of their lives in the lagoons, buoyed up by the water.

Diplodocus (fig. 11), originals or replicas of which are found in many museums, was longer (a mounted skeleton measures 87½ ft) but more slenderly built, and weighed perhaps but 25 tons. The true giant of the group was *Brachiosaurus* (fig. 4), known both from North America and East Africa. In this form, estimated to have weighed as much as 50 tons, the tail was short but the body massive. The front legs were longer than the hind, in contrast to typical dinosaur build, and the neck was long. In consequence the head was high enough to have seen over a three-story building, *Brachiosaurus* could have lived in relatively

deep bodies of water.

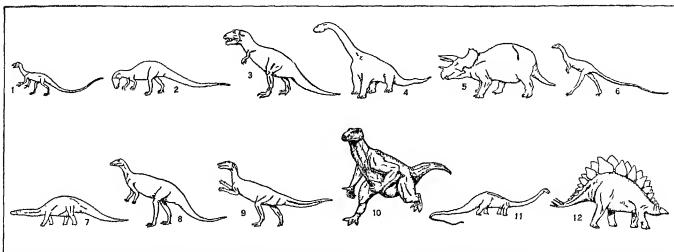
The second of the dinosaur orders is that of the Ornithischia, easily recognized osteologically by the bird like, four-pronged structure of the pelvic bones. Unlike the saurischians, these dinosaurs were, from the first, plant eaters. There were usually numerous leaf-shaped teeth in the back of the jaws for the treatment of vegetable food, but teeth were almost always absent from the front of the mouth, where a horny bill or beak was present.

The ornithischians were slower to develop than their reptile-like cousins, for they are practically unknown in the Triassic. The primitive bird like forms constituted the suborder Ornithomirid. These were bipeds, of which the more primitive genera, such as *Camptosaurus* (fig. 8), were relatively small and lightly built. The front legs were never as strongly reduced in size as in the case of the bipedal saurischians, and it is probable that a four-footed gait was retained to some extent. *Iguanodon* (fig. 10) was a larger and more heavily built genus from the Lower Cretaceous of Europe, the thumb was developed as a spike-like defensive weapon. Best known of ornithomirids were the duck-billed dinosaurs of the late Cretaceous, such as *Anatosaurs* [*Trachodon*] (fig. 9). These were amphibious reptiles with webbed feet (impressions have been found of the skin of "mummified" individuals). In many duckbills the bones surrounding the nose expanded into a curious crest or "horn" above the head, this contained the air passage from the nostrils and may have developed in connection with the water-dwelling habits of the group.

As among the saurischians, so in the ornithischians we find a strong tendency for increase in size to be accompanied by a reversion to a four-footed gait. In correlation with the need for protection against contemporary carnivorous dinosaurs, we find that these quadrupeds universally developed defensive structures of some sort. Three subordinal groups may be distinguished. The Stegosauria are the characteristic armoured dinosaurs of the Jurassic, *Stegosaurus* (fig. 12) of North America is the best known of the group, there were related genera in Europe and Africa. The head was small, the short front legs, contrasted with the long hind limbs, are indicative of the earlier bipedal stage in the animal's ancestry. The flanks of the animal appear to have been unprotected, and the armour consisted merely of two rows of large bony plates extending upward from the back, and paired spines borne on the tail. In *Stegosaurus*, as in certain other dinosaurs, the spinal cord shows an enlargement in the hip region, larger than the brain. This indicates a high development of local reflexes for the movement of the hind legs. It will be noted that in large dinosaurs it would have taken an appreciable amount of time for a nerve impulse to travel up the trunk to the brain and back, with consequent problems in the attainment of accurate muscular co-ordination.

In the Cretaceous dinosaur beds the stegosaurs are replaced by the Ankylosauria. *Ankylosaurus*, *Palaeosaurus* and their allies were armoured forms of a very different sort, sometimes termed "reptilian tanks." The body was low, broad and flattened. The trunk was completely covered above by an armour of larger and smaller bony plates which formed a carapace somewhat comparable to that of a turtle. The limbs were defended by spines projecting outward from the body armour. The broad head and short neck were protected by bony armor, and the short tail was sheathed in armor and sometimes furnished with spikes at its tip. The ankylosaurs are not saurischian descendants but evolved independently from bipedal ancestors.

A final group is that of the Ceratopora, the horned dinosaurs of the late Cretaceous, mainly found in North America. The large head remained in a powerful cutting beak. Typical genera developed massive bony horns, a median one above the nose and paired horns somewhat comparable to those of cattle, over the orbits. In *Triceratops* (fig. 5) the nasal horn was small, the paired horns large, in *Monoclonius* the reverse was the case, the nasal horn being the prominent one. Back of the skull region proper, the skull roof is extended into a great frill of bone protecting the neck region—a favourite place for the attack of carnivores. The body stockily built and four-footed carried no armour, although presumably there was a tough hide.



(1) ORNITHOLISTES BASED UPON A SPECIMEN IN THE AMERICAN MUSEUM OF NATURAL HISTORY LENGTH ABOUT 7 FT (2) ALLOSAURUS BASED UPON A SPECIES IN THE AMERICAN MUSEUM OF NATURAL HISTORY 34 FT IN LENGTH (3) TYRANNOSAURUS BASED UPON A SPECIMEN IN THE AMERICAN MUSEUM OF NATURAL HISTORY 47 FT IN LENGTH (4) BRACHIOSAURUS WEIGHING PERHAPS 50 TONS (5) TRICERATOPS 20 TO 25 FT LONG (6) PODOCOSAURUS LENGTH ABOUT 4 FT (7) BRONTOSAURUS BASED UPON A SPECIMEN IN THE AMERICAN MUSEUM OF NATURAL HISTORY 50 FT LONG (8) CAMPTOSAURUS ABOUT 6 FT LONG (9) ANATOSAURUS (TRACHOODON) BASED UPON THE MOUNTED SKELETON IN THE YALE UNIVERSITY MUSEUM OF NATURAL HISTORY 30 FT LONG (10) EUCEPHALOPUS (11) DIPSOSAURUS (12) STEGOSAURUS BASED UPON THE MOUNTED SKELETON IN THE YALE UNIVERSITY MUSEUM LENGTH ABOUT 8 1/2 FT.

A primitive ceratopsian stage is that represented by *Protoceratops* of Mongolia. This was a small reptile, in which the full and other ceratopsian characters were present, but in which there is practically no trace of horns. *Protoceratops* is famous as the one dinosaur in which the reproductive habits are well known. In Mongolia, clutches of eggs undoubtedly laid by this reptile have been discovered neatly arranged in a nest-like depression in the ancient sands, and nearby in the same area, there was apparently a dinosaur "nursery," with numerous skeletons of young individuals.

Almost all of the major dinosaur groups were still flourishing in the latter part of the Cretaceous period closing the Mesozoic era or age of reptiles, at the opening of the succeeding Tertiary period, all were extinct, and the mammals were rapidly evolving to replace them as rulers of the earth. What caused this spectacular sudden extinction of the dinosaurs is far from clear. It is probable, however, that geologic events may have been a major factor. In late Cretaceous times many new mountain chains (including the Rockies) were arising and in consequence there may have been marked climatic and other environmental changes disadvantageous to such specialized forms. Perhaps related to climatic changes, we find that the world flora changed notably at the close of the Cretaceous, probably many of the herbivorous dinosaurs were unable to adapt themselves to new types of vegetation as a food supply. The extinction of carnivorous dinosaurs would necessarily follow that of the herbivores upon which they preyed.

[illegible]

DINOSAUR NATIONAL MONUMENT, a reservation (190,801.65 ac in area) located in northeastern Utah and northwestern Colorado, U.S., about 12 mi east by north of Vernal, Utah. The reservation, created Oct 4, 1915, contains fossil remains of prehistoric animal life of great scientific interest.

DINOTHERIUM (DINOHERIUM), a genus of large extinct mammals allied to the mastodons and elephants and belonging, with these, in the order Proboscidea (*q v*). Dinotheres are particularly abundant in the late Miocene and early Pliocene of Europe, where complete skeletons have been found, but they also ranged widely in Asia and Africa and are known from the early Miocene to the Pleistocene. The dinotheres were 8 to 12 ft in height, about the same size as living elephants. The body was elephantlike and the animal had a trunk, but the tusks were in the lower, not upper, jaws and they pointed downward and backward. The grinding teeth, normally five in each jaw, were transversely crested and mastodonte-like.

 $(G \quad G \quad S_f)$

DINTER, GUSTAV FRIEDRICH (1760-1831), German divine and educator, was born on Feb. 29, 1760, at Borna, Saxony. He was educated at Leipzig university, and while pastor of a village near Borna, became interested in the training of teachers. From 1797 to 1807 he was principal of the Dresden normal school, and after founding a *progymnasium* at Goernitz, in 1816 was appointed inspector of schools of the province of Prussia and shortly afterwards professor of theology at Koeningberg university. In education, Dinter introduced the methods of Pestalozzi and in his famous *Schullehrer-bibel* (1826-30) advocated the use of the Bible as an authority in religion only, not in science. He died at Koeningberg on May 20, 1831.

See *Sämtliche Schriften*, 42 Bde (Neustadt, 1840-51), and his autobiography (Neustadt, 1829)

DINWIDDIE, ROBERT (1603-1730). British colonial governor of Virginia, was born near Glasgow, Scotland, in 1603. From the position of customs clerk in Bermuda, which he held in 1727-28, he was promoted to be surveyor-general of the customs "of the southern ports of the continent of America," as a reward for having exposed the corruption in the West Indian customs service. In 1751-58 he was lieutenant-governor of Virginia. He was energetic in the discharge of his duties, but aroused much animosity among the colonists by exacting heavy fees. It was his chief concern to prevent the French from building in the Ohio valley a chain of forts connecting their settlements in the north with those on the Gulf of Mexico, and in the autumn of 1753 he sent George Washington to Ft. Le Boeuf, a newly established French post at what is now Waterford, Pa. with a message to

tions the following are the most important *Borysthenica* (xxvii), on the advantages of monarchy, addressed to the people of Olbia, and containing information about the Greek colonies on the Black sea, *Olympica* (xi), in which Pheidias is represented as setting forth the principles which he had followed in his statue of Zeus, one passage being supposed by some to have suggested Lessing's *Laocoon*, *Rhodiaca* (xxii), an attack on the Rhodians for alighting the names for their statues to those of famous men of the day, *De regno* (i iv) addressed to Trajan and describing the stoic ideal kingship, *De Aeschyle et Sophocle et Euripide* (li), a comparison of the treatment of the story of Philoctetes by the three tragedians, and *Philoctetes* (lix), a summary of the prologue to the lost play by Euripides. In his later life, Dio, who had originally attacked the philosophers, himself became a convert to Stoicism. To this period belong the essays on moral subjects, such as the denunciation of various cities (Tarsus, Alexandria) for their immorality. Most pleasing of all is the *Euboeica* (vi), a description of the simple life of the herdsmen and huntsmen of Euboea. Amongst his lost works were attacks on philosophers and Domitian, and *Getica*, an account of the manners and customs of the Getae.

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DIOCLETIAN (GAIUS AURELIUS VALERIUS DIOCLETIANUS) (AD 245-313), Roman emperor 284-305, is said to have been born at Dioclae, near Salona, in Dalmatia. His original name was Diocles. Of humble origin, he held important military commands under the emperors Probus and Aurelian, and accompanied Carus to the Persian War. After the death of Numerianus he was chosen emperor by the troops at Chalcedon, on Sept. 17, 284, and slew with his own hands Artorius Aper, the praefect of the praetorians. Having been installed at Nicomedia, he received general acknowledgment after the murder of Carinus. In consequence of the rising of the Bagaudae in Gaul, and the threatening attitude of the German peoples on the Rhine, he appointed Maximian Augustus in 286, and, in view of further dangers and disturbances in the empire, proclaimed Constantine Chlorus and Galerius Caesars in 293. Each of the four rulers was placed at a separate capital—Nicomedia, Mediolanum (Milan), Augusta Trevirorum (Trier), Sirmium. This amounted to an entirely new organization of the empire, on a plan commensurate with the work of government which it now had to carry on. Diocletian abdicated his sovereignty on May 1, 305, and retired to Salona, where he died eight years afterwards (others give 316 as the year of his death). The end of his reign was memorable for the persecution of the Christians. He hoped to strengthen the empire by reviving the old religion, and the church as an independent State appeared to be a standing menace to his authority. Under Diocletian the senate became a political nonentity, the last traces of republican institutions disappeared, and were replaced by an absolute monarchy. He wore the royal diadem, assumed the title of lord, and introduced the whole ceremonial of Eastern monarchy. His first work was the reform of the administration of the empire, this is partly dealt with under Roxse *Ancient History*, and a brief summary is all that can be attempted here. The titular supremacy of Italy disappears, and a uniform system of administration comes into play throughout the empire. Beginning with Diocletian, local autonomy gradually disappears, and the empire is administered by a huge bureaucracy, entirely dependent on the emperor. The empire was sick of civil war and continual insecurity, and Diocletian and his successors saved it at the price of practically destroying its economic and political life. The old,

regular, intricate system of taxation was abolished, and a simplified, but oppressive and inelastic system substituted, which was really a systematization of the practice of exacting forced contributions of produce and labour, based on acreage, which resulted in the country people becoming compulsorily tied to their land. The responsibility for the city taxes was put on the members of the municipal councils. In the military sphere Diocletian only laid the foundations of the new system, which was the work of Constantine, but he took the first steps by largely increasing the numbers of the army. His attempted stabilization of prices (see DIOCLETIAN, EDICT OF) was a failure. In addition, he adorned the city with numerous buildings, such as the thermae, of which extensive remains are still standing (see Aurelius Victor, *de Caesaribus* 39, Eutropius iv 13, Zonaras xii, 31). The problem before Diocletian was much the same as that before Augustus but the conditions were much more unfavourable. "By his genius Augustus succeeded in restoring not only the State but also the prosperity of the people. Diocletian and Constantine sacrificed the interests of the people to the preservation of the State."

See M. Rostovtzev, *Social and Economic History of the Roman Empire* (1926), and Roxse, *History*.

DIOCLETIAN, EDICT OF, an imperial edict (AD 301) fixing a maximum price for provisions and other articles, and a maximum rate of wages. Incomplete copies of it have been discovered, the first (in Greek and Latin) in 1709, at Stratonicea in Caria, containing the preamble and the beginning of the tables down to No. 403. A second fragment (now in the museum at Aix, in Provence) was brought from Egypt in 1809, it adds the titles of the emperors and Caesars, and the number of times they had held them, whereby the date can be determined. Other fragments have been found, e.g., at Elateia, Plataea, and Megalopolis. Latin being the official language all over the empire, there was no official Greek translation. All the fragments come from the provinces which were under the jurisdiction of Diocletian, i.e., the eastern portion of the empire. No traces have been found in the western empire. The articles mentioned in the edict, giving their relative values at the time, include cereals, wine, oil, meat, vegetables, fruits, skins, leather, furs, foot-gear, timber, carpets, and articles of dress, and the wages range from those of the ordinary labourer to those of the professional advocate. The unit of money was a copper coin introduced by Diocletian, of which the value has been fixed at one-fifth of a penny. The punishment for exceeding the prices fixed was death or deportation. The edict was a well-intended but abortive attempt to meet the distress caused by several bad harvests and commercial speculation. The actual effect was disastrous, and the edict soon fell into abeyance.

See *Corpus Inscriptionum Latinarum*, Lactantius, *De mortibus persecutorum*, a contemporary who, as a Christian, writes with natural bias against Diocletian, J. E. Sandys, *Companion to Latin Studies* (1921), with useful bibliography. There is an edition of the whole edict by Mommsen, with notes by H. Blummer (1893).

DIODATI, GIOVANNI (1576-1649), Swiss Calvinist, was born in Geneva on June 6, 1576, of a refugee Protestant family from Lucca. In 1606 he became professor of theology, in 1608 pastor at Geneva, and in 1609 succeeded Beza as professor of theology. Diodati is chiefly famous for his Italian translation of the Bible (1603, edited with notes, 1607). He died at Geneva on Oct. 3, 1649.

Among his other works are his *Annotaciones in Biblia* (1609, Eng. trans. 1648) and polemical treatises, such as *De felicitate Pontificum* (1619), *De usula secessione Reformatum ab Ecclesia Romana* (1628), *De Antichristo*, etc. He also published a French translation of his friend Sarpi's *History of the Council of Trent*.

DIODE, in radio, a type of vacuum tube containing two electrodes, which passes current wholly or predominantly in one direction, and which, therefore, may be used as a rectifier.

DIODORUS CRONUS (4th century B.C.), Greek philosopher of the Megarian school. Practically nothing is known of his life. Diogenes Laertius (ii 111) tells a story that, while staying at the court of Ptolemy Soter, Diodorus was asked to solve a dialectical subtlety by Sulpio. Not being able to answer on the spur of the moment, he was nicknamed *ὁ Κρόνος* (Father Time) by Ptolemy. The story goes that he died of shame at his failure. Strabo, however, says (xv 658, xvii 838) that he took the name of

from Apollonius, his master. He belonged to the Megarian school. He was the famous sophist known as the *Kuriolobos*. The impossible cannot result from the possible, a past event cannot become other than it is, but if an event, at a given moment, had been possible, from this possible would result something impossible, therefore the original event was impossible. From his great dialectical skill he earned the title *ὁ διαλεκτικός* or *διαλεκτικιστάτης*.

See Cicero *De Fato*, 6, 7, 9, Aristotle *Metaphysics*, 83, Sext. Empiricus *adv. Math.* x 85, Ritter and Preller *Hist. Philos. Gr. et Rom. chap. v* §§ 234-236 (ed. 1869).

DIODORUS SICULUS, Greek historian, born at Agrigum in Sicily, lived in the times of Julius Caesar and Augustus. From his own statements we learn that he travelled in Egypt between 60-57 B.C. and that he spent several years in Rome. The latest event mentioned by him belongs to the year 21 B.C. His history, *Bibliotheca historica*, "Historical Library" consisted of forty books, and was divided into three parts. The first treats of the mythic history of the non-Hellenic, and afterwards of the Hellenic tribes, to the destruction of Troy, the second section ends with Alexander's death, and the third continues the history as far as the beginning of Caesar's Gallic War. Of this extensive work there are still extant only the first five books, treating of the mythic history of the Egyptians, Assyrians, Ethiopians and Greeks, and also the 11th to the 30th books inclusive, beginning with the second Persian War, and ending with the history of the successors of Alexander, previous to the partition of the Macedonian empire (302). The rest exists only in fragments preserved in Photius and the excerpts of Constantine Porphyrogenitus. The faults of Diodorus arise partly from the nature of the undertaking, and the anachronistic form which he adopts. He lacks the critical faculty, he repeats and contradicts himself, and his simple diction, intermediate between pure Attic and the colloquial Greek of his time, enables us to detect the undigested fragments of the materials which he employed. Yet the *Bibliotheca* is of considerable value as supplying to some extent the loss of the works of older authors, from which it is compiled. Unfortunately, Diodorus does not always quote his authorities, but his general sources of information were in history and chronology, Castor, Ephorus and Apollodorus, in geography, Agatharchides and Artemidorus. In special sections he followed special authorities, e.g., in the history of Sicily, Philistus and Timaeus.

Editio princeps, by H. Stephanus (1550), of other editions the best are P. Wesseling (1746) not yet superseded, L. Dindorf (1828-31), (text) L. Dindorf (1866-68) (revised by F. Vogel, 1888-93 and C. T. Fischer, 1905-06). The standard works on the sources of Diodorus are C. G. Heyne, *De Iosibus et auctoribus huiusmodi Diodori*, printed in Dindorf's edition, and C. A. Volquardsen, *Die Quellen der griechischen und lateinischen Geschichten des Diodor* (1868); A. von Meiss, *Rheinisches Museum* (1906), see also L. O. Bröcker, *Untersuchungen über Diodor* (1870), short, but containing much information; O. Maass, *Kleinarch und Diodor* (1894 etc.); G. J. Schneider, *De Diodori Iosibus*, 1-iv (1880); C. Wachsmuth, *Einführung in das Studium der alten Geschichte* (1895); *GREECE Ancient History*, "Authorities."

DIODOTUS, Seleucid satrap of Bactria, who rebelled against Antiochus II (about 255) and became the founder of the Graeco-Bactrian kingdom (*Trogus Procl.* 41, Justin xli 4, 5, where he is wrongly called Theodotus, Strabo xi 513). His power seems to have extended over the neighbouring provinces Arsaces, the chieftain of the nomadic (Dassan) tribe of the Pami, fled before him into Parthia and here became the founder of the Parthian kingdom (Strabo 1c). When Seleucus II in 239 attempted to subjugate the rebels in the east he seems to have united with him against the Parthians (Justin xli 4, 6). Soon afterwards he died and was succeeded by his son Diodotus II, who concluded a peace with the Parthians (Justin 1c). Diodotus II was killed by another usurper, Euthydemus (Polyb. xi 34, 2). Of Diodotus I we possess gold and silver coins, which imitate the coins of Antiochus II, on these he sometimes calls himself "sovereign," "the saviour." As the power of the Seleucids was weak and continually attacked by Ptolemy II, the eastern provinces and their Greek cities were exposed to the invasion of the nomadic barbarians

and threatened with destruction (Polyb. xi 34, 5), thus the erection of an independent kingdom may have been a necessity and indeed an advantage to the Greeks, and this epithet well deserved. Diodotus Soter appears also on coins struck in his memory by the later Graeco-Bactrian kings Agathocles and Antimachus. Cf. A. v. Sallet *Die Nachfolger Alexanders d. Gr. in Baktrien und Indien*, Percy Gardner *Catal. of the Coins of the Greek and Scythian Kings of Bactria and India* (Brit. Mus.), see also BACTRIA (Ed. M.).

DIOGENES, "the Cynic," Greek philosopher, was born at Sinope about 412 B.C., and died in 323 at Corinth, according to Diogenes Laertius, on the day on which Alexander the Great died at Babylon. When his father was exiled Diogenes was included in the charge and went to Athens. Attracted by the ascetic teaching of Antisthenes, he became his pupil, and rapidly excelled his master both in reputation and in the austerity of his life. The stories which are told of him are probably true, in any case, they serve to illustrate the logical consistency of his character. He injured himself to the vicissitudes of weather by living in a tub belonging to the temple of Cybele. The single wooden bowl he possessed he destroyed on seeing a peasant boy drink from the hollow of his hands. On a voyage to Aegina he was captured by pirates and sold as a slave in Crete to a Corinthian named Xenades. Being asked his trade, he replied that he knew no trade but that of governing men, and that he wished to be sold to a man who needed a master. As tutor to the two sons of Xenades, he lived in Corinth for the rest of his life, which he devoted entirely to preaching the doctrines of self-control. It was, probably, at the Isthmian games, during which he used to lecture, that he craved from Alexander the single boon that he would not stand between him and the sun, to which Alexander replied "If I were not Alexander, I would be Diogenes." On his death the Corinthians erected to his memory a pillar on which there rested a dog of Parnassus. His ethical teaching will be found in the article CYNICS (q.v.). It may suffice to say here that virtue, for him, consisted in the avoidance of all physical pleasure, that pain and hunger were positively helpful in the pursuit of goodness, that morality implies a return to nature and simplicity. Both in ancient and in modern times, his personality has appealed strongly to sculptors and to painters. Ancient busts exist in the museums of the Vatican, the Louvre and the Capitol. The interview between Diogenes and Alexander is represented in an ancient marble bas-relief found in the Villa Albani.

The chief ancient authority for his life is Diogenes Laertius vi 20, see also Mayor's notes on Juvenal, *Satires*, xiv 308-314, *Quellen-Untersuchungen zu Leben u. Philosophie des Diogenes von Sinope* (Philologia, Supplementband 18, 1916).

DIOGENES APOLLONIATES (c. 460 B.C.), Greek natural philosopher, was a native of Apollonia in Crete. Although of Dorian stock, he wrote in the Ionic dialect, like all the *physiologists* (physical philosophers). He moved to Athens, where his opinions once endangered his life. It is his theories that are ridiculed as those of Socrates in the *Clouds* (264 ff.). An eclectic in doctrine, he drew his views from many sources but his main position is a reconciliation of the theories of Anaximenes and Anaxagoras, which he achieved by taking Anaximenes' theory that air is the one source of being and attributing intelligence to it as well. His most important work was *Ἰστέφειρος* (*De natura*), of which considerable fragments are extant (chiefly in Simplicius); it is possible that he wrote also *Against the Sophists* and *On the Nature of Man*, to which the well-known fragment about the veins would belong, possibly these discussions were subdivisions of his great work.

Fragment in F. Mullach, *Fragmenta philosophorum Graecorum*, 1 (1860); F. Panzerbieter, *Diogenes Apolloniates* (1830), with philosophical dissertation, J. Burnet, *Early Greek Philosophy* (1892); H. Ritter and L. Preller, *Historia Philosophiae* (4th ed., 1869), §§ 59-68; E. Krause, *Diogenes von Apollonia* (1909).

DIOGENES LAERTIUS (or LAERTIUS DIOGENES), the biographer of the Greek philosophers, is supposed by some to have received his surname from the town of Laerte in Cilicia, and by others from the Roman family of the Laerti. Of the circum-

stances of his life we know nothing. It is probable that he flourished during the reign of Alexander Severus (A.D. 222-235) and his successors. His own opinions are equally uncertain. By some he was regarded as a Christian, but it seems more probable that he was an Epicurean. The work by which he is known deals with the lives and sayings of the Greek philosophers. Of no philosophical value itself, its interest lies in the glimpses given of the private life of the philosophers. He treats his subject in two divisions which he describes as the Ionian and the Italian schools. The biographies of the former begin with Anaximander, and end with Cleitomachus, Theophrastus and Chrysippus, the latter begins with Pythagoras, and ends with Epicurus. The Socratic school, with its various branches, is classed with the Ionic, while the Eleatics and sceptics are treated under the Italian. The whole of the last book is devoted to Epicurus, and contains three most interesting letters addressed to Herodotus, Pythocles and Menocleus. The text seems once to have been much fuller than that now in existence. In addition to the *Lives*, Diogenes was the author of a work in verse on famous men, in various metres.

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DIOGENIANUS, of Heraclea on the Pontus (or in Caria), Greek grammarian, flourished during the reign of Hadrian. He was the author of a lexicon (sometimes known as *περιερωνυμικόν* for "industrious poor students") which was perhaps abridged from the great lexicon of Pamphilus of Alexandria (fl. A.D. 50) and other similar works. It formed the basis of the lexicon of Hesychius of Alexandria, described in the preface as a new edition of the works of Diogenianus. We still possess a collection of proverbs under his name (ed. by E. Leutsch and F. W. Schneidewin in *Paroemiographi Graeci*, 1839). Diogenianus was also the author of an anthology of epigrams, of geographical treatises, and of a list (with map) of all the towns in the world.

See H. Weber, *Philol. Suppl.* III, 454 f. (1878), Bursian's *Jahresb.* xvi, 125 (1881).

DIOGNETUS, EPISTLE TO, one of the early Christian apologetes. Diognetus, of whom nothing is known, has expressed a desire to know what Christianity really means—"What is this new race" of men who are neither pagans nor Jews? "What is this new interest which has entered into men's lives now and not before?" The anonymous writer, after attacking idolatry and the ceremonialism of Judaism in the usual way, proceeds in a passage of great eloquence to show that Christians have no obvious peculiarities that mark them off as a separate race. In spite of blameless lives they are hated. Their home is in heaven, while they live on earth. "In a word, what the soul is in a body, thus the Christians are in the world. The soul is enclosed in the body, and yet itself holdeth the body together: so Christians are kept in the world as in a prison-house, and yet they themselves hold the world together." This strange life is inspired in them by the almighty and invisible God, who sent no angel or subordinate messenger to teach them, but His own Son by whom He created the universe. No man could have known God, had He not thus declared Himself. "If thou too wouldst have this faith, learn first the knowledge of the Father. For God loved men, for whose sake He made the world. . . . Knowing Him, thou wilt love Him and imitate His goodness, and marvel not if a man can imitate God: he can, if God will." By kindness to the needy, by giving them what God has given to him, a man can become "a god of them that receive, an imitator of God." No early Christian writing outside the New Testament appeals so much to modern readers. The best edition is that of Otto, *Corpus Apologeticum*, vol. ii (3rd ed. 1879), based on accurate collations of the one ms. which contained this letter and which perished by fire at Strasbourg in 1870.

See also Lightfoot, *Apostolic Fathers* (shorter edition), and (very

conveniently) Kirsopp Lake, *Apostolic Fathers*, vol. ii (in Loeb Classical Library).

DIOMEDEIDAE see ALBATROSS

DIOMEDE ISLANDS, two small adjacent islands in the Bering strait. The larger, Big Diomed, belongs to the U.S.S.R. the other, Little Diomed, is a part of Alaska. They were sighted by Vitus Berling Aug. 16, 1728.

DIOMEDES, Latin grammarian, flourished at the end of the 4th century A.D., author of an extant *ars grammatica* in three books. The third book is the most important, as containing extracts from Suetonius' *De poetis*. Diomedes wrote about the same time as Charisius (*q.v.*) and used the same sources independently.

The best edition is in H. Keil's *Grammatica Latina*, i, see also C. von Paucker, *Kleinere Studien*, i (1883), on the Latinity of Diomedes.

DIOMEDES, in Greek legend, son of Tydeus (*q.v.*), in Homer one of the bravest of the heroes of the Trojan War. In the post-Homeric story, he and Odysseus steal the Palladium, the presence of which within the walls secured Troy against capture (Virgil, *Aeneid*, ii. 164). On his return to Argos, finding that his wife had been unfaithful, he removed to Aetolia, and thence to Daunia (Apulia), where he married the daughter of King Daunus. He was burned or mysteriously disappeared on one of the islands in the Adriatic called after him Diomedea, where his companions were turned into birds (Ovid, *Metam.* xiv. 457 ff.). He was worshipped as a hero in Greece, and on the coast of the Adriatic.

DION (408-354 B.C.), tyrant of Syracuse, the son of Hipparchus, and brother-in-law of Dionysius the Elder. He was a friend of Plato, who had visited the court of the elder Dionysius, and whom Dion now summoned to teach the theory of government to Dionysius' son. But the historian Philistus set Dion at variance with the tyrant, and procured his banishment on a charge of intriguing with the Carthaginians. Dion remained awhile at Athens, but in 357, assembling a small force at Zacynthus, he sailed to Sicily and was received with demonstrations of joy. Dionysius, who was in Italy, returned to Sicily, but was defeated and obliged to flee. Dion himself was soon after banished through the intrigues of Heracleides (356). But the incompetence of the new leader soon led to Dion's recall, Heracleides submitted, and soon afterwards the supporters of Dionysius surrendered. Dion retained the tyranny, but in 354 he was assassinated by Callippus, an Athenian who had accompanied him in his expedition.

See *Lives* by Plutarch and Cornelius Nepos (*cf.* *Diod. Sic.* xvi. 6-20) and in modern times by T. Lau (1860), Freeman, *History of Sicily* (vol. iv) (1894), and *Camb. Anc. Hist.*, vol. vi, ch. x with bibliography, see also SYRACUSE and SICILIA. *History*.

DIONAEA, see VENUS'S FLY-TRAP

DIONE, cult partner of Zeus of Dodona (Strabo vii. 329). As the partner and wife of Zeus is normally Hera, Dione was variously described in the *Iliad* (v. 370) as mother by Zeus of Aphrodite, in Hesiod (*Theog.* 353) as a daughter of Oceanus.

DIONNE, NARCISSE EUTROPE (1848-1917), Canadian author and librarian, was born at Saint-Denis de la Beaulieu. He studied at St. Anne's college, at the Quebec grand seminary and at Laval university, where he graduated in medicine. He became editor of *Le Courrier du Canada* and then of *Le Journal de Québec*, and in 1892 chief librarian of the Quebec legislature. He has published *Jacques Cartier* (1889), *La Vie de C. F. Panhard* (1894), *Les ecclésiastiques et les royalistes français réfugiés au Canada à l'époque de la révolution, 1791-1802* (1905), *Champlain* (1905), *Québec et Nouvelle France* *Bibliographie* (4 tom., 1905-12), and in the *Galerie Historique* series of 1910 his chief studies are *Chouart et Radisson*, J. Richard, *Sulpicien, Mgr de Forbin-Janson, Sainte-Ame de la Pocatière and Pierre Bédard*.

DIONNE QUINTUPLETS, five phenomenal daughters of Olva and Elzire Dionne, born near Callander, Ontario, May 28th, 1934. The attending physician was Dr. Allan Darfoe. These children, weighing collectively but 11½ pounds six days after their premature birth, were rescued from the hazards and handicaps of freak exploitation by the Government of Ontario, which made them King's wards. Against all precedent, the five continued to thrive through childhood. See plate, TWINS and TWINNING.

DIONYSIA, festivals of Dionysus (*qv*). These were numerous and widespread, the most famous being those of Attica, which were (1) the Little or Rustic Dionysia, a festival held in various country places in the month Poseideon (December), characterized by simple, old-fashioned rites, (2) the Lenaia ("festival of Maenads"), in the following month, Gamelion, held at Athens, the chief rites were a festal procession and dramatic performances at the theatre of Dionysus, (3) the Anthesteria (*qv*), in the next month, Anthestherion, (4) The Great or City Dionysia, in Elaphebolion (about the end of March), also accompanied by dramatic performances (see **DRAMA**), and the most famous of all, (5) the Oschophoria ("Carrying of Grape clusters"), in Pyanepsion (about the end of October). The times and what we know of the ritual of these festivals show them to have been originally rites of a kind common in the worship of gods of fertility.

See A. Mommsen, *Feste d. Stadt Athen* (1898), L. R. Farnell, *Cults of the Greek States* (1896-1919) v, ch vi.

DIONYSIUS, pope from 259 to 268. To Dionysius fell the task of reorganizing the Church after the persecution of Valerian. At the protest of some of the faithful at Alexandria, he demanded from their bishop (also called Dionysius) explanations touching his doctrine. He died on Dec. 26, 268.

DIONYSIUS (c. 432-367 B.C.), tyrant of Syracuse, began life as a clerk in a public office, but took advantage of war with Carthage to seize the tyranny (405). The next eight years were spent in strengthening his power. He fortified Epipolae (402), defeated his political opponents, and removed the Greek citizens of Naxos, Catania, and Leontini, handing the cities over to foreign mercenaries and Sikels. His first Punic War (397-396), during which the Greeks besieged Motya, and the Carthaginians Syracuse, ended with a notable victory, and Carthage's power in Sicily was confined to the north-west. His second war in 392 was ended by a treaty greatly in his favour. After 390 he led an expedition against Rhegium and its allied cities in Magna Graecia. In one campaign in which he was joined by the Lucanians, he devastated the territories of Thurii, Croton, and Locri. After a protracted siege he took Rhegium (386), thus making himself the chief power in Greek Italy. At the next Olympic festival (384), whither he sent a splendid embassy, the Athenian Lysias attacked him in a speech (Or. 33) and the crowd pillaged the tents of his envoys.

His third Punic War (383-378) proved disastrous, he suffered a crushing defeat and was obliged to pay an indemnity of 1,000 talents and cede to Carthage the territory west of the River Halykas. He was engaged in another war against Carthage when he died. He had friendly relations with the Spartans, whom he assisted more than once with mercenaries, and two inscriptions record his alliance with Athens (369-367). The success of his tragedy at the Lenaia (369) is probably to be connected with this friendship, though he had frequently competed at Athens he had never till now won a first prize. Dionysius reigned 38 years, and was succeeded by his son Freeman says of him "He had destroyed the freedom of his native city, but he had made it both the greatest city and the greatest power in Europe" (See **SICILY** and **SYRACUSE**).

See Dioid Sic. xlii, xiv, xv (the earlier part based on Philistus, Dionysius' friend and contemporary), Freeman *Hist. of Sicily* (Vols. iii and iv) (Oxford, 1894), *Comp. Anc. Hist.* Vol. vi ch. v, with bibliography, J. Basle *Dionysius I. von Syrakus* (Vienna, 1881), with full refs. to authorities.

His son **DIONYSIUS**, known as "the Younger," succeeded in 367 B.C. He was driven from the kingdom by Dion (356) and fled to Locri; but during the commotions which followed Dion's assassination, he managed to make himself master of Syracuse. On the arrival of Timoleon he was compelled to surrender and retire to Corinth (343) (Diodorus Siculus, xvi, Plutarch, *Timoleon*).

See **SYRACUSE** and **TIMOLEON**, and, on both the Dionysii, arts by B. Niese in Pauly-Wissowa's *Realencyklopädie*, v pt I (1905).

DIONYSIUS AREOPAGITICUS (or "The Areopagite"), named in Acts xvii. 34 as one of those Athenians who believed when he had heard Paul preach on Mars Hill. Beyond this men-

tion our only knowledge of him is the statement of Dionysius bishop of Conon (fl. 171), recorded by Eusebius (*Church Hist.* iii. 4, iv. 23), that this same Dionysius the Areopagite was the first "bishop" of Athens. Some hundreds of years afterwards his name was attached to a number of anonymous theological writings of unknown origin. These were destined to exert enormous influence on mediaeval thought, and their form led to a great development of the personal legend of the original Dionysius (see for example, "The Life and Passion of the Most Holy Dionysius," by Hilwin, abbot of St. Denis, printed in Migne, *Patrologia Latina*, vol. 106).

The author, date and place of composition of these writings are alike unknown. External evidence precludes a date later than 500, the internal evidence from the writings themselves precludes any date prior to 4th-century phases of Neo-platonism, while the first certain dated reference to them is at the Council of Constantinople in 533. The extant writings of the Pseudo-Areopagite are (a) *Περὶ τῆς οὐρανίας λειτουργίας*, Concerning the Celestial Hierarchy, in 15 chapters, (b) *Περὶ τῆς ἐκκλησιαστικῆς λειτουργίας*, Concerning the Ecclesiastical Hierarchy, in 7 chapters, (c) *Περὶ βέλων ἐνοχλῶν*, Concerning Divine Names, in 13 chapters, (d) *Περὶ Μυστικῆς Θεολογίας*, Concerning Mystic Theology, in five chapters, (e) ten letters addressed to various worthies of the apostolic period. They are all of great interest, first as a striking presentation of the heterogeneous elements that might unite in the mind of a gifted man in the 5th century, and secondly, because of their enormous influence upon subsequent Christian theology and art. Their ingredients—Christian, Greek, Oriental and Jewish—are united into an organic system, not crudely mingled. Perhaps theological philosophic fantasy has never constructed anything more remarkable. The system of Dionysius was a proper product of its time—lofty, and apparently complete.

His constructive principles the writer owed to Hellenism in its last great philosophical creation, Neo-platonism, since the general principle of the transmission of life from the ultimate Source downward through orders of mediating beings unto men might readily be adapted to the Christian God and his ministering angels. Pseudo-Dionysius had lofty thoughts of the sublime transcendence of the ultimate divine Source. That Source was not remote or inert, but a veritable Source from which life streamed to all lower orders of existence,—in part directly, and in part indirectly as power and guidance through the higher orders to the lower. Life, creation, every good gift, is from God directly, but his flaming ministers also intervene to guide and aid the life of man, and the life which through love floods forth from God has its counterflow whereby it draws its own creations to itself. God is at once absolutely transcendent and universally immanent. To live is to be united with God, evil is the non-existent, that is, severance from God.

The transcendent Source, as well as the universal immanence, is the Trine God. Between that and men are ranged the three triads of the celestial hierarchy: Seraphim, Cherubim and Thrones, Dominations, Virtues, Powers, Principalities, Archangels, Angels. Collectively their general office is to raise mankind to God through purification, illumination and perfection, and to all may be applied 'the term angel. The highest triad, which is nearest God, contemplates the divine effulgence, and reflects it onward to the second, the third, and more specifically angelic triad, immediately ministers to men. The sources of these names are evident: seraphim and cherubim are from the Old Testament, later Jewish writings gave names to archangels and angels, who also fill important functions in the New Testament. The other names are from Paul (Eph. i. 21, Col. i. 16).

Such is the system of Pseudo-Dionysius, as presented mainly in *The Celestial Hierarchy*. That work is followed by *The Ecclesiastical Hierarchy*, its counterpart on earth. What the primal Trine Godhead is to the former, Jesus is to the latter. The ecclesiastical hierarchy likewise is composed of triads. The first includes the symbolic sacraments: Baptism, Communion, Consecration of the Holy Chism. Baptism signifies purification, Communion signifies enlightening, the Holy Chism signifies perfecting. The second is made up of the three orders of Bishops, Presbyters and

of a *Chronicle* narrating the history of the world from the creation to the year AD 774-775, but on the completion of its publication by M. Chabot in 1895, Noldeke (*Vienna Oriental Journal*, x, 160-170), and Nau (*Bulletin critique*, xvi, 321-327), clearly proved that the chronicle was the work not of Dionysius but of an earlier writer, a monk of the convent of Zukin near Amid (Diarbekr) on the upper Tigris. Though the author had limited intelligence and little historical skill, the last part of his work has considerable value as a contemporary account of events during the middle of the 8th century.

See W. Wright, *Hist. of Syriac Literature* (1894), and Chabot's introduction to his translation of pt. iv of the *Chronicle*.

DIONYSIUS THRAX (so called because his father was a Thracian), the author of the first Greek grammar, flourished about 100 B.C. He was a native of Alexandria, where he attended the lectures of Aristarchus, and afterwards taught rhetoric in Rhodes and Rome. His grammar, which we possess (though probably not in its original form), begins with the definition of grammar and its functions. Dealing next with accent, punctuation marks, sounds and syllables, it goes on to the eight parts of speech and their inflections. No rules of syntax are given, and nothing is said about style. The authorship of Dionysius was doubted in the middle ages, and in modern times its origin has been attributed to the occasional college founded by Constantine the Great, which existed until 730. But there seems no reason for doubt, that the great grammarians of imperial times (Apollonius Dyscolus and Herodian) knew the work in its present form, although additions and alterations may have been made later. Dionysius also wrote commentaries on Homer and Hesiod and various other works, including an account of Rhodes, and a collection of *Météora* (literary studies), to which the considerable fragment in the *Stromata* (v. 8) of Clement of Alexandria probably belongs. The grammar, first edited by J. A. Fabricius from a Hamburg ms., was published in his *Bibliotheca Graeca*, vi (ed. Hales). An Armenian translation, belonging to the 4th or 5th century, containing five additional chapters, was published with the Greek text and a French version, by M. Ciriébe (1830).

Editions, with scholia, by I. Bekker in *Anecdota Graeca*, v and G. Uhlig (1884), reviewed exhaustively by P. Egenolf in *Bursian's Jahresbericht*, vol. xlv (1888); Scholia, ed. A. Hilgard (1901), *Engl. transl.* J. Davidson, 1874, see also W. W. Goodwin, *De Dionysii Thracis interpretibus veteribus* (1874); J. E. Sandys, *Hist. of Classical Scholarship*, i (1906).

DIONYSUS, in Greek mythology originally a nature god of fruitfulness and vegetation, especially of the vine, hence, dissonately, the god of wine. [Gr. *Διόνυσος*, *Διόνυσος*, Thracian, *Ζώνησις*, Phrygian, *Διόνυσος* etymology doubtful, *Διόν*, name of Thracio-Phrygian god resembling Zeus, *νύξ*, possibly akin to Lat. *nux*, Gr. *νύξ*, and may mean "child" or "son", hence perhaps "son of God".] The names Bacchus (*Βάκχος*), in use among the Greeks from the 5th century), Sabazus, and Bassareus, are also Thracian names of the god. All are of doubtful significance, for various interpretations of these and other cult-titles see O. Gruppe, *Griechische Mythologie*, ii, pp. 1408, 1534, especially the notes.]

There seems little doubt that he is a Thracio-Phrygian deity, introduced into Greece from Thracian or possibly from both Thracian and Phrygia, and blending with the local gods of similar character, e.g., *Iacchus* at Eleusis. In Homer, notwithstanding the frequent mention of the use of wine, *Dionysus* is never mentioned as its inventor or introducer, nor does he appear in Olympus. Hesiod is the first who calls wine the gift of Dionysus. On the other hand, he is called *οἰνός* in the *Iliad* (vi, 136, 191), at "Bacchus" in *Odyssey* (xv, 191) but already the orgiastic character of his worship was introduced in his native country. His worshippers sought to become possessed by his assumed to him by wild dancing and perhaps the use of intoxicants. In Greece, this was practised down to the time of the Peloponnesian war, but he was born at Thebes and was the son of Zeus and Semele, the daughter of Cadmus. Before the child was mature, Zeus appeared to Semele, whose name is simply the Phrygian for "earth" (*Γῆ*), and her request in his name, as god of lightning, by which he was killed, took him up, enclosed him within his oak leaf (for *κλυτὸν ἔρπον*), and then brought him to the light, so that he was fully mature, born, an allusion to this was found in the word *κλυτὸν ἔρπον*, a name of the god and of a hymn in his honour, which perhaps is really to be connected with Phrygian *cliternu*, a tomb. (See Calder in

Class. Rev., xxvii, p. 11, ff. xlv, p. 161 ff.) Dionysus was then conveyed by Hermes to be brought up by the nymphs of Nysa, a purely imaginary spot. As soon as Dionysus was grown up, he started on a journey through the world, to the cultivation of the vine and spread his worship among men. While so engaged he met with opposition, even in his own country, as in the case of Pentheus, king of Thebes, who opposed the orgiastic rites introduced by Dionysus among the women of Thebes, and, having been discovered watching one of these ceremonies, was mistaken for some alien of the chase, and slain by his own mother. A similar instance is that of Lycurgus a Thracian king, from whose attack Dionysus saved himself by leaping into the sea, where he was kindly received by Thetis. Lycurgus was blinded by Zeus and soon died, or became triumphal and bowed down his own son, mistaking him for a vine. At Orchomenus, the three daughters of Minyas refused to join the other women in their nocturnal orgies, and for this were transformed into birds. (See *AGRIOTIA*.) These and similar stories may point to the vigorous resistance offered to the introduction of the mystic rites of Dionysus or to some ceremony in which the god, or a priest representing him, was killed and probably brought to life again. See below. On the other hand, when the god was received hospitably he repaid the kindness by the gift of the vine, as in the case of Icarus of Attica. (See *DIOSKOTRI*.)

The worship of Dionysus continued to flourish in Asia Minor, particularly in Phrygia and Lydia. His cult is closely associated with that of numerous Asiatic deities, as Sabazus (*qv*), and from the time of Alexander, he appears as conqueror of India. The other incidents in which he appears in a purely triumphal and heroic way, his transforming into dolphins the Tyrrhenian pirates who attacked him, and his part in the war of the gods against the giants. The adventure with the pirates occurred on his voyage to Naxos, where he found Ariadne abandoned by Theseus. At Naxos Ariadne (probably a Cretan mother goddess) was associated with Dionysus as his wife, and their marriage was annually celebrated by a festival. Having compelled all the world to recognize his divinity, he descended to the underworld to bring up his mother. Like most deities connected with vegetation, Dionysus, at least in Thracian, died and rose again. This is reflected principally in Orphic mythology, not in normal Greek belief. Zeus had by Persephone a wonderful child Zagreus. He was brought up secretly, watched over by Curetes, but the jealous Hera discovered where he was, and sent Titans to the spot, who, finding him at play, tore him to pieces, and cooked and ate his limbs. When Athena gave his heart to Zeus. This myth is probably to be connected with the savage rite of *omophagia* (eating of raw flesh) in the worship of Dionysus, in which a victim, perhaps originally human in some cases, incarnating the god, was torn to pieces and ceremonially eaten raw. It is variously reconciled with the tale of Semele. (See also *TRAI*.)

Dionysus further possessed the prophetic gift, and at Delphi was received by the priesthood of Apollo on almost equal terms. His followers included spirits of fertility, as the satyrs, and in his ritual the phallus was prominent. He often takes bestial shape, and is associated with the panther, the lion, the snake, the tiger, the ass, the goat, and sometimes also the dolphin. His personal attributes are an ivy wreath, the thyrsus (*qv*), and the kantharos, a large two-handled goblet. His later representations in art show a youth of soft, nearly feminine form, occasionally an infant, but the earlier type is a bearded man. His title *Dendrites* ("he of the tree") arises most probably from his functions as a god of the productivity of nature, not of the vine only. For the connection of Dionysus with Greek tragedy see *DRAMATICA*.

BIBLIOGRAPHY.—See Farrall, *Cults of the Greek States*, v (1910); J. E. Harrison, *Prolegomena to the Study of Greek Religion* (1903); Sir J. G. Frazer, *Golden Bough*, 3rd ed. see index v. P. A. Vogt in Roscher's *Lexikon der Mythologie*, L. Preller, *Griechische Mythologie* (4th ed. by C. Robert), F. Lenormant, (*qv* "Bacchus") in Daremberg and Saglio's *Dictionnaire des antiquités*, O. Kern in Pauly's *Realencyclopädie* (1897) (with list of cult titles); E. Rohde, *Psyche*, 4th ed. v. 103 ff. O. Gruppe, *Griechische Mythologie und Religionsgeschichte*, ii (1907). For a striking survival of Dionysus rites in Thracian (Buzze), see Dawkins, in *J. H. S.* (1906), p. 191.

DIOPHANTINE EQUATIONS or **DIOPHANTINE ANALYSIS**, is the name given to that branch of the Theory of Numbers which treats the problem of finding the solutions, in whole numbers (integers) or rational fractions, of one or more conditional algebraic equations whose coefficients are rational. For example, the problem of finding the whole numbers x and y satisfying $x^2 + y^2 = 20$ is a Diophantine problem and this equation is called Diophantine. Our topic takes its name from the Greek mathematician Diophantus who probably flourished about the middle of the 3rd century AD. He treated a number of problems such as the following to find three rational numbers such that the product of any two added to the sum of these two gives a square, to find three squares such that their continued product added to any one of them gives a square.

Following our definition of it, the subject really includes much material from a number of topics in the theory of rational integers, usually discussed separately, such as *Waring's Theorem*, the *Theory of Congruences*, the *Theory of Quadratic and Higher Forms* (see *NUMBERS, THEORY OF*). In view of this it is not to be confined ourselves here to the consideration of the parts of our subject which have not been so definitely classified.

Diophantus solved the problem of finding formulas giving all the right triangles whose sides are integral. To obtain these we may reason as follows. Let the triangle have the sides x, y and z , then we are to find an expression for all the positive integers which satisfy

$$(1) \quad x^2 + y^2 = z^2$$

It may be shown that the formulas

$$(2) \quad x = 2kn, \quad y = k(m^2 - n^2), \quad z = k(m^2 + n^2)$$

where k is an arbitrary positive integer, give all the positive integral solutions of (1).

A generalization of (1), namely the equation

$$x^{2n} + y^{2n} = z^{2n}$$

$n > 2$, has received a great deal of attention (see FERMAT'S LAST THEOREM).

A particular topic in Diophantine Analysis which is now generally referred to as the theory of quadratic forms, treats, by the use of linear transformation, the problem of solving the equation

$$ax^2 + bxy + cy^2 = m,$$

in integers x and y for a, b and c given integers. (See NUMBERS, THEORY OF.)

Continued fraction methods are also known for expressing a prime p in the form $x^2 + ny^2$, $m > 0$, for various classes of values of p and m . Such a method was first derived by Adriaen M. Legendre (1824) for $m = x$ and $p = x(4x + 1)$.

We now consider homogeneous quadratic equations. Using Joseph L. Lagrange's results on $x^2 - Dy^2 = m$, Legendre (1768) found the elegant result that if each of the positive integers a, b and c has no square factor, no two have a common factor and if there exist integers λ, μ, ν such that

$$\frac{a\lambda^2 + b}{c}, \quad \frac{a\mu^2 - b}{c}, \quad \frac{c\nu^2 - a}{c}$$

are all integers then $ax^2 + by^2 = cz^2$ has integral solutions not all zero and if the three conditions are not all satisfied then there are no integral solutions. Adolph Mayer (1884) gave a criterion that

$$(4) \quad ax^2 + by^2 + cz^2 + dw^2 = 0$$

with a, b, c and d integers none zero, without square factors and such that no three have a common factor, has solutions in integers. He also arrived at the result that

$$(5) \quad ax^2 + by^2 + cz^2 + dw^2 + ew^2 = 0$$

is solvable in integers not all zero if the coefficients are odd and not all of the same sign. L. E. Dickson (1930) noted that Mayer's arguments concerning (4) and (5) were not complete. Thanks to his contributions (1930, 1935) and those of H. Hasse (1933) and L. J. Mordell (1931) the complete criteria for the solution of (4) for any nonzero integers a, b, c, d has been obtained. Also Dickson (1930) gave the first complete proof that (5) is always solvable in integers if not all the nonzero integers a, b, c, d , and e are of like sign. Hasse (1933) obtained a number of elegant results concerning quadratic Diophantine equations by the use of Congruences. An example is the theorem that the equation is solvable in integers if and only if

$$\sum a_i, x_i, z_i \equiv 0 \pmod{M}$$

is properly solvable for all integers M . In this statement the term properly solvable means that $(x_i, M) = 1$ for each i . E. T. Bell (1933) and Morgan Ward (1935) gave, when any point, all the solutions of

$$A_1 x_1^{a_1} x_2^{a_2} \dots x_n^{a_n} = B, \quad y_1^{b_1} y_2^{b_2} \dots y_k^{b_k}$$

In parametric form.

The Skolem (1938) gave a number of applications of the theory of Algebraic Numbers (see NUMBERS, THEORY OF) to Diophantine problems. In this connection he examined the equation

$$(6) \quad N(\alpha x_1 + \dots + \alpha_n x_n) = a$$

where the α_i are integers in an algebraic field K of degree n and $N(\omega)$ denotes the norm of ω in K , a being a rational integer, and treats by the use of units in K the problem of finding other sets of solutions of (6), having given one set, as well as methods for determining if any set exists.

It is clear that if we have any Diophantine equation and we know all its rational solutions, then these solutions will include all the integral solutions. However, Dickson (1920) pointed out many cases in the literature where formulas had been given for finding all the rational solutions of equations and no method had been supplied for picking out any integral ones. In view of this he considered the problem of finding the integral solutions of

$$(7) \quad ax^2 + bxy + cy^2 = m$$

in integers x, y, w, z , m with a, b and c given integers, and gave a complete solution. Generalizations to forms of any degree were obtained by Wahlen (1924) and Skolem (1938). The special case of (7) namely

$$ax^2 + bxy + cy^2 = x^n$$

has been treated by many writers. Lagrange (1766) and Euler (1770) obtained an infinitude of solutions of

$$(8) \quad x^2 - my^2 = z^n$$

with m an integer. Morgan Ward (1935) applied the theory of quadratic algebraic fields to (8) and gave a set of formulas for its complete solution.

Considerable literature has resulted from the examination of equations of the type

$$f(x, y) = c$$

where $f(x, y)$ is a polynomial in x and y with integral coefficients and c is an integer $\neq 0$. These developments seem to have had their beginning in the work of C. Runge (1887), who proved, more, other results the following one. "Let $f(x, y)$ be a polynomial with integral coefficients irreducible in the rational field, the homogeneous part of f of highest degree not being the power of an irreducible polynomial. Then $f(x, y) = c$ has only a finite number of solutions in rational integers." This was followed by the work of A. Thue (1900) who proved the following celebrated theorem. "If $f(x, y)$ is a homogeneous polynomial with integral coefficients, irreducible in the field of rational numbers and of degree > 2 , and c is an integer $\neq 0$, then $f(x, y) = c$ has only a finite number of integral solutions." In view of the above results we may consider

$$f(x_1, x_2, \dots, x_n) = c$$

where f is a homogeneous polynomial in x_1, x_2, \dots, x_n with integral coefficients, of degree n and irreducible in the rational field c being an integer. We know from the theory of units in an algebraic field that for $k = n$ and $c = 1$ there exist equations of this type with an infinity of integral solutions. On the other hand, if $k = 2$, $n > 2$, Thue's theorem states that there cannot be more than a finite number of solutions. An interesting question is, how far must k be increased to obtain equations of this type with an infinity of solutions? If $n = 3$ we have $k = 3$. Related to this is a conjecture which Euler (1772) made, and which amounts to a generalization of Fermat's Last Theorem. He stated that, in his opinion, the equation

$$(9) \quad x_1^n + x_2^n + \dots + x_n^n = y^n$$

has no integral non-zero solutions for $r < k < n$. The particular case $n = 2$ has been much studied. For $k = 2$ it is known that there are no such solutions, for $k = 4$ some solutions have been found but for the difficult case $k = 3$ we as yet (1946) cannot say whether or not solutions exist. Ward (1945) proved that there is no non-zero solution of (9) with $k = 3$, $n = 4$ and $y < 10000$.

The problem of finding rational solutions of certain types of equations has been successfully attacked by the use of geometric methods. This is often expressed as the problem of finding the rational points on a curve or surface. The curves

$$f(x, y) = 0 \text{ or } f(x, y, z) = 0$$

in homogeneous co-ordinates, are classified for arithmetical purposes according to their genus (see Curve), the coefficients of the equations being integral. Two curves are called equivalent when they are connected with each other by a birational transformation with rational coefficients. Thus two curves

$$f_1(x, y, z) = 0, \quad f_2(x, y, z) = 0$$

are equivalent if the co-ordinates x, y, z are rationally expressible with rational coefficients in terms of ξ, η , and conversely. If a curve is of genus zero, it was shown by David Hilbert and A. Hurwitz (1890) and Jules H. Poincaré (1901) that it is equivalent to a straight line or a conic, from which the theory of the rational points on the original curve is easily derived.

For a curve of genus unity, Poincaré (1901) also proved that if it has a rational point, it is equivalent to a curve of the third degree, and, in particular, the cubic is equivalent to a curve whose equation can be written in the Weierstrass normal form

$$(10) \quad y^2 = 4x^3 - g_2x - g_3$$

The latter statement was proved by Mordell in 1912. Poincaré (1901) and A. Hurwitz (1917) noted that the equation (10) could be given in parametric form by the use of Weierstrass' elliptic p functions (see ELLIPTIC FUNCTIONS) so that

$$(11) \quad x = p(u), \quad y = p'(u)$$

It was proved by Mordell (1922) with the use of those ideas that all the rational points on (10) could be found from a finite number of rational points, so that, using (11), if u_1, u_2, \dots, u_n satisfy (10) then all rational points are given by $m_1u_1 + m_2u_2 + \dots + m_nu_n$ where the m_i are integers.

Quite recently the subject of the rational solutions of cubic ternary equations has been extensively investigated and general results obtained, by the use of both geometric and algebraic methods. B. Serre (1943) took up this type of problem using geometric ideas, and proved that if $f(x, y, z)$ is a given cubic polynomial in x, y, z with rational coefficients which is not expressible as a polynomial in a single linear function of x and y , the equation

$$z^2 = f(x, y)$$

has an infinity of solutions in x, y and z . From this he showed that an indeterminate ternary cubic equation which cannot be reduced to an equation involving less than three variables has either no rational solution or an infinity of rational solutions, and each case is possible. Mordell (1943) obtained similar results using algebraic methods exclusively.

In spite of the fact that our subject has been attacked by some of the most powerful weapons known to analysis, geometry and abstract algebra, it contains vast domains which have hardly been touched by investigators, and offers great opportunities for a mathematical pioneer.

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DIOPHANTUS, of Alexandria, Greek algebraist, probably flourished about the middle of the 3rd century. Not that this date rests on positive evidence. But we gather from a passage of Michael Psellus (*Diophantus*, ed P. Tannery, II, p. 38) that he was not later than Anatolius, bishop of Laodicea from AD 270, while he is not quoted by Nicomachus (fl. c. AD 100), nor by Theon of Smyrna (c. AD 130), nor does Greek arithmetic as represented by these authors and by Iamblichus (early 4th century) show any trace of his influence, facts which can only be accounted for by his being later than those arithmeticians at least who would have been capable of understanding him fully. On the other hand he is quoted by Theon of Alexandria (who observed an eclipse at Alexandria in AD 356), and his work was the subject of a commentary by Theon's daughter Hypatia (d. 415). The *Arithmetica*, the great treatise on which the fame of Diophantus rests, purports to be in 13 books, but none of the Greek mss which have survived contain more than six (though one has the same text in seven books). They contain, however, a fragment of a separate tract on *Polygonal Numbers*. The missing books were apparently lost early, for there is no reason to suppose that the Arabs who translated or commented on Diophantus ever had access to more of the work than we now have. The difference in form and content suggests that the *Polygonal Numbers* was not part of the larger work. On the other hand the *Porisms*, to which Diophantus makes three references ("we have it in the *Porisms* that..."), were probably not a separate book, but were embodied in the *Arithmetica* itself, whether placed all together or spread over the work in appropriate places. The "*Porisms*" quoted are interesting propositions in the theory of numbers, one of which was clearly that the difference between two cubes can be resolved into the sum of two cubes.

Among the great variety of problems solved are problems leading to determinate equations of the first degree, in one, two, three or four variables, to determinate quadratic equations and to determinate equations of the first degree in one or more variables, which are, however, transformed into determinate equations by arbitrarily assuming a value for one of the required numbers, Diophantus being always satisfied with a rational, even if fractional, result, and not requiring a solution in integers. But the bulk of the work consists of problems leading to indeterminate equations of the second degree, and these universally take the form that one or two (and never more) linear or quadratic functions of one variable x are to be made rational square numbers by finding a suitable value for x . A few problems lead to indeterminate equations of the third and fourth degrees, an easy indeterminate equation of the sixth degree being also found. The general type of problem is to find two, three or four numbers such that different expressions involving them in the first and second, and sometimes the third, degree are squares, cubes, partly squares and partly cubes, etc., e.g., to find three numbers such that the product of any two added to the sum of those two gives a square (III 13), to find four numbers such that, if we take the square of their sum $+ 4$ or $- 4$ or any one of them singly, all the resulting numbers are squares (III 19), to find 10 numbers such that their product ± 1 or $- 1$ is a square or a cube (IV 23), to find three squares such that their product ± 1 is equal to any one of them singly, or to any one of them squared (V 21). Book VI contains problems of finding rational or integral solutions to such that different functions of the parts (the sides and the area) are squares. A word is necessary on Diophantus's notation. He has only one symbol (written somewhat like a final sigma) for an unknown quantity, which he calls *anagoge* (defined as "an undetermined number of units"), the symbol may be a contraction of the initial letters $\alpha, \beta, \gamma, \delta, \epsilon, \zeta, \eta, \theta, \iota, \kappa, \lambda, \mu, \nu, \xi, \omicron, \pi, \rho, \sigma, \tau, \upsilon, \phi, \chi, \psi, \omega$, etc., are used for the powers of the unknown (δ for x^2 , ϵ for x^3 , etc.), $\alpha, \beta, \gamma, \delta, \epsilon, \zeta, \eta, \theta, \iota, \kappa, \lambda, \mu, \nu, \xi, \omicron, \pi, \rho, \sigma, \tau, \upsilon, \phi, \chi, \psi, \omega$, etc., are used for the powers of the unknown (δ for x^2 , ϵ for x^3 , etc.), $\alpha, \beta, \gamma, \delta, \epsilon, \zeta, \eta, \theta, \iota, \kappa, \lambda, \mu, \nu, \xi, \omicron, \pi, \rho, \sigma, \tau, \upsilon, \phi, \chi, \psi, \omega$, etc., are used for the powers of the unknown (δ for x^2 , ϵ for x^3 , etc.). The only algebraic symbol is A for $\frac{1}{x}$, plus being expressed by merely writing terms one after another. With one symbol for an unknown, it will easily be understood that "equation" is not a direct assumption, for the required number, or expression, in the one unknown which are at once seen to satisfy some of the conditions, leaving only one or two to be satisfied by the particular value of x to be determined. Often assumptions are made which leave equations in x which cannot be solved "rationally," i.e., would give negative, surd or imaginary values, Diophantus then traces how each element of the equation arose and formulates the auxiliary problem of determining how the assumptions must be corrected so as to lead to an equation (in place of the "impossible" one) which can be solved rationally. Sometimes his has to do duty twice, for different unknowns, in one problem. In general his object is to reduce the final equation to a simple one by making such an assumption for the side of the square or cube to which the expression in x is to be equal as

will make the necessary number of coefficients vanish. The book is valuable also for the propositions in the theory of numbers, other than the "*porisms*," stated or assumed in it. Thus Diophantus knows that no number of the form $8n+7$ can be the sum of three squares, "it must be so added" (i.e., no number of the form $8n+3$, or $4n-1$, can be the sum of two squares), and goes on to add, practically, the condition stated by Fermat, "and the double of it increased by one when divided by the greatest square which measures it must not be divisible by a prime number of the form $4n-1$," except for the omission of the words "when divided by measures it".

BIBLIOGRAPHY.—The first to publish anything on Diophantus in Europe was Rafael Bombelli, who embodied in his *Algebra* (1572) all the problems of Books I-IV and some from Book V interspersing them with his own problems. Next Xylander (Wilhelm Holzmann) published a Latin translation (Basle, 1575), an altogether meritorious work, especially having regard to the difficulties he had with the text of his ms. The Greek text was first edited by C G Bachet (*Diophanti Alexandrini arithmeticonum libri sex, et de numeris multilinguis liber unus, nunc primum graece et latine editi, aique absolutissimis commentariis illustrati*, Lutetiae Parisiorum MDCXXI). A reprint of 1670 is valuable because it contains Fermat's famous notes, so far as the Greek text is concerned it is much inferior to the other editions. There are two German translations, one by Otto Schulz (1882) and the other by G Wertheim (Leipzig, 1890), and an English edition in modern notation (T L Heath, *Diophantus of Alexandria: A Study in the History of Greek Algebra* (Cambridge 1885 second edition 1910). The Greek text has now been definitively edited (with Latin translation, scholia, etc.) by Tannery (Gauthier, 1893, 1894, 1895). General accounts of Diophantus's work are vol. 1 1893, vol. 2 1893. General accounts of Diophantus's work are to be found in the histories of mathematics and in Pauli Wissowa, more elaborate analyses are those of Nesselmann (*Die Algebra der Griechen*, 1842) and G Loria (*Lo scienze esatte nell' antica Grecia*, 1914, pp. 845-919) (T L H).

DIOPSIDE, an important member of the pyroxene (q_2) group of rock-forming minerals.

DIOPTR. A unit of measurement used in optics to measure the power of a lens or lens system. The power of a lens is the reciprocal of its focal length, and when the focal length is expressed in metres the power of the lens is in dioptries. Thus a lens whose focal length is one metre has a power of one diopter, a lens of focal length 50 cm (½ metre) a power of 2 dioptries, a lens of focal length 2 metres ½ diopter and so on. (See Lenses.)

DIORITE, the name given by R J Haüy to a family of rocks of granitic texture, composed of plagioclase feldspar and hornblende. Since they are richer in the dark-coloured ferromagnesian minerals, they are usually gray or dark gray and have a higher specific gravity than granite. They also rarely show visible quartz. But there are diorites of many kinds, since the name applies rather to a family of rocks than to a single species. Some contain biotite, others augite or hypersthene, many have a small amount of quartz. Orthoclase is rarely entirely absent, and when it is common the rock becomes a monzonite. It is rare to find the pure types of "hornblende diorite," "augite diorite," etc., but in most cases the rocks contain two or more ferromagnesian silicates, and such combinations as "hornblende-biotite diorite" are commonest in nature.

The feldspar of the diorites ranges, in composition, from oligoclase to labradorite and is often remarkably zonal, the external layers being more alkaline than the internal. Small fluid inclusions and black grains probably from oxides often occur in it in great numbers. Weathering produces epidote, calcite, sericite and kaolin. The matrix is always brown or yellow, the hornblende usually green, but sometimes brown or yellowish brown. In those diorites which have a fine texture to the amphibophyllite. The hornblende usually has a reddish tinge, brownish and hypersthene have their usual green and brown shades. Epidote iron oxides and zircon are almost invariably present. Spinel, garnet and orthite are occasionally observed, calcite, chlorite, monzonite, beryl, epidote and biotite are secondary. The structure is not essentially different from that of granite. The ferromagnesian minerals crystallize comparatively early and have some idiomorphism, the feldspar usually follows and only in part shows good crystalline outlines. Orthoclase and quartz, if present, are last to separate out, and fill the spaces between the other minerals, often they interpenetrate to form micropegmatite. In many diorites the plagioclase feldspar has crystallized before the hornblende, which consequently has less perfect outlines and forms irregular plates which enclose sharply formed individuals of feldspar, thus producing the optically structure (common also in the dolerites). More rarely biotite and augite exhibit the same relations to the plagioclase. Granular structure also occasionally appears in these rocks, in fact the crystalline diorite of Corsica (also called "napoleonite")

[*q v*] or "corste") was for a long time the best known example of this structure. Occasional diorites have a parallel banded or foliated structure, but these must not be in any manner confounded with the epidiorites, which are metamorphic rocks without conspicuous foliation.

Diorites must also be distinguished from hornblende gabbros, which contain more basic feldspars, rarely quartz and occasionally olivine, but the boundary lines between diorites and gabbros are admittedly somewhat vague, e.g. some authors would call rocks gabbro which others would regard as augite diorite. The hornblende diorites differ from the diorites in containing little feldspar, and consist principally of hornblende. Among varietal designations given to rocks of the diorite family are "basanite" for an augite-diorite with or without quartz (from the Schemnitz district), "granodiorite" for a quartz-hornblende diorite (essentially the same as tonalite) from California, etc., "ornate" for a hornblende-diorite rich in feldspar, from Sweden (J S F).

DIOSCOREACEAE, a family of monocotyledonous plants which includes the yam (*q v*), the black bryony (*Tamus communis*), and the elephant's foot (*q v*). There are nine genera and about 550 species, all climbing herbs or shrubs with tubers or rhizomes. The flowers are small, usually inconspicuous, unisexual or perfect, usually regular, the parts in threes. The fruits are for the most part of a three-winged capsule, the seeds mostly winged. The family is economically important, as many species of *Dioscorea* are cultivated for their edible tubers, those of the greater yam (*D. alata*) sometimes attaining a weight of 40 lb. Other cultivated species are *D. batatas*, *D. esculenta*, *D. cayenensis*, *D. bulbifera*, *D. pentaphylla* and *D. triloba*.

For a monographic treatment see R. Knuth, *Dioscoreaceae* Phytoneuron 87 (iv, 43) 1-278 fig. 1-69 (1924).

DIOSCORIDES, PEDANIOS (fl. c. A.D. 50), Greek medical man, born in Cilicia, served in the army of Nero. He was the first to establish medical botany as an applied science. He is known through his *Materia Medica*. It details the properties of about 600 medicinal plants and describes animal products of the tetter and medicinal value. He was a contemporary of Pliny.

See F. H. Garrison, *Introduction to the History of Medicine*, pp. 100-110, 4th ed. rev. (1925).

DIP, in magnetism (see TERRESTRIAL MAGNETISM), the angle made by the direction of the earth's magnetic field and the horizontal is the angle of dip, commonly called the dip. In astronomy (*q v*) and surveying (*q v*) the dip of the horizon is the angular distance between the true horizon and the apparent horizon, due to the observer's elevation. In geology (*q v*) the angle which the line of maximum slope of a stratum makes with the horizontal.

DIPAVAMSA, a poem ("History of the Island") composed in Ceylon in the Pāli language, relating the history of Buddhism in India and its propagation in Ceylon. It belongs to the 4th century A.D., and is the earliest example of a purely historical composition relating to India. It contains 22 chapters, and begins with the enlightenment of Buddha, the immediately following events and his three legendary visits to Ceylon. Then follows the genealogy of the kings of Buddha's ancestry from the first king of this cycle (*kālapa*) down to Buddha and his son Rāhula. The historical portion begins with chapter 4, the history of Buddhism in the Magadha kingdom down to the third council in the reign of Asoka. From this point it continues with the history of Ceylon, the settlement of the island by king Vijaya, the subsequent kings down to Devānampiya Tissa, under whom Buddhism was introduced by Asoka's son Mahinda, with a continuation of the history of the island ending with king Mahāsena at the beginning of the 4th century A.D.

As the *Dipavamsa* is the oldest connected account of Buddhism and of contemporary secular events in India for the first three centuries of its history, it is important to determine if possible in what sense it can be called historical. There are two circumstances to be first considered, the fact that its record of events (apart from purely local Sinhalese history) was compiled in India, and consequently cannot be treated as the composition or invention of a Sinhalese author, and secondly that it corresponds in important features with the Purāṇas. The Purāṇas, like the *Dipavamsa*, contain genealogies of kings which are traced up to the purely legendary beginnings of the cycle, and recent study has not only shown that the Purāṇas contain genealogies belonging to actual lines of

kings, but further that in the case of the Magadha kings between Buddha and Asoka both the Purāṇas and the *Dipavamsa* rest on a common historical basis. This is further corroborated by the lists found in Jain works. What we possess is not a historical record in the modern sense, for the chroniclers, recording events uncritically and accepted legends about quite historical persons. This is very different from free invention. What we have to guard against is not deliberate romancing, but faults due to the very defective means of transmitting and recording events, and the unhistorical attitude of the compilers.

The probable mode of composition has been most closely studied by H. Oldenberg, who first edited the *Dipavamsa*, and by W. Geiger, who has edited the later chronicle, the *Mahāvamsa*. A native commentary (*ṭīṭṭa*) on the *Mahāvamsa*, was compiled about A.D. 1000. References in it show that at that time there was in existence a Sinhalese historical work which formed part of the great Sinhalese commentary on the Buddhist scriptures. The existence of this Sinhalese commentary at least as early as the 4th century A.D. is known from frequent references found in the existing Pāli commentaries. It was on the basis of this work in Sinhalese that the *Dipavamsa* was compiled, and its repetitions and the disjointed arrangement of various passages show that it must have been compiled from just such a source. The main details of the work correspond so closely with those in the Indian records (the Purāṇas and Buddhist Sanskrit works) that it is clear that they are of Indian origin. This Sinhalese work must have at first ended with the introduction of Buddhism into Ceylon by Mahinda, but it appears to have been later on extended to the reign of Mahāsena. This is the period covered by the *Dipavamsa*, and this work is probably a recension and adaptation of the whole of the Sinhalese work. These conclusions are essentially the views of Geiger, who has summarized his results about both the *Dipavamsa* and the *Mahāvamsa* in his translation of the latter work. References will also be found here to the criticisms of R. O. Franke, whose attitude on the historical value of the chronicles is one of complete scepticism (see MAHĀVAMSA).

BIBLIOGRAPHY—H. Oldenberg (ed and tr.), *The Dipavamsa* (1879), W. Geiger (tr.), *The Mahāvamsa* (1912), M. Winternitz, *Geschichte der Indischen Literatur*, vol. 2 (1920).

DIP CIRCLE. An instrument used for measuring the magnetic dip. It consists essentially of a magnetic needle pivoted at the centre of a graduated metal circle. The circle is mounted with its plane vertical and the axis about which the needle turns horizontal. If such an instrument is placed with the plane of the circle in the magnetic meridian the needle will be in the direction of the earth's magnetic field. See TERRESTRIAL MAGNETISM.

DIPHENYL or **BIPHENYL**, an aromatic hydrocarbon found in that fraction of the coal-tar distillate boiling between 240°-300° C. from which it may be obtained by warming with sulphuric acid, separating the acid layer and strongly cooling the undissolved oil. It crystallizes in plates (from alcohol) melting at 70-71° C. and it boils at 254° C. It is sometimes called phenyl benzene, having the structure $C_6H_5.C_6H_5$. It may be prepared by passing benzene vapour through a red-hot tube, by the action of sodium or bromobenzene dissolved in ether, by the action of stannous chloride on phenyldiazonium chloride, by the decomposition of phenyldiazonium sulphate with warm benzene or with alcohol and copper powder, or a yield of 82% of diphenyl is obtained by heating iodobenzene with copper powder at 320° C. The principal use of diphenyl itself is as a heat-transfer fluid, either alone or in the form of its eutectic mixture (Dowtherm A) with diphenyl ether (C_6H_5)₂O (See also BENZIDINE).

DIPHILUS, of Sinope, poet of the New Attic Comedy and contemporary of Menander (342-291 B.C.). Most of his plays were written and acted at Athens, but he led a wandering life and died at Smyrna (Athenaeus xii, pp. 579, 583). He is said to have written 100 comedies, the titles of 50 of which are preserved. He sometimes acted himself. To judge from the imitations of Plautus (*Casina* from the *Κληρονομία*, *Asinaria* from the *Ὀνείρων*, *Rudens* from some other play), he was very skilful in the construction of his plots. Terence also tells us that he introduced into the *Adelphi* (ii, 1) a scene from the *Συναποθήκη*, which had been omitted by Plautus in his

adaptation (*Commorantes*) of the same play. The ancients were undecided whether to class him among the writers of the New or Middle Comedy.

DIPHThERIA, is a specific localized and superficial bacterial infection which is associated with formation of membrane, composed of fibrin and necrotic tissue and with general intoxication. The lesion is normally situated in the upper respiratory tract but occasionally related to previous wounds or ulcers of the skin.

Although primary localizations of the infection in the nose or nasopharynx on the one hand and the larynx on the other are not uncommon, the tonsils and faucial pillars are the site at which the lesion most often appears. A tough, closely adherent membrane which leaves a raw surface when torn away is most characteristic but there are a number of early or mild cases, especially those in the immunized, which present scattered patches of softer membrane more readily detached. These are not easily distinguished from follicular tonsillitis. It is also noteworthy that the severest infections may present lesions in which oedema and swelling are more prominent than membrane formation and so mask it.

Although there is no absolute relationship between the extent of membrane formation and the severity of the infection, it is generally accepted that the spread of membrane over the whole tonsil with progressive involvement of the soft palate, uvula, pharynx and larynx normally indicates a severe case. In rarer instances extension to the oesophagus or downward in the bronchial tree is observed. Swelling of the lymphatic glands of the neck and oedema of the periglottic tissue may be a marked feature and in the worst cases goes on to "bull neck". Nasal discharge and fetor are also common features of the severer cases. The membrane passes through three phases, an early one not often recognized, in which it resembles raw white of egg, a second one in which it suggests the same substance after heat coagulation, and a final one suggesting rubber, with all colour shades from gray to reddish brown. Special sites are the larynx and nose and more rarely the eye, vagina and skin.

General Symptoms—These may be slight or absent in mild cases. In moderate or severer cases there are the usual prodromata of any infection, considerable initial fever of very short duration is the rule, and sore throat is present but is not a commanding symptom. In the severest cases evidences of profound toxæmia are pallor, a soft and irregular pulse, general weakness and marked subjective consciousness of illness. Vomiting, a rapid fall in the pulse and hemorrhagic manifestations are all of grave prognostic significance. Evidences of toxic neuritis appear in a variable percentage of cases and are observed between the sixth day and the sixth or seventh week. In order of frequency and time of appearance paralytic of the palate, the eye, the pharynx and the muscles of the trunk and limbs are observed. The palate lesion is indicated by nasal voice and regurgitation of fluids by the nose, that of the eye muscles by squint, failure of accommodation and, more rarely, ptosis, and the pharyngeal lesion by difficulty in swallowing.

Causes of Death—Death may result in four different ways: a primary massive toxæmia affecting mainly the heart and leading to death within three days, a less profound toxæmia leading to heart failure within the first two weeks, obstruction of breathing caused by membrane formation and oedema of the upper respiratory tract, and late deaths associated with extensive paralytic manifestations which may be directly or indirectly responsible, e.g. diaphragmatic paralysis or inhalation pneumonia, but in which heart involvement probably also plays an important part.

Diagnosis—Although many well-developed cases of diphtheria will be diagnosed without hesitation by any experienced observer, a proportion of early, mild or unusual cases can be certainly diagnosed only by bacteriological investigation. Even with a positive bacteriological result, in such cases there remains the question whether a diphtheria carrier condition coincides with some other infection which is actually responsible for the clinical symptoms. Bacteriological diagnosis is usually made by combining the observation of morphology of mixed cultures on F. Löffler's inspissated serum medium and the appearance of individual colonies on one

of the blood tellurite agar media. The sugar fermentations of the isolated strains are frequently determined and when by these means the strain is shown to belong to one of the three main types, virulence tests may be restricted to cases of special difficulty—carriers of long standing, wound diphtheria, etc. This is especially so when the *gravis* and *intermedius* types are in question.

Actiology—There was a gap of 57 years between Pierre Bretonneau's classical description (1826) of the disease as a sharply defined infectious condition and E. Kleb's demonstration of the appearance of the bacillus in the superficial layers of the membrane in 1883, followed by F. Löffler's much more convincing and significant bacteriological investigations.

The causative bacillus described by Löffler and for long known as the Klebs-Löffler bacillus, or K.L.B., and now generally referred to as the *Corynebacterium diphtheriae*, is a gram positive bacillus, nonmotile and nonsporing with a special affinity for methylene blue which particularly emphasizes the presence of granules showing different staining affinities from the rest of the bacillus, metachromatic granules and irregular swellings of the bacillary body, "clubbing".

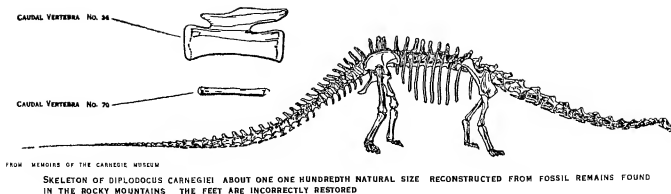
The bacillus is extremely pleomorphic. It grows moderately well on the usual media with a basis of meat extract and peptone, but peculiarly well on inspissated serum reinforced with peptone broth and glucose (Löffler's original medium). It ferments glucose and other sugars without gas formation but not saccharose, although some rare exceptions have been observed.

Three well defined cultural types of the *C. diphtheriae*, *gravis*, *intermedius* and *mitis*, were first described in Leeds, 1930-34. These are distinguished by the appearance of their colonies especially in primary culture on blood tellurite agar. *Gravis* is further differentiated from the others by its capacity to ferment starch and glycogen and *intermedius* by the fact that it never produces haemolysis. Broadly, *gravis* and *intermedius* strains are associated with the severer toxic cases of diphtheria and *mitis* more often with extensive membrane formation and phenomena of respiratory obstruction. The *gravis* strain appears to play a special role in epidemic diphtheria and in the diphtheria of the inoculated.

Diphtheria Toxin—The fact that filtrates of culture free from bacteria could kill experimental animals with the systemic lesions of a diphtheria infection was first demonstrated by P. P. E. Roux. From that time production of toxin for immunization of man and of horses was the subject of a vast amount of investigation, and it was only after 1930 that the underlying principles were so far elucidated that the perplexing irregularities in toxin yield from cultures were largely eliminated. The essentials appear to be a suitable peptone as source of nitrogen, combined with fatty acid and carbohydrate, especially maltose, as sources of energy in such proportions as to ensure a slow reversal of reaction from slight acidification to a pH of about 8.6 after several days' incubation in conditions in which there is a large exposure of surface relative to the volume of culture. The importance of the iron content of the medium has also been demonstrated. The Park-Williams 8 strain maintained its place as a constantly highly toxigenic strain and was almost universally used for toxin production on a large scale. The toxin was purified till it is believed to contain little more than 1% of impurity, and such products kill the guinea pig in ratio of 1/1,000,000 g per kilogram of animal body weight. It appears to be a protein free from carbohydrate and phosphorus but containing sulphur.

Treatment—The existence of curative properties in the serums of animals which had recovered from infections was first observed by Emil von Behring in 1890, and the correlation of his work with that of Roux led to the rapid development of antitoxin therapy with the serums of immunized horses. The therapeutic value of such serums was established beyond doubt by the halving of the death rate in the disease in Paris in 1894 (Roux and others) and by the treatment of alternate cases with and without antitoxin over a year in the Blegsdam hospital in Copenhagen by J. Fibiger in 1898.

It was increasingly used thereafter, and emphasis was put on large doses and early treatment. The former were facilitated by new methods of antitoxin purification—partial enzyme digestion



followed by differential heat denaturation in acid solution. It is doubtful, however, whether the use of huge doses of concentrated serums gave results much superior to those obtained in the early days in which smaller amounts of cruder preparations were employed. There are trustworthy records of death in the hypertoxic cases of diphtheria seen so much in Europe after 1925, notwithstanding intensive serum treatment within 24 hours of onset. Estimations of circulating toxin in such cases on admission reveal amounts greater than a lethal dose for man (Wildfuhr, 1947, *Zeit Innere Medizin Grenz*, 2, 186).

Tracheotomy—This operation was much less common after 1927. How far this was the result of the higher age incidence of diphtheria or to changes in the aetiological agent is not certain, both may have played a part.

Epidemiology and Prophylactic Control—In considering the epidemiology of diphtheria, it is necessary to take into account both the natural fluctuations of the disease and the effect of artificial measures of control which were introduced in modifying these fluctuations. The measures of control are (1) the bacteriological recognition of cases of the disease followed by the search for, and segregation of, carriers of the bacillus, (2) the institution of serum treatment of cases and contacts, and (3) the recognition of persons susceptible to diphtheria by the Schick test and their subsequent immunization by prophylactic inoculations.

That there are marked fluctuations of the severity of diphtheria and of its tendency to epidemic spread both from place to place and over periods of years in the same area is beyond question. The causes underlying these fluctuations in severity and epidemic spread of diphtheria are complex and may include sequences of cold and wet years on the one hand and dry and warm years on the other (Friedrich Wolter), periods of malnutrition following wars and consequent famine or partial famine, the replacement of less formidable by more formidable types of the *C. diphtheriae* consequent on extensive migrations of population in wartime and, finally, fluctuations in mass immunity of the population following epidemic outbreaks.

A comparative study of available mortality and case incidence figures for North America and Europe shows that, notwithstanding a marked fall in diphtheria deaths from the time of the introduction of serum in 1894, diphtheria was still responsible in the 1920s for a considerable morbidity and mortality in North America and most countries of northern and central Europe. This declined steadily in North America to become almost negligible in some of the great cities of Canada and the U.S. following intensive campaigns of prophylactic inoculation. In Europe there was great diversity. In Norway and the Netherlands low levels similar to those experienced in North America were recorded between 1935 and 1939 independently of prophylactic inoculation, whereas the appearance of an unusually severe diphtheria was recorded in central Europe and some of the Irish and English cities, and diphtheria throughout Germany reached very high levels. This culminated in an explosive outbreak of diphtheria in the countries surrounding Germany during World War II which reached its apex between 1943 and 1946, except in Great Britain, where an extensive campaign of immunization appeared to cut it short about 1941. After the close of World War II diphtheria continued to recede gradually

in North America and receded sharply in western Europe but more slowly in Germany and Switzerland, while in Hungary it actually increased.

An outstanding problem is how far the better results in the western hemisphere are attributable to more thorough campaigns of inoculation and how far to a less severe type of diphtheria. It is notable that the type of bacillus described as *C. diphtheriae gravis* is widespread in Europe and rare in North America.

Methods of Prophylactic Inoculation—The original method of giving toxin-antitoxin mixtures was abandoned because of occasional disasters caused by persistence of toxin after destruction of the antitoxin. This was liable to happen when the mixtures were frozen and the cresol preservative separated in concentrated form. For many years formal treated toxin has been used either as alum-precipitated toxoid (A.P.T.) or as toxoid-antitoxin flocculi which are better tolerated by adolescents and adults. The dosage which has been found most satisfactory is two 1 c.c. injections of A.P.T. at intervals of four to six weeks, provided the A.P.T. contains at least 50 Lf per cubic centimetre. Inoculation should be carried out between the 6th and 18th months of life and followed by a further booster dose before a child goes to school. The incidence of infection among children so treated is greatly diminished and diphtheria deaths are exceedingly rare. Even better results were claimed with prophylactics such as P.T.A.P. prepared from highly refined toxoid absorbed on pure aluminum phosphate. There was also emphasis on the need to immunize earlier in infancy in communities where diphtheria is rare and there is little inherited immunity.

Transmission—This occurs in several ways: (1) the ejection of infected droplets from the throats of cases or carriers, (2) spread of contamination from infected nasal discharges, probably of little importance, (3) persistence of *C. diphtheriae* in the dust of ward floors which investigations reveal as common, (4) infection of milk or ice cream, to which several well authenticated minor epidemics have been convincingly traced.

Control—In school and closed institutions this is effected by inoculation or re-inoculation of all not recently immunized, which may be combined with immediate passive protection with antiserum and followed by the detection and isolation of carriers. In the community at large, only prophylactic inoculation has yielded convincing results. It is obvious from the recrudescence of epidemic diphtheria after many years of detection and isolation of carriers that the efficacy of such methods is limited.

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DIPLODOCUS, a large amphibious dinosaur found in the Upper Jurassic rocks of the Rocky mountain region, skeletons or replicas are to be seen in many museums. It reached a length of 87 ft, but was relatively slender in build. (See illustration in *Dinosauria*.) (A. S. Ra.)

DIPLOMACY is a word often used vaguely with different meanings. Sometimes it is used to express the whole content of international affairs, sometimes to express the manner in which personal affairs are conducted. Sometimes it is used in a pejorative sense, sometimes it is described as highly commendable activity. Its proper and main meaning is, however, the manner in which international relations are conducted. Numerous definitions of it exist but, perhaps, the best is that of the *Oxford English Dictionary*. Diplomacy is "the management of international relations by negotiation: the method by which these relations are adjusted and managed by ambassadors and envoys, the business or art of the diplomatist." This definition seems too limited, for a president, a prime minister or a foreign secretary negotiating in Washington, London or Paris is engaging in diplomacy as much as any ambassador or envoy. It stresses, however, the main point that it is the method not the object of the negotiation that is the subject of diplomacy. But objects may be sought by good diplomacy and vice versa. Still diplomacy is in a sense a substitute for force, it is the means of obtaining the maximum national advantage without the use of violence and, perhaps one might add, with the minimum of friction and resentment. It is also true however, that sometimes it is interspersed with the threat of coercion, and it always depends in some degree on the power, whether military, economic, moral or deriving from association with others, of the state for which the diplomatist is acting. Some writers define it as a science, others as an art. It has indeed characteristics of both, though it is certainly more an art than a science.

The word in the use defined above is comparatively a newcomer. It is derived through the French from the Greek word *διπλωμα* that is, diploma (literally, a doubling), meaning a folded paper, such as was early used for state papers, charters, etc., and hence a privilege, licence or degree conferred on a person. Thus a "diplomat" was a person so licensed, and in the 18th century this word came to be specially applied to those authorized to negotiate on behalf of the state. Long before this, the word "diplomatic" was used to denote the science of deciphering documents such as the original diplomas, and it is still used in this sense.

HISTORY

Though the word is new, the thing itself has existed since the beginning of civilization—or even earlier. When one group of men wished to come to some arrangement with another group so as to avoid the use of force, they sought to reach an understanding by negotiation. This is the essence of diplomacy. In the early days of human history, when groups of men were small and nomadic, negotiation was often the only way to settle disputes. As societies grew larger and more complex, the need for formalized methods of negotiation became more apparent. The development of written language and the use of treaties and charters marked the beginning of formal diplomacy. The ancient Greeks and Romans developed sophisticated systems of diplomacy, with professional diplomats and established protocols. The Middle Ages saw the rise of the papacy and the development of diplomatic immunity. The Renaissance and the Age of Discovery brought new challenges and opportunities for diplomacy, as European powers sought to establish colonies and trade routes. The modern era, beginning with the French Revolution and the Napoleonic Wars, saw the emergence of the nation-state and the development of international law. Diplomacy has continued to evolve, adapting to the changing needs of the world, from the industrial revolution to the present day of globalization and international organizations.

skilful of Greek statesmen, who cultivated the art of persuasion, and a set of rules for diplomacy began to appear. The Romans took less from the Greeks in this than in some other arts though they used diplomacy effectively both in their relations with the Greeks themselves and in obtaining the control of Egypt. But when the Roman empire was fully established diplomacy was mainly employed to divide and control the barbarians who surrounded it. When the empire split, the western part became a Christian commonwealth owing allegiance to an emperor and to a pope, and though diplomacy was necessary between its warring members and was often conducted by church dignitaries, not only was it sporadic but also, in a sense, there was an appeal to a superior over all participants. The power of these superiors was, however, always very limited, and the papal court itself through the legates contributed a great deal to the development of the diplomatic system.

The eastern empire slowly decayed and, as its power weakened, had to employ negotiation to preserve itself against its attackers, so that it gradually developed a body of professional experts for that purpose who established the reputation of Byzantine diplomacy (see ROMAN EMPIRE, LATER). In the middle ages diplomatists were called by many different names such as legates, nuncios, procurators, agents or ambassadors. In all this development there was no permanent diplomatic machinery even between states which had frequent relations with one another.

The Italians were first to establish permanent missions, in the 15th century. The intense rivalries of the city states, their various combinations and alliances, the growth of their trading connections with the Levant and with northern Europe and the energy intellectual eminence and ambitious spirit of their peoples made them the leaders in the new art of diplomacy. It is usual to attribute to this Italian pre-eminence that characteristic of unscrupulous diplomacy to which the term Machiavellian is given because Niccolò Machiavelli described it in remarkable language in his *Principe* and his *Discorsi sopra la prima deca di Tito Livio*. But in the age of the Renaissance rulers of other nationalities, Louis XI of France, for example, were no less unscrupulous than the Italians, though the latter produced more subtle and refined personalities and had distinguished men of letters among their envoys. It cannot be said when the first resident embassy came into existence. The system grew out of the various methods of conducting international relations established during the middle ages among the countries of the Mediterranean area. One cause of delay was the fear that a permanent representative might be corrupted by the ruler to whose court he was accredited. But whatever its origin, it was in the Italian city states that the system came to fruition, Milan and Venice playing the leading part. It was Venice, because of its vast connections in the eastern Mediterranean, threatened by the rising power of the Turk after the fall of Constantinople in 1453, that extended the system into one that became European. Preoccupied with obtaining support for its colonies and for its trade, Venice sent a succession of envoys to Burgundy, since neither the Holy Roman emperor nor the king of France seemed likely to lead the alliance of Christian states which, it was fondly hoped, might arise to resist the infidel. When these efforts failed, Venice used diplomatic methods at Constantinople itself with considerable success. Meanwhile Venice had begun to establish permanent missions in western Europe.

The Development of the Profession—New types of monarchies were then arising as the power of the pope and of the emperor declined and new methods of organizing the central power of the state came into existence. These monarchies naturally began to negotiate with one another in the new way. For some time they regarded it with great suspicion. Henry VII of England, Ferdinand of Spain and Louis XI of France considered foreign agents as little better than spies. But if they were forced to allow rulers of other states to find out much about their own situation, they in their turn obtained much information and important contacts by means of their own agents.

It is also perhaps significant, as has been suggested, that permanent embassies arose at the same time as permanent armies. One could be regarded as the antidote of the other. At any rate in the

first half of the 16th century, in the age of Thomas Wolsey, of Francis I and of Charles V, the system of permanent diplomatic missions became firmly established among the leading European states, and for reasons both of prestige and security smaller states had necessarily to follow their example. Thus arose in nearly all capitals a diplomatic body which came later to be called the diplomatic corps, a number of diplomats each intent on forwarding the interests and defending the honour of the monarch or republic which he represented.

Naturally such men could not be subjected to the ordinary laws of the state where they resided, as is described below, a system of special immunities was gradually elaborated so that they could go about their business without interference. But they had also to establish their names and titles, their method of intercourse, ceremonial procedure and conventional language. The rules that were gradually adopted were part of the system of what was later called international law (*q.v.*) which grew up in the 17th and 18th centuries.

The term "ambassador" (from French *ambassadeur*, the form used by Jean Froissart, *cf.* Low Latin *ambactia*, service) became the designation of the monarch's representative in the 16th century, except the representatives of the pope, who were termed nuncios or legates—though the latter were something more than diplomats. To save expense and for other reasons an inferior and less costly class of agents was instituted, at first called residents or ministers resident, later called envoys. In both classes the word "extraordinary" was added to the title, being at first used to designate special missions but coming gradually, because of disputes as to precedence, to be assumed by all. Later a further class accredited not to the monarch but to his ministers, was used to fill up intervals or when some incident prevented full diplomatic representation, members of this class became known as *chargés d'affaires*. By the end of the 18th century there were four main classes, which were definitely recognized as such in an annex to the treaty of Vienna of June 9 1815; and in a protocol of the congress of Aix la Chapelle (Nov. 21 1818): (1) ambassadors, legates and nuncios, (2) envoys extraordinary and ministers plenipotentiary, (3) ministers resident, and (4) *chargés d'affaires*. (See *AMBASSADOR*.)

The title Excellency (*q.v.*) was first given to an ambassador when Henry IV of France gave it to Louis, duke of Nevers who was entitled to it as he belonged to the Italian princely house of Gonzaga. The ambassadors of Spain and Venice immediately claimed the same title, and at the congress of Munster, which prepared the peace of Westphalia (*q.v.*), it was given to all ambassadors. It was shared by nuncios and legates but not by lesser ranks. In the course of time it also came to be given, on the continent of Europe to all those who hold or have held the position of minister in a cabinet, and, in the British Commonwealth to viceroys, to governors general and to some other governors. It has been also claimed that an ambassador has the right at any time to an interview with the monarch to whom he is accredited, but this privilege was never fully established. The language of diplomacy was originally the international language of mediæval Europe, Latin. In the 17th century this was superseded by French, which remained the principal diplomatic language until the end of the 19th. The use of English had been carefully safeguarded, however, and the right to use English in diplomatic communications insisted upon by the government in Westminster, while other governments made analogous reservations. Not until the Paris conference of 1919 was the perfect equality of English with the French language accepted by other governments, largely thanks to the influence of the United States.

By the beginning of the 19th century diplomacy had developed in extent and technique. In some states the foundations of departments of foreign affairs had been established, and the ministers were assisted by professional advisers. Instructions to ambassadors were drafted with competent skill, notably in France, courier services were organized, and ciphers, first used by the Venetians, were employed with imperfect success to guard the secrets of correspondence.

The ambassadors were much preoccupied with the dignity of

their office for un affront was considered as reflecting on the honour of the monarch whom they represented. The pupil nuncio was given precedence and in most states was recognized as the *deus* or *doyen* of the diplomatic corps. But the rivalry of France and Spain, each claiming special precedence, led to many bitter quarrels, and it is said that some doors in London houses were made especially wide so that the two ambassadors could enter the room side by side. Representatives of smaller states had their own special rivalries and court officials everywhere had to be aware of the injury that might be caused to the interests of their own country if these sensibilities were not taken into account. Not until the above mentioned agreements of Vienna and of Aix la Chapelle was precedence by date of appointment accepted by all states for the classes of diplomats then established. Alphabetical order in the French language was also agreed to in the signature of treaties and similar documents, each state coming first in its own copy. Conventional rules as to the form of correspondence and address had also been established though each court had its own ceremonial practice for the reception and entertainment of diplomatic agents. As relations between states increased practical questions occupied the minds of diplomatists and etiquette was of less importance.

The 19th Century.—Thus the diplomatic profession while still largely in its higher ranks in the hands of the nobility, became in many countries a definite career. In the 19th century foreign affairs were dealt with in great departments, as other business of the state. By 1815 in France and in Austria prominent officials already managed much of this business. In Great Britain the foreign ministers for a longer period did most of the important work themselves aided only by a few clerks. But in London also by the middle of the century the permanent officials had necessarily to do much more as the dispatches multiplied. First the railroad and then to a much greater extent, the telegraph transformed the tempo of diplomacy, and some of the older statesmen found the change a trying one.

The position of an ambassador also became somewhat different when he could seek instructions from home and receive an answer in a matter of hours instead of days or even weeks. Technical questions especially those of trade, occupied more of the time and energy of diplomats. Commercial treaties had for a long time been negotiated by special envoys working under the general direction of the ambassador and receiving their instructions from ministers of finance or of commerce—in Great Britain from the board of trade. Finally commercial attachés were appointed. There were also military and naval attachés to report on the ever-growing armies and navies.

In addition an attempt had been made in 1815 to set up a permanent international organization of the Great Powers, the European alliance, often called mistakenly the Holy Alliance, the latter name being that of the less practical treaty sponsored by Tsar Alexander I. The alliance broke down in 1833, but in 1830 began the system of ambassadorial conferences—mainly of the Great Powers—which persisted sporadically throughout the century. In 1899 and 1907 two conferences of wider scope met at The Hague to lay down rules for arbitration and revise the rules of war. A number of technical international organizations were also set up with their own conferences and secretariats. Thus the origins of what was later called "diplomacy by conference" were already in existence.

Diplomatic Immunities.—Diplomatists could not be governed by the same laws as the people among whom they dwelt, and from an early date it was recognized that they had special privileges. Hugo Grotius gave his great authority to the theory, already adumbrated, that these immunities as they were called were based on extraterritoriality (*q.v.*) or extraterritoriality, the fiction that the diplomatist's dwelling was part of the territory of his own country and that he carried with him its law. They are, however, really based on practical convenience. Without them, though not necessarily in their most extreme form it would be impossible for the diplomatic agent to perform his functions satisfactorily. Diplomatic agents were thus placed outside the criminal and civil law of the land. They could not be arrested on a criminal charge or sued for debt in a civil court.

During the 16th and 17th centuries these immunities were firmly

established by numerous precedents. There were, indeed, a few exceptions, and even as late as the early 19th century ambassadors at Constantinople might be threatened with imprisonment. But the rules were very generally observed in all civilized communities. Perhaps the one most challenged was exemption from prosecution for refusal to pay debts, which was more than once successfully contested. But the immunities were extended to the diplomatic agent's wife and suite and even to his menial servants, since otherwise his freedom of action would be limited by consideration for those who depended on him and on whom he depended for the exercise of his functions.

This privilege was in many countries, especially in the orient, often abused in earlier centuries, and even in the 19th century it was sometimes a source of profit to the diplomatic agent. Since a diplomatic agent's house is inviolable the right of asylum for political refugees was at one time of importance, especially in Latin America, but it was always regarded with jealousy and not held to be good in the case of ordinary criminals who could be taken by force if not surrendered. A diplomatic agent has also the right of worshiping in his own faith inside his residence, at one time a matter of great importance. He and his suite are exempted from taxation and customs duties. He has naturally also the right of free communication with his own country unless he allows himself to be shut up in a besieged town. On this analogy the diplomatic body in Great Britain was prevented from using cipher dispatches or couriers during the period before the invasion of the European continent in 1944.

In return for these privileges the diplomatic agent had the duty of never creating a breach of the peace or civil disturbance. He was indeed expected to avoid all interference in the internal affairs of the host country. If he failed to do so the only remedy was expulsion. This was the case even when he could be shown to have plotted with others against the sovereign to whom he was accredited (as more than once happened in the 16th, 17th and 18th centuries), though he could be seized so as to be rendered harmless until the expulsion had taken place. In 1915 Constantin Dumba, the Austro-Hungarian ambassador, and Capt. Carl Boy Ed and Capt. Franz von Papen, the German military and naval attaches, were summarily expelled from the United States for attempted sabotage by fomenting strikes and violence in munitions factories, and later a similar fate befell Count von Luxburg, the German minister in Buenos Aires, Arg. The same penalty had often been inflicted for much smaller offenses, some of them little more than a failure in tact or judgment.

It was, however, more usual to ask that the diplomatic agent should be recalled by his own government. Such action should not be taken without sufficient cause, though it has been maintained that it is simply sufficient to declare an agent to be *persona non grata* as justification for desiring his removal. But if this is done unreasonably, reprisals may follow and a rupture of diplomatic relations take place.

THE 20TH CENTURY

During the 19th century diplomacy became a highly organized profession, and its exponents were for the most part chosen for their technical efficiency. In democratic countries the foreign minister was nearly always a politician who might have had no experience whatever of diplomacy, he was also the member of a cabinet or under a president who decided policy, subject to certain legislative control. In the more autocratic countries the foreign minister was often himself a professional diplomatist. The old aristocracy still played a notable part in the profession in many countries, and in Great Britain there was an income qualification for the diplomatic service, and its members tended to be chosen exclusively from the upper class. Moreover of the foreign ministers of Great Britain between 1815 and 1914 only two were not either a peer or the son of a peer (George Canning and Sir Edward Grey). The control of parliament was also limited by ignorance of many important facts. "It is in the Cabinet alone that questions of foreign policy are settled," Lord Palmerston told Richard Cobden. "We never consult Parliament until after they are settled." Diplomacy still remained highly secret and, to one man in the

street, mysterious. The treaties which bound the states of Europe together in the period before World War I were nearly all unknown to the peoples whose actions they pledged. Even Great Britain had secret discussions with France which, though they left the former free to determine its own course of action, yet were a moral obligation which could not be disregarded. During the war secret treaties were made which only became known when revealed by the Bolsheviks after the Russian Revolution.

The press it is true, took an increasing interest in foreign affairs. In return the foreign ministers and diplomatists generally took an increasing interest in the press and tried to control it either by bribery or by more subtle methods. Its use became part of the technique of diplomacy. Some journals were controlled by powerful financial and commercial interests, which thus obtained an influence on foreign affairs. Independent papers such as the *Times* (London), the *Frankfurter Zeitung* or the *Neue Freie Presse* exerted a real effect on public opinion and consequently on legislatures and cabinets. Governments had to defend themselves by publishing correspondence showing the manner in which diplomatic transactions had taken place. But it still remained true that many things, and often the most important, were kept secret. It was natural therefore, that there should have arisen during World War I an insistent demand in many countries that secret treaties should be abolished and that much more information should be given to the public about foreign affairs. In addition, two other developments in international affairs began after that war to exercise an important effect on diplomatic methods: for the first time in history a world wide permanent international organization had been set up in the League of Nations, which brought together diplomatists from many different countries, and new technological developments including those which affected communications, made the use of expert knowledge on many different subjects a necessity to the diplomatic profession.

Democratic Control.—In a number of countries the constitution provided machinery through which the legislature exercised some control over the executive in foreign affairs. The most famous and effective was that of the United States, where all treaties had to be sanctioned by a two thirds majority of the senate before they could be ratified, the president also had to obtain the consent of the senate to the higher diplomatic appointments. This system had resulted in the rejection of many treaties, including the most famous of all, the treaty of Versailles, signed by Pres. Woodrow Wilson in 1919.

In some other countries there was provision for the legislature to be consulted before treaties could be ratified. In France, committees of the chambers on foreign affairs were able to obtain secret information from the foreign minister, and the same device was also used in some other states. In Great Britain the executive had the power to ratify treaties, but it was recognized that it could only do so in important cases if parliament had previously indicated approval. British ministers could be questioned in parliament, but there was no formal method by which secret information could be disclosed. Military and naval staffs played an active part in the determination of foreign policy in all countries and the military and naval attaches in contacts between governments. In Great Britain this position had been recognized by the establishment of the committee of imperial defense, which in effect became the war cabinet during World War I.

It was no easy task to devise means by which these processes should be made more democratic. The first President Wilson's fourteen points laid down that there should be "open covenants of peace openly arrived at, after which there shall be no private international understandings of any kind, but diplomacy shall proceed always frankly and in the public view." This meant that there should be no more secret treaties and not that treaties should be negotiated in public, and it was implemented by a clause in the Covenant of the League of Nations that no treaties should be considered binding unless registered with the secretariat of that body and published. This did, indeed, prevent secret treaties between members of the League of Nations, though military arrangements for mutual defense naturally could not be disclosed. In Great Britain the first Labour government established the rule that no

treaty should be ratified until it had lain on the table of the house of commons for at least 21 days. In other countries similar principles were accepted, though none went so far as the United States, since it was widely held that the control of the senate had done great harm to international co-operation and understanding.

Another step was to make the diplomatic profession more easily accessible to candidates from every class. In Great Britain the income qualification for the diplomatic service was abolished and new methods of appointment and examination introduced. It took, however, some time for such measures to have any great effect and it was often said, both there and in other countries, that the diplomatic profession was out of touch with the classes that had most power in the more democratic society that was growing up. At the same time diplomacy became even more concerned than before with economic and technical questions, and this meant that men of many different types took some part in it. The embassies of the Great Powers in each other's capitals became large and highly organized machines.

Attempts were also made to educate public opinion on the real nature of diplomatic transactions and on the complicated character of the problems with which diplomatists have to deal. Debates in parliament on foreign affairs multiplied, and a larger quantity of diplomatic documents was laid before the legislatures. One example of this was the publication by many countries of the diplomatic correspondence of the period before World War I, in order that the causes of the great catastrophe might be more fully understood. In many countries, also, new institutions for the study of foreign affairs and for the dissemination of information about them were set up, a notable example being the Royal Institute of International Affairs in London. The new international institutions also assisted in the education of public opinion wherever it could follow what took place in them.

A further step was greater co-operation with the press. In all foreign offices press departments were set up and press attachés were stationed at the principal missions abroad. Most of this work was done with the object of getting sufficient attention paid to the policy of the operating country both in its domestic and in the foreign press. But there were also, inevitably, attempts to influence the press to support a particular policy. The cruder forms of journalism, on the other hand, often distorted the information by sensational writing which appealed to national susceptibilities. It was apparent on such questions as that of reparations from the defeated countries after World War I that the governments learned their lessons before the public on which their actions ultimately depended.

As the power of an only partly instructed public opinion over foreign affairs became greater, governments began to use new methods to influence it, not only in their own country but in others. Departments of propaganda were organized which appealed to peoples over the heads of their governments. This practice, first begun by the Soviet government at the end of World War I, was adopted by other authoritarian regimes that appeared elsewhere. The development of radio communication provided them with a new instrument for their purpose. The Italian radio station at Bari, for example, poured out a flood of anti-British propaganda to the Arab countries, and when the National Socialist state had been established in Germany, propaganda, which Hitler himself laid down should be based on lies, was developed into an instrument of aggression. Though this new form of propaganda had great effect in the period between World Wars I and II, it was shown in World War II that a more realistic and truthful presentation of the facts was in the long run more advantageous. After World War II when much radio activity was being employed by both blocs into which the world was divided in the 'cold war' between Communist and anti-Communist states, a similar result was to be expected.

Thus diplomacy had to take place in a new atmosphere in which its professional exponents sometimes found it hard to adjust themselves. The high hopes that a more democratic approach to its problems would ensure a more peaceful world were disappointed. It is true that aggression came from countries where democracy failed. But in the democratic countries there was an inadequate

conception of the true nature of diplomatic transactions and public opinion was often deceived and misdirected until it was too late to achieve the desired ends.

Diplomacy by Conference—Meanwhile the new international institutions had done much to transform the technique of diplomacy. They also gave the smaller powers a greater opportunity to play an important role in it than they had ever before possessed. The increase in communications and the new technical developments had made new forms of international co-operation necessary, and the process had long been going on. But the discussion of acute international problems in public by men of different nations was a new phenomenon, and still more so the attempt to solve them around the council table in this manner. Of course, there had to be much confidential discussion at Geneva either in secret meetings of the council or among the foreign ministers who came there from many European countries and even from other continents. But there was also much done by public debate in the council and assembly. Opinions were divided as to the effect of this process on the solution of international problems, some insisting that public opinion was thus able to exercise a beneficial influence, others that it made it more difficult for governments to make the necessary concessions and compromises. However that might be the process certainly depended on free communications between states. Where authoritarian governments controlled the sources of information, the public received only a distorted picture of events at Geneva. The deduction was sometimes made that international institutions could be successful only if their members were truly democratic in the sense of allowing the full expression of different points of view.

The effect on the technique of diplomacy was certainly considerable. Not only had a new language to be learned for the public discussion of controversial problems, but personal contacts multiplied between the foreign ministers themselves and between their principal officials. The use of an international secretariat also transformed the methods of reaching agreement on international problems.

Nevertheless, contacts through the ordinary diplomatic channels still played an important part in the relations between states, and the diplomat had to retain his mastery of the old technique as well as to learn the new methods made necessary by the progress of democracy and of new international institutions. After World War II these institutions increased in number and activity, and a diplomatic struggle took place within them in a manner previously unparalleled. Language was used which in previous periods would have been equivalent to a declaration of war, indeed it was said that such methods were appropriate only to war and could not be given the name of diplomacy. At the same time, all the while, negotiation went on as before, both publicly and secretly, and the art of diplomacy remained of fundamental importance in the relations between states.

The Qualities of a Diplomatist—The essential qualities of a diplomatist have been laid down by many writers, some with considerable experience of the profession, others after studying and analyzing historical records. Some few writers, of whom Machiavelli is the principal representative, have described diplomacy as an attempt to outwit opponents by artifice and treachery, and it is true that much diplomacy has used such means. But the majority of writers have rather tended to stress more virtuous qualities as essential to real success in the profession. Certainly one of the main assets of a successful diplomatist is the confidence of those with whom he negotiates, and this he can obtain only if he takes into account the interests of other countries as well as those of his own and can be trusted to tell the truth, if not always all the truth.

Much negotiation now takes place between groups of states whether in international institutions or in more limited meetings, and a fruitful result can be obtained only by creating the climate of opinion in which agreement is possible. It is then necessary to devise the written instruments in which agreement can be recorded and to perceive the right moment at which to make the maximum effort. Good timing is indeed, an essential factor of diplomacy. It is, of course, also necessary to have debating skill and a complete

Papal Chancery—First and foremost stands the papal chancery, which has served as a model for all others. Organized in remote times, it adopted for the structure of its letters a number of formulae and rules which became more and more precise from century to century. The apostolic court being organized from the first on the model of the Roman imperial court, the early pontiffs naturally collected their archives, as the emperors had done, into *scrinia* (boxes). Pope Julius I, A.D. 337-353, reorganized the papal archives and Pope Damasus, A.D. 366-384, built a record office at the Lateran. The collection and orderly arrangement of the archives provided material for the establishment of regular diplomatic usages, and the science of formulae naturally followed.

For the study of papal documents four periods have been defined, each being distinguished by some particular development of forms and procedure. The first period is reckoned from the earliest times to the accession of Leo IX, A.D. 1048. For almost the whole of the first eight centuries no original papal documents have survived. But copies are found in canonical works and registers, many of them false, and others probably not transcribed in full or in the original words, but still of use, as showing the growth of formulae. The earliest original document is a fragment of a letter of Adrian I, A.D. 788. From that date there is a series, but documents are rare before the beginning of the 11th century, all of which exist, being written on papyrus. The latest existing papyrus document is dated A.D. 1022, the earliest on vellum A.D. 1005. The nomenclature of papal documents even at an early period is rather wide. In their earliest form they are letters, called in the documents themselves *litterae*, *epistolae*, *pagma*, *scriptum*, sometimes *decretum*. A classification, generally accepted, divides them into (1) Letters or Epistles the ordinary acts of correspondence with persons of all ranks and orders, including constitutions (a later term) or decisions in matters of faith and discipline, and encyclicals giving directions to bishops of the whole church or of individual countries, (2) Decrees, being letters promulgated by the popes of their own motion, (3) Decretals, decisions on points of ecclesiastical administration or discipline, (4) Rescripts (called in the originals *preceptum*, *auctoritas*, *privilegium*), granting requests to petitioners. The comprehensive term "bull" (the name of the leaden papal seal, *bulia*, being transferred to the document) did not come into use until the 13th century.

The second period of papal documents extends from Leo IX to the accession of Innocent III, A.D. 1048-1198. At the beginning of the period formulae tended to take more definite shape and to become fixed, but it was under Urban II, A.D. 1088-99, that the principal formulae became stereotyped. The distinction between documents of lasting and those of transitory value became more exactly defined, the former class being known as greater bulls, *bullae majores* (also called *privilegia*), the latter lesser bulls, *bullae minores*. The introduction of subscriptions of cardinals as witnesses to greater bulls had gradually become a practice. Under Victor II, A.D. 1055-57, the practice became more confirmed, and after the time of Innocent II, A.D. 1130-45, the subscriptions of the three orders were arranged according to rank, those of the cardinal-bishops being placed in the centre under the papal subscription, those of the priests on the left, and those of the deacons on the right.

By degrees the use of the lesser bulls almost entirely superseded that of the greater bulls, which became exceptional in the 13th century and almost ceased after the migration to Avignon in 1309. In modern times the greater bulls occasionally reappear for very solemn acts, as *bullae consistoriales*, executed in the consistory.

The third period of papal documents extends from Innocent III to Eugenius IV, A.D. 1198-1431. The pontificate of Innocent III was a most important epoch in the history of the development of the papal chancery. Formulae became more exactly fixed, definitions more precise, the observation of rules and precedents more constant. The staff of the chancery was reorganized. The existing series of registers of papal documents was then commenced. The growing use of lesser bulls for the business of the papal court led to a further development in the 13th century.

They were now divided into two classes, *tituli* and *mandamenta*. The former conferred favours, promulgated precepts, judgments, decisions, etc., the latter comprised ordinances, commissions, etc., and were executive documents.

In the fourth period, extending from 1431 to the present time, the *tituli* and *mandamenta* have continued to be the ordinary documents in use, but certain other kinds have also arisen. Briefs (*brevia*), or apostolic letters, concerning the personal affairs of the Pope or the administration of the temporal dominion, or conceding indulgences, came into general use in the 13th century in the pontificate of Eugenius IV. They are written in the italic hand on thin white vellum, and the name of the Pope with his style as *papa* is written at the head of the sheet, e.g., *Eugenius papa iii*. They are closed and sealed with the Seal of the Fisher man, *sub anulo Piscatoris*. Briefs have almost superseded the *mandamenta*.

Merovingian Chancery—Of the chancery of the Merovingian line of kings of France as many as 90 authentic diplomas are known, and of these 37 are originals, the earliest being of the year 625. The most ancient examples were written on papyrus, vellum superseding that material towards the end of the 7th century. All these diplomas are technically letters and were authenticated by the king's subscription, that of the *referendarius* (the official charged with the custody of the royal seal), the impression of the seal, and exceptionally by subscriptions of prelates and great personages. The royal subscription was usually autograph, but, if the sovereign were too young or too illiterate to write, a monogram was traced by the scribe. They are of two classes: (1) Precepts, conferring gifts, favours, immunities, and confirmations, entitled in the documents themselves *preceptum*, *preceptio*, *auctoritas*, some drawn up in full form, with preamble and ample final clauses, others less precise and formal, (2) Judgments (*iudicia*), which required no preamble or final clauses as they were records of the sovereign's judicial decisions, they were subscribed by the referendary and were sealed with the royal seal.

Carolingian Chancery—The diplomas of the early Carolingians differed but little from those of their predecessors. The royal subscription was in form of a sign-manual or mark, but Charlemagne elaborated this into a monogram of the letters of his name built up on a cross. Most of his diplomas were authenticated by the subscription of the chancellor and impression of the seal. A novelty in the form of dating was also introduced, two words, *datum* (for time) and *actum* (for place), being then employed. The character of the writing of the diplomas, founded on the Roman cursive hand, which had become very intricate under the Merovingians, improved under their successors, yet the reform which was introduced into the literary script hardly affected the cursive writing of diplomatic until the latter part of Charlemagne's reign. The archaic style was particularly maintained in judgments, which were issued by the private chancery of the palace, a department more conservative in its methods than the imperial chancery. It was in the reign of Louis Debonair, A.D. 814-840, that the Carolingian diploma took its final shape. A variation then appears in the monogram, that monarch's sign-manual being built up, not on a cross as previously, but on the letter H, the initial of his name Hludovicus, and serving as the pattern for successive monarchs of the name of Louis.

In the Carolingian chancery the staff was exclusively ecclesiastical, at its head was the chancellor, whose title it traced back to the *cancellarius*, or petty officer under the Roman Empire, stationed at the bar or lattice (*cancelli*) of the basilica or other law court and serving as usher. As keeper of the royal archives his subscription was indispensable for royal acts. The diplomas were drawn up by the notaries, an important body, upon whom devolved the duty of maintaining the formulae and traditions of the office. It has been observed that in the 9th century the documents were drawn carefully, but that in the 10th century there was a great degeneration in this respect. Under the early Capetian kings there was great confusion and want of uniformity in their diplomas, and it was not until the reign of Louis VI, A.D. 1108, that the formulae were again reduced to rules. The acts of

the imperial chancery of Germany followed the patterns of the Carolingian diplomas, with little variation down to the reign of Frederick Barbarossa, AD 1152-1190.

England—For the study of diplomatic in England material exists in two distinct series of documents, those of the Anglo Saxon period and those subsequent to the Norman Conquest. The Anglo Saxon kings appear to have borrowed, partially, the style of their diplomas from the chanceries of their Frankish neighbours, introducing at the same time modifications which give those documents a particular character marking their nationality. In some of the earlier examples the lines of the foreign style are followed more or less closely, but very soon a simpler model was adopted which lasted in general construction down to the time of the Norman Conquest. The royal charters were usually drawn up in Latin, sometimes in Anglo-Saxon, and began with a preamble or exordium, in the early times of a simple character, but later drawn out not infrequently to great length in involved and bombastic periods. Then immediately followed the disposing or granting clause, often accompanied with a few words explaining the motive, such as for the good of the soul of the grantor, and the text was closed with final clauses of varying extent, protecting the deed against infringement, etc.

In early examples the dating clause gave the day and month (often according to the Roman calendar) and the year of the indiction, but the year of the Incarnation was also immediately adopted, and later the regnal year also. The subscriptions of the king and of the personages witnessing the deed, each preceded by a cross, but all written by the hand of the scribe, usually closed the charter. A peculiarity was the introduction in many instances, either in the body of the charter or in a separate paragraph at the end, of the boundaries of the land granted, written in the native tongue. The sovereigns of the several kingdoms of the Heptarchy, as well as those of the United Kingdom, usually styled themselves *rex*. But from the time of Aethelstan, AD 852-840, they also assumed fantastic titles in the text of their charters, such as *rex et princeps, rex et rector, gubernator et rector, monarchus* and particularly the Greek *basileus* and *basileus induratus*. At the same time the name of Albin was also frequently used for Britain.

A large number of documents of the Anglo Saxon period, dating from the 7th century, has survived, both original and copies entered in chartularies. Of distinct documents there are nearly two hundred, but a large proportion of these must be set aside as copies (both contemporary and later) or as spurious deeds.

Although there is evidence of the use of seals by certain of the Mercian kings, the method of authentication of diplomas by seal impression was practically unknown to the Anglo-Saxon sovereigns, save only to Edward the Confessor, who, copying the custom which obtained upon the Continent, adopted the use of a great seal.

Immediately after the Norman Conquest of England the old tradition of the Anglo-Saxons disappeared. The Conqueror brought with him the practice of the Roman chancery, which naturally followed the Capetian model, and his diplomas of English origin differed only from those of Normandy by the addition of his new title, *rex Anglorum*, in the superscription. But even from the first there was a tendency to simplicity in the new English chancery, not improbably suggested by the brief formalities of Anglo Saxon charters, and, side by side with the more formal royal diplomas, others of shorter form and less ceremony were issued, which by the reign of Henry II had quite superseded the more solemn documents. By the reign of John these simpler forms had taken final shape, and from this time the acts of the kings of England have been classified under three heads, viz. (1) Charters, generally of the pattern described above, (2) letters patent, in which the address is general, the king himself is his own witness, and the great seal is appended, (3) close letters, administrative documents conveying orders, the king witnessing.

The style of the English kings down to John was, with few exceptions, *Rex Anglorum*; thenceforward, *Rex Anglie*. Henry II added the feudal titles, *dux Normannorum et Aquitanorum et*

comes Andegavorum, which Henry III curtailed to *dux Aquitanie*. John added the title *dominus Hibernie*, Edward III, on claiming the crown of France, styled himself *rex Anglie et Francie*, this title being borne by successive kings down to the year 1801, and Henry VIII, in 1521, assumed the title of *fides defensor*. The formula *Dei gratia* does not consistently accompany the royal title until the reign of Henry II, who adopted it in 1173.

The forms adopted in the royal chanceries were imitated in the composition of private deeds, which in all countries form the mass of material for historical and diplomatic research. The student of English diplomatic will soon remark how readily the private charters, especially conveyances of real property, fall into classes, and how stereotyped the phraseology and formulae of each class become, only modified from time to time by particular acts of legislation. The brevity of the early conveyances was maintained with only moderate growth through the 12th, 13th and 14th centuries. The different kinds of deeds must be learned by the student from the text-books, but a particular form of document which was especially in favour in England should be mentioned. This was the chirograph (Gr *χρῆφ*, a hand, *γράφειν*, to write), which is found even in the Anglo Saxon period, and which got its name from the word *chirographum*, *cirographum* or *cyrographum* being written in large letters at the head of the deed. At first the word was written, presumably, at the head of each of the two authentic copies which the two parties to a transaction would require. Then it became the habit to use the word as a tally, the two copies of the deed being written on one sheet, head to head, with the word between them, which was then cut through longitudinally in a straight, or more commonly wavy or indented line, each of the two copies thus having half of the word at the head. Any other word, or a series of letters, might thus be employed for the same purpose. The chirograph was the precursor of the modern indenture, the commonest form of English deeds, though no longer a tally. In other countries, the notarial instrument has performed the functions which the chirograph and indenture have discharged for us.

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DIPLOPIA, seeing a single object as double, occurs when ever one of the two eyes leaves the correct position of fixation, i.e., when one eye can not focus on an object simultaneously with the other eye. An object clearly seen by the normal eye gives rise to an image in the deviated eye to one side of the macula and is referred by the mind to a position different from that which it really occupies. Thus, there seem to be two objects, one clearly seen with the normal eye and one indistinctly seen by the deviated eye. Causes of deviation of one eye are (1) disturbances in the motor apparatus of the eye, (2) tumour or abscess in the orbit, (3) limitation of motion of the eyeball from without. Paralysis, or weakness of one or more of the eye muscles, is by far the commonest cause of ocular deviation, and it is in those cases which come on suddenly that diplopia is a striking feature. It occurs frequently in alcoholic intoxication and in encephalitis lethargica and less often in poisoning by lead or carbon monoxide and in certain acute infectious cases as diphtheria and poliomyelitis.

DIPNOI, see FISHES, LUNG-FISH

DIPPOENUS and **SCYLLIS**, early Greek sculptors, who worked together, and are said to have been pupils of Daedalus. Pliny assigns to them the date 580 B.C., and says that they worked at Sicily, which city from their time onward became one of the great schools of sculpture. They also made statues for Cleonae and Argos. They worked in wood, ebony and ivory and apparently also in marble. It is curious that no inscription bearing their names has come to light.

DIPPER, or **WATER-OUSEL**, a bird about the size of a thrush, squatly built and of an active disposition. The dipper (*Cinclus cinclus*) haunts the rocky streams of Europe and North Asia. The dipper, belonging to a small family of its own, the Cinclidae, feeds upon small fresh water molluscs and crustacea, which it captures under the water, walking along the bottom of the stream and aiding its progress with its wings. It can also swim on the surface of the water, despite the fact that its feet are not webbed. The upper parts are dark, the throat and breast white, and the belly has a chestnut band. Its ringing song may be heard even in winter. The white eggs, four to seven in number, are laid in a cup shaped nest of grass, lined with dead leaves and completely encased and domed with moss, except for a small hole to admit the bird. There are five species in the family, found in the northern hemisphere (see OUSEL).

In North America, this genus is represented by *C. mexicanus* in the mountains of the west. The American bird lacks the white throat of the European form, which it otherwise resembles closely. The Costa Rican dipper (*C. ardesiacus*) of the highlands of Costa Rica and Chiriqui is similar, with the general colour a lighter gray.

DIPSACACEAE, a family of dicotyledonous plants, the best-known member of which is the teasel (*q.v.*). The family includes 10 genera and 150 species. The scabiouses (*Scabiosa* *Knausia*) also belong to this family.

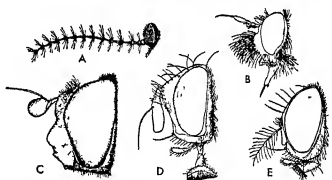
DIPSOMANIA, a term formerly applied to the attacks of delirium (*q.v.*) caused by alcoholic poisoning. It is sometimes loosely used as equivalent to the condition of incurable inebriates but strictly should be confined to the pathological and insatiable desire for alcohol, sometimes occurring in paroxysms.

DIPTERA, the term used in zoological classification for the two winged or true flies which form one of the largest orders of insects. Their chief character is expressed in the name of the order (*Gr* *dis* double, and *ptera* wing) and, with certain aberrant exceptions, flies possess a single pair of membranous wings corresponding with the anterior pair in other winged insects. hind wings are absent and are represented by a pair of small knobbed organs termed halteres or balancers. The mouth parts are always adapted for sucking and sometimes for piercing also, and the various organs combined form a proboscis. Flies undergo complete metamorphosis and their larvae are always devoid of legs and most often have a much reduced head, the pupae are either

free or enclosed in a hardened shell or puparium. The foregoing definition embraces about 75,000 described species, and, of this number, about 3,500 kinds inhabit the British Isles, and new species are continually being found in almost all countries. As a rule, flies are of small or moderate size. Some species are even minute, measuring one millimetre long, while some Australian robber flies exceed three inches in wing expanse with a body length of one and three quarters inches. The majority of flies are diurnal and frequent flowers for their nectar or haunt decaying organic matter of diverse kinds, very many kinds never visit flowers but are found on foliage, tree trunks, fallen logs, in grass, on the ground or on mud where they seek their food. Some are crepuscular (active only at dawn or dusk or on very dark days). The primitive blood-sucking species, such as mosquitoes and sand flies, are mostly crepuscular or nocturnal. Many species are predaceous upon smaller insects, mites and small worms. A relatively small number have acquired the blood-sucking habit, confined chiefly to the females, and a small number of these are of great importance because of their ability to transmit various diseases to man and other animals. The pathogenic organisms of malaria, yellow fever, elephantiasis, onchocerciasis and other diseases are transmitted from animal to man, and from man to man, through the agency of biting flies, and can not be contracted in any other way.

Diptera are generally of sombre coloration, but many are conspicuously banded or spotted with black and yellow, many are metallic green, blue or violaceous, while others are densely hairy and coloured like bees. Many of them resemble wasps and act like them, when captured, they buzz loudly by vibrating the wings and some even bend the tip of the abdomen against the skin as though to sting. Some of those that resemble small bees are parasitic on them, while most of the ones that live in the nests of ants and termites are usually greatly modified, at least in the females. The sexes are usually closely alike but dimorphism is not uncommon. In some flies with long antennae (mosquitoes, etc.) these organs are much more densely plumose in the males, and in this sex the compound eyes often approach each other more closely than in the females, and very frequently they are contiguous.

General Structure.—The head is generally a somewhat spherical capsule, with much of its surface often occupied by the compound eyes, which are usually very large and comprised of



BY COURTESY OF C. H. CURRAN

FIG 1.—HEADS OF FLIES (MAGNIFIED) SHOWING TYPES OF ANTENNAE. A CECIDOMYIIDAE (NEMATOCERA) B ASILIDAE (BRACHYCERA) C SYRPHIDAE (ASCHIZA) D TACHINIDAE (CALYPTERÆ) E MUSCIDAE (CALYPTERÆ)

hundreds of facets, rarely small and having very few facets and absent in only a few cases, usually three ocelli are situated near the top of the head between the eyes, but these are frequently absent. The antennae, generally rising close to the middle of the front of the head are of diverse form (fig 1) and are of great importance in classification. The mouth parts (fig 2) are highly modified for sucking. Mandibles are only present in those flies that feed by piercing and are lancet like, the maxillae in such flies are of similar form but usually they are reduced, partly fused with the head and chiefly represented by their palpi. The labium is membranous and forms the greater part of the proboscis, and

its apex is expanded to form two sucking lobes or labella. The thorax is fused into a single mass chiefly formed by the large mesothorax and the legs have five jointed tarsi. The membranous wings (fig. 4) frequently have the venation reduced and there are but few cross veins, in certain parasitic and other flies wings are absent. In the female the abdomen often has its terminal segments tubular and retractile forming an ovipositor. The tracheae are frequently expanded to form large air sacs, while the digestive

segments, sometimes with terminal style or with dorsal or terminal arista (fig. 1), the distinction between style and arista is one of thickness, but when dorsal it is always termed arista. Pupa free, often mobile, splitting down the back of the anterior part for the emergence of the adult.

This suborder is subdivided into two series, the Nematocera and Brachycera, these are further subdivided by some authors.

Series Nematocera—Mostly slender flies with elongate antennae of seven or more segments, maxillary palpi with four or five segments. Wings with median cells usually absent. Larvae with an evident head, pupae free.

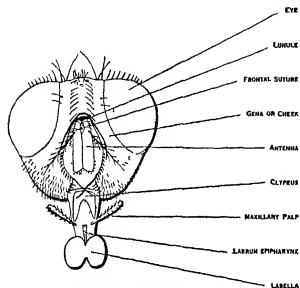
The Nematocera include 20 families, the most important are the following:

The Tipulidae are commonly called crane flies, or "daddy long legs," and are recognized by the long fragile legs, long wings with many veins, and the presence of a V-shaped suture on the back of the thorax. The winter crane flies (Trichoceridae), false crane flies (Ptychoptendae) and primitive crane flies (Tanyderidae) have the V-shaped suture and are frequently included in the Tipulidae. The amazing, practically wingless genus *Chiron* (of Europe and America) is found crawling actively about on snow and quickly becomes inactive if held in the hand or taken into a warm room. The larvae of most species are pale cream coloured or grayish, usually quite soft, and are aquatic or semiaquatic and numerous in swamps and marshes, they inhabit both fresh and brackish water. Those that feed on the roots of grasses and other plants have a heavier covering and are known as "leatherjackets" (qv). The crane flies occur in all land areas of the world, several thousand species having been described. The smallest is about two millimetres, the largest, almost two inches in length.

The Culicidae (figs. 3, 4, *Anopheles*) are known as gnats and mosquitoes (qv), they are slender and delicate, with long legs, the posterior pair being held up by the mosquito when it is at rest. The body and wing veins are partly or wholly clothed with scales of various colours and shapes, in most species those on the wings are spindle shaped or lanceolate, in others they may be broader than long and toothed at the tip, sometimes inflated, or of any intermediate form, there may be only one type of scale on the body or several, there are also bristles and hairs, the former being of the greatest importance in classification, it is the scales which give the colour patterns to mosquitoes and some of them are the most gorgeously coloured of all insects. The mouth parts are stylet like and used, in the females, for sucking blood or sap, the males do not bite. The larvae and pupae are aquatic and are very active, they come to the surface to breathe. *Anopheles* larvae are surface feeders, turning their heads 180° to bring the mouth uppermost. Many larvae have been fully described and the dangerous ones are well known. By 1946 more than 1,700 kinds had been described of which only 20 occurred in Great Britain. The disease carrying species mostly belong to the genera *Anopheles*, *Culex* and *Aedes*. (See ENTOMOLOGY Medical Entomology)

The Simuliidae are called black flies, buffalo gnats and turkey gnats and are easily recognized by their thick antennae and broad delicate wings, the anterior veins heavy, the others very fine. In the males, the eyes broadly touch each other, the two sexes usually differ markedly, the males being much brighter and often with metallic hairs on the thorax. Despite the rather short proboscis the females are vicious biters, but some kinds do not bite man. The larvae and pupae are aquatic, living in running water, the larvae with a pair of mouth fans for securing food and living in a tubular net, pupation takes place in a cocoon in the net, when the adult is ready to emerge, the pupa rises to the surface, the fly emerges and flies away. In 1946 more than 300 kinds were known at least 6 of which carry diseases. (See BLACK FLY)

The Chironomidae, or midges, are small, delicate flies with moderately long, slender legs, venation delicate, the front veins stronger, antennae of the males plumose. The larvae are aquatic or semiaquatic and have been dredged from a depth of more than 1,000 ft. from the bottom of Lake Superior, many are red and are called bloodworms. The adults of many kinds are frequently mistaken for mosquitoes; since the mouth parts are short and not



FROM DR. IMMS' GENERAL TEXT BOOK OF ENTOMOLOGY (REVISED EDITION)

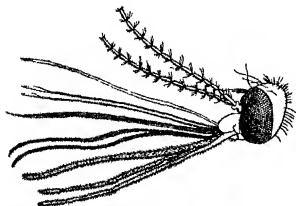
FIG. 2—HEAD AND MOUTH PARTS OF A FLY ALLIED TO THE HOUSEFLY

system usually has a special food reservoir opening into it by a narrow duct. In many flies the ganglia of the ventral chain are fused into a single mass and in some cases, the female reproductive organs are adapted to retain the larvae for a variable period after developing from the eggs.

Classification—The classification of flies is of a very technical character and is somewhat simplified in the following arrangement. Wing venation and the structure of the antennae are the chief criteria for the separation of the major groups and families, but every structure—often very obscure ones—is employed at one time or another in the separation of genera and species. There are three main suborders which embrace most of the families, these are further subdivided. Only the more important families are included below.

SUBORDER ORTHORRHAPHA

Flies in which the head lacks a frontal suture, antennae composed of few to many segments, when composed of four or fewer



FROM THE JOURNAL OF HYGIENE, BY COURTESY OF DR. G. N. F. RUTLAND, F.R.S.

FIG. 3—HEAD AND MOUTH PARTS OF AN ANOPHELES MOSQUITO SHOWING THE PIERCING AND SUCKING APPARATUS

adapted for biting they are harmless

The Ceratopogonidae, or biting midges, differ from the chironomids in that the wings are held flat over the back when at rest instead of roof-like, and the femora are sometimes swollen. All are very small, the biting ones usually about two millimetres long, the predaceous ones seldom more than five millimetres. The antennae are long and plumose, the wing venation is typical and the wings are frequently short haired over most of the surface, often resulting in distinct spots. At least half the species are predaceous, others suck the blood of other insects, a few attack warm blooded animals. The life histories are varied, some are aquatic, others live in mud, decaying vegetation and tree holes, others in the tide zone of sandy beaches. The family is small but nearly 50 species occur in Great Britain. (See SANDFLY FEVER)

The Psychodidae, or moth flies, are easily recognized because they are very hairy and quite small, and the wings are bent at a sharp angle near the base and are held roof like over the body

The wings are usually pointed, the veins and margins haired rarely with scales, there are two forked veins three in *Phlebotomus*, two in front of the middle of the wing. The larvae live in decaying vegetable matter, dung and water and possess both open spiracles and tracheal gills. Species of *Phlebotomus* (incorrectly *Phlebotomus*) suck blood and transmit a number of diseases to man—*Verruga peruviana*, Carrion's disease or Oroya fever in the western Andes, papataci or three day fever, kala-azar or Dum dum fever, and oriental sore in the old world. The adults are mostly nocturnal, including all *Phlebotomus*, but may be found during the day on tree trunks and the undersides of leaves. They walk with a jerky motion, none are more than five millimetres long. *Psychoda* is sometimes a problem in sewage disposal areas and sometimes breeds in washbasin and bathtub drains. There are no *Phlebotomus* in Great Britain, and only four or five in the United States, they are essentially tropical. Other genera are widely distributed. (See ENTOMOLOGY Medical Entomology)

The Cecidomyiidae, or gall midges, are minute flies with very

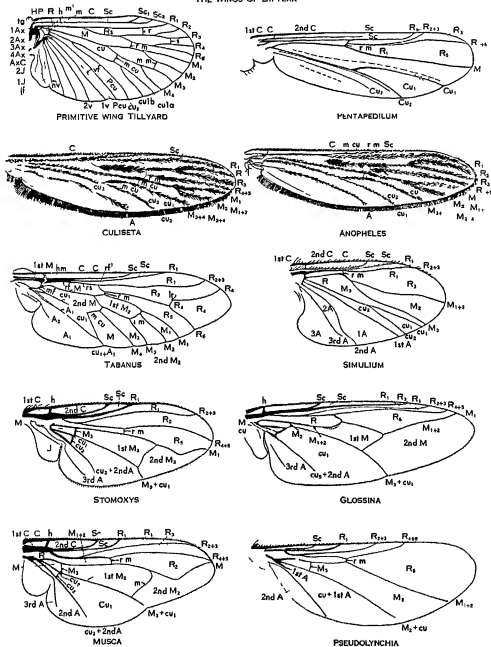
few veins in the wings, which are usually covered with tiny hairs, the antennae are head like and adorned with erelets of hairs, and circumfila—long, filamentous organs arranged in varying patterns and designs and usually attached in several places—are present in most genera. The larvae are often orange in colour, with a minute head, they have a "breast bone" behind the mouth. They make galls of many types and live in the axils of leaves and in flowers, many are serious pests, the best known of which are the Hessian fly (*q v*) and the chrysanthemum midge. A few are predaceous on plant lice. (See GALL MIDGE)

The Mycetophilidae, or fungus gnats, are moderately small to small, slender flies in which the corae are elongated and the eyes widely separated, antennae with 12 to 17 segments, the basal 2 large, the others cylindrical, flattened or petiolate, venation simple, at most 2 cross veins present. The larvae generally feed on fungus and the adults are found in moist places, a very few larvae are luminous and predaceous

The Sciaridae, or dark-winged fungus gnats, differ from the Mycetophilidae in having the eyes closely approach each other above the antennae, most of them have smoky wings and are dark in colour, a few being rusty reddish, veins weak except in front, only one vein branched. The larvae feed on fungus and are sometimes injurious to mushrooms. (See FUNGUS GNAT)

Other families belonging to the Nematoecera are the Anisopodidae, Blephariceridae, or net winged midges, with their remarkable aquatic larvae, the Deuterophlebeidae, their larvae and pupae equally curious, the Thaumaleidae, with larvae similar to the chironomids, the Bibionidae or, in North America, March flies, and the

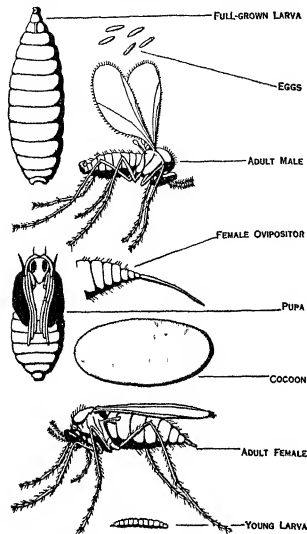
THE WINGS OF DIPTERA



FROM HERMES MEDICAL ENTOMOLOGY (BY PERMISSION OF THE MACMILLAN CO. PUBLISHERS)
FIG 4—WINGS OF DIPTERA, THE LETTERINGS REPRESENT TERMS USED TO DESIGNATE VEINS AND CELLS

Scatopsidae, or minute black scavengers, which feed on decaying vegetation and are often carried into houses in the soil of potted plants

Series Brachycera—Mostly stoutly built flies, the antennae usually with three segments, which may or may not bear a terminal style or dorsal arista, sometimes with four to six segments, rarely more (in some Stratiomyidae and the Khachicidae), maxillary palpi with one or two segments. Wing venation variable.



BY COURTESY OF THE U. S. DEPARTMENT OF AGRICULTURE
FIG 5—THE LIFE HISTORY OF THE ROSE MIDGE (*DASYNEURA RHODO-
PHAGA*), A NATIVE OF THE UNITED STATES

the veins usually strong. Larvae generally with greatly reduced retractile head (fig 8); pupae free, or enclosed in the larval skin and called puparium.

This large suborder is further divided by some authorities from 17 to 30 families are recognized, the most important being mentioned below.

The Stratiomyidae, or soldier flies, are typically more or less flattened, blackish, with white, yellow or green markings; many are metallic blue and green, abdomen often slender and sub-cylindrical; scutellum often with two or more spines. Antennae variable, the third segment usually annulate, long or short, often with terminal or dorsal arista, sometimes as many as ten freely articulated segments. Wing venation is typical—a small cell beyond the middle of the wing toward the front from which three or four usually weak veins arise. The larvae are aquatic or live in mud, decaying vegetation, under bark or on decaying fruit, etc., at least some are predaceous, a few live in brackish water.

There were more than 1,200 described species by 1946. Their chief value lies in their pollination of flowers.

The Tabanidae, commonly called horseflies, deer flies, clegs or greenheads, have more or less broad, somewhat flattened heads, piercing mouth parts and, in life, brightly coloured eyes. The third antennal segment is always annulate, sometimes long, but often short and angulate above, near the base. The eyes of the males are contiguous. The costal vein is continued completely around the wing, the squamae are large. The larvae are predaceous and aquatic or live in mud. The eggs are laid in masses on foliage or twigs over water or mud. More than 2,500 species were known in 1946, mostly belonging to the genus *Tabanus*. All suck blood and many are pests. Some are believed to feed chiefly on birds. Several species of *Chrysops* (deer flies) transmit disease among animals and to man, and some of the clegs (*Haematopota*) carry animal diseases. The females of the American *Gomops chrysochroma* incubate their eggs.



FROM DR. H. H. H. GENERAL TEXT BOOK OF
ENTOMOLOGY (HUTCHINSON & CO.)
FIG 6—THE BRITISH HORSEFLY
(*TABANUS MACULICORNIS*)

The Rhagionidae, or snipe flies, generally have a tapering body and moderately long legs. Third antennal segment usually with a terminal style or arista, in *Symphoromyia* and *Atherix*—both blood sucking—it is kidney shaped, the arista dorsal. Adults and larvae are predaceous, the former frequenting foliage and tree trunks, the larvae living in fresh water, under bark, in dung, etc. The larvae of *Vermileo* and related genera build funnels in dust in which to trap their prey, the adults are long and slender, with long legs.

The Mydaidae, or Midas flies, are all large and have the veins arranged so that they end before the tip of the wing, antenna with four segments, the fourth long, usually without a short style. The larvae live in decaying wood.

The Asilidae, assassin or robber flies, are extremely varied in size, shape, and habits, all are predaceous. They are recognized by having the head concave above, when viewed from in front, and by their wing venation. The eyes usually have an area of enlarged facets, and the ocelli are situated on a tubercle. The antennae have three, very rarely four segments, the third segment with or without a terminal style or arista. The legs are usually spiny, the claws long. The larvae are spiny and occur in a variety of habitats, none are known to be aquatic, some bore in dead trees. (See ROBBER FLY.)

The Bombyliidae, or bee flies (fig 7), are usually clothed with dense hair, which may be mostly tomentose, but some are almost bare. The colours are the result of the hair, which rubs off very easily, many of them have scales on the body and a few have them on the wings. The mouth parts are usually long, antennae with three segments, and usually short, apical style composed of one or two segments. The adults suck nectar and fly during the hottest part of the day, they often rest on hot soil or warm foliage, and most of them hover.

The larvae are parasitic or predaceous. Of the more than 2,000 species known in 1946, only 9 occur in Great Britain, the largest numbers occur in the tropics. (See BEE FLY.)

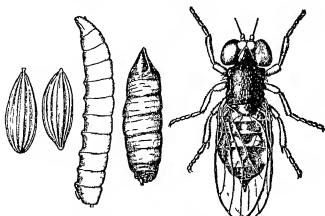
The Nemestrinidae, or tangle-veined flies, have the veins arranged so that they form several to many extra cells in the wings, and most of them are quite hairy. The adults hover and produce a loud buzzing sound. The larvae, at least of the species of *Hirmonychia*, are parasitic or predaceous upon the larvae of root-feeding beetles.

The Cyrtidae, or small-headed flies, are remarkable not only for



FROM DR. H. H. H. GENERAL TEXT BOOK OF
ENTOMOLOGY (HUTCHINSON & CO.)
FIG 7—A COMMON BEE FLY (*BOM-
BYLIUS MAJOR*), OF EUROPE AND
AMERICA, WHICH HAS EXTERNAL
RESEMBLANCE TO CERTAIN BEES

their small, spherical heads but also because they are parasitic on spiders. The eggs of at least some species are broadcast on the soil, the larva develops in the abdomen of the spider. Antennae usually short and with terminal style, proboscis very short or very long, eyes often densely hairy. Although consisting of only about 200 species, the family is cosmopolitan.



FROM KESIG: COLLEGE ENTOMOLOGY (BY PERMISSION OF THE MACMILLAN CO., PUBLISHERS)
FIG. 8—LIFE STAGES OF HIPPELATES PUSIO: AN EYE GNAT OR FRUIT FLY
EGGS, LARVA, PUPA AND ADULT

The Empididae, or dance flies, are small, robust or slender, with moderately long legs, antennae with three, rarely two, segments and usually with terminal style or dorsal arista. Adults and larvae are predaceous upon smaller insects and animals, some larvae are aquatic but most live in damp places, such as moss, decaying vegetation, mud and under bark of trees. Many of them visit flowers. The males of some capture prey which is used as a lure for the females, some blow bubbles for the same purpose. The species of *Hilae* spin silken threads which are used to entrap small prey. The length ranges from one-fifth to almost one-half inch. More than 1,600 species were known by 1946, from all parts of the world.

The Dolichopodidae or Dolichopodidae, the long-headed or long legged flies, are generally metallic green, the eyes are much higher than wide, or at least oval, rarely round, antennae three-segmented, with dorsal or apical arista, thorax with bristles, wings with only one large closed cell. The larvae mostly live in mud and humus, some under bark, a few in the stems of plants. The adults are predaceous upon smaller insects, mites and worms and are of great importance, they occur on mud, foliage and tree trunks. Their appendages are often beautifully ornamented and many indulge in nuptial displays. Many kinds run over water consistently. *Dolichopus* is the largest genus of the northern hemisphere, *Condylostylus* replaces it in the tropics, larvae of some species of *Medeterus* destroy bark beetle larvae. More than 2,000 species were known by 1946, the smallest 1 mm, the largest 8 mm long.

SUBORDER CYCLORRHAPHA

Head usually with a frontal suture, with a small plate or lunule (fig. 2) above it, antennae usually with dorsal arista, but sometimes with a short apical style (fig. 1 B-E). Larvae with minute retractile head, pupae enclosed in the hardened larval skin or puparium (fig. 8), which ruptures by means of a circular fracture.

In these flies a kind of bladder (the ptilinum) is protruded through the frontal suture in order to force open the puparium, thus allowing the insect to emerge, the bladder is then withdrawn into the head.

Series Aschiza.—Frontal suture rudimentary or absent, frontal lunule present. Eight families belong here, the most important ones being as follows:

The Phoridae, very small flies, the third antennal segment usually round, the arista usually apical, head and thorax with bristles, wings with strong veins only in front, three or four weak oblique ones behind. Wings very frequently absent in females.

The larvae are found in a variety of habitats, living in fungus and decaying vegetation, on spider eggs and in the nests of termites, ants and bees. More than 1,000 species were described by 1946, all are very small.

The family Brauhidae contains a single species, *Braula coeca*, which originated in Europe and occurs in many parts of the world. It lacks wings and halteres and is known as the bee louse, it is often injurious to weakened hives of bees.

The Platypidae, or flat-footed flies, have the hind tarsi broadened and flattened on one side, the arista is apical, the larvae live in fungi. The males and females are usually dissimilar in colour.

The Pipunculidae, or big beaded flies, have a large, spherical head, the face and front are extremely narrow, the third antennal segment usually produced downward into a point, the arista dorsal. They are parasitic on bugs, particularly those belonging to the families Cixiellidae and Fulgoridae, at least 12 species attack the beet leaf hopper in North America.

The Syrphidae, commonly called hover flies, flower flies, etc., are the most important of the Aschiza, containing, by 1946, more than 3,000 known species of very diverse habit and form. They are distinguished by having a spurious vein, running between the third and fourth veins and crossing the anterior cross vein (fig. 9). The arista is usually dorsal, bare or plumose, third antennal segment variable, rarely with a terminal style, form usually broad, but often very slender. Most of them bear some resemblance to bees or wasps. The larvae are varied in form and habit, many are predaceous upon aphids, etc., others are aquatic or are scavengers, while others live in the nests of bees, wasps, ants and termites. A few are injurious. (See HOVER FLY.)

Series Schizophora.—The Muscoidea.—Flies having the antennae short, composed of three segments, arista dorsal, rarely a terminal style, frontal suture present.

The Acalypterae.—Squamae or calypteres usually narrow, transverse suture of the mesonotum usually complete, thorax usually with bristles.

This group, a subdivision of the Muscoidea, contains about 40 families of chiefly small flies, some of which are of great economic importance. There is no good dividing line between them and the Calypterae, but the apical cell of the wing is usually fully open and there is no dorsal suture on the second antennal segment, the arista is dorsal, seldom apical. The most important families are included below.

The Conopidae, or thick headed flies, have the anal cell closed near the margin of the wing, an apical style or dorsal arista present. The adults frequent flowers, they are parasitic on bees and wasps, laying their eggs on them during flight. *Stylogaster*, the female with a very long ovipositor, is associated with ants, but its exact status is not known. More than 500 species had been described by 1946.

The Pyrgotidae resemble the Outidae but lack ocelli, they are crepuscular or nocturnal and are parasitic on the larvae of June beetles.

The Outidae, or pictured-wing flies, are also known as Ortalidae and Platystomidae. Almost all have the wings banded or spotted with brown, gray or yellowish, they like bright sunlight, where they crawl about on foliage or tree trunks and wave their wings. Most are believed to be scavengers, but the species of *Tritoxa* attack onion bulbs.

The Trupaneidae, or fruit flies, also have pictured wings and wave them in the same way as the Outidae, they differ in having the subcostal or mediastinal vein evanescent at the apex or curved forward at a near-right angle, and in other minute details. The adults are found on flowers, fruits and foliage, the larval habits are varied, some make galls, others feed on seeds, mine in plants and bore in fruits. The family is cosmopolitan, more than 1,000 species were known in 1946. (See FRUIT FLY.)

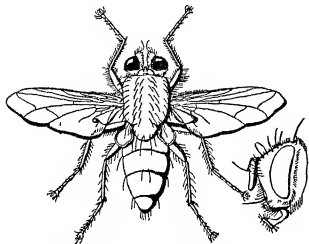
The Protophidae is a very small family of black flies. They are



FIG. 9—WING OF A SYRPHID, SHOWING SPURIOUS VEIN (A)

scavengers but the larvae of *Prophila cases* feed on cheese and preserved meats. They are able to jump an inch or more, the larva grasps the edge of a ridge on the posterior of the body with its mouth hooks and lets go suddenly, causing it to leap into the air.

The Drosophilidae, or small fruit flies, usually have the arista loosely plumose, with more rays above than below. They are used in the study of heredity (see DROSOPHILA, GENETICS) and are attracted to ripe fruit and fermenting substances.



BY COURTESY OF THE U. S. DEPARTMENT OF AGRICULTURE
FIG. 10.—TACHINID FLY (*EXORISTA LARVARUM*) MALE AND HEAD IN PROFILE

The Agromyzidae, or leaf miners, are small, usually black flies, sometimes marked with yellow, rarely mostly yellowish. The larvae make characteristic winding mines in the leaves of plants, several kinds are rather serious pests of flowers and garden crops. The Chloropidae, or fruit flies, are small and usually mostly black. There is no anal cell, and the third antennal segment is usually more or less rounded, the arista dorsal. Several species are injurious to cereals, others carry disease (See FLY FLY).

The Ephyridae, or shore flies, also lack the anal cell and the arista may be plumose, pectinate (with rays on upper surface only) or bare. They are found near water. The larvae of some are aquatic, others live in mud in stems of aquatic or semiaquatic plants or in flowing sap, some are pests in rice fields. The larvae of *Psilopa petrolei* live in crude petroleum in California, the breathing tube projects above the oil.

The Cryptochaetidae are mostly shining black, they are distinguished from related flies by the absence of an arista, the larvae live on scale insects, in America, *Cryptochaetum scervae*, imported from Australia is an effective parasite of the cottony cushion scale, living within its body, pupation occurs in the host. The flies are rather sluggish. Only about a dozen species were known in 1946.

The Chamaemyiidae are small flies of sombre coloration, usually thickly ashy pollinose. The larvae of *Leucops* somewhat resemble those of the aphid feeding syrphids, but the posterior end is transverse and bears a short appendage at each side, giving them a somewhat triangular outline; they feed on aphids, often hiding in the axils of leaves during the day.

The Psilidae have a peculiar weakened line running across the basal third of the wing; the species of *Loxocera* have long, thin antennae. *Psila rosae* attacks carrots and other umbellifera, on carrots, its tunnels look rust-like and it is known as the carrot rust fly, it occurs in Europe and North America, where, at times, it causes serious damage.

The Calyptridae.—The second antennal segment has a dorsal suture extending practically its whole length, the lower lobe of the squamae is large (except in some Muscidae), the thorax is conspicuously bristled.

This group contains an extremely large number of species of economic importance, they attack man and domestic animals,

carry disease and destroy crops, but the damage they cause is more than offset by their control of other insects. The distinctions between the families are of a minor sort, and the number of recognized families varies with different authors, those generally recognized are discussed below.

The Muscidae (including Anthomyiidae and Scatophagidae) lack bristles on the hypopleura, the third and fourth longitudinal veins are usually parallel, the fourth sometimes curved strongly forward as in *Musca*, the lower lobe of the squamae is narrow (Scatophagidae and most Anthomyiidae), large in the Muscidae, abdomen usually without conspicuous bristles. The adults occur everywhere, are of varied form but are generally robust. The habits of the larvae are variable, most live in decaying vegetation and dung, some are leaf miners or feed upon the roots of plants and sprouting grain, others are semiaquatic, living in mud, wet humus and moss. The larvae are generally similar in appearance, but a few, like *Fannia*, bear fleshy appendages and spines (See BEET LEAF MINER, HOUSEFLY, ONION MAGGOT).

The Glossinidae, or tsetse flies, are distinguished from all other flies by the presence of long, plumose rays on the upper surface of the arista, the proboscis is long and swollen at the base, palpi very long, apical cell of the wing strongly narrowed at apex. The family is found only in Africa (See TSETSE FLY).

The Gasterophilidae are the true botflies, living in horses and related animals. The fourth wing vein is evanescent apically, there are no hypopleural bristles and the lower lobe of the squamae is narrow, the exact position of the family is in doubt, some authors placing it in the Acalypterae. The eggs are laid on the animal, in varying places, according to the species concerned. The mouth parts are very greatly reduced in this and the following two families (See BOTFLY).

The Cuterebridae, or robust botflies, are confined to the new world and are parasites of rodents, monkeys and large quadrupeds and sometimes man. They have generally very robust forms and are strong fliers, the squamae are large, and hypopleural bristles are present, the postscutellum is not developed. The posterior breathing spiracles of the larvae are situated in a depression which may be closed when the insect is away from the surface. The family, by the two last mentioned characters, shows relationship to the Metopidae (See BOTFLY).

The Oestridae, or botflies, gadflies, warble flies, etc., are usually robust and hairy, the postscutellum is well developed, hypopleural bristles are present and the squamae are large. The posterior spiracles are not situated in a depression. They are parasites of cattle, sheep, deer, etc. They are apparently related to the Tachinidae (See BOTFLY).

The Metopidae, or flesh flies, bluebottles, blowflies, etc., are also called Sarcophagidae, Calliphoridae and Stephanostomatidae. Some authors divide them into a number of families, basing their decision upon the value of certain characters. The arista is bare, pectinate or plumose, hypopleural bristles are present, squamae large, postscutellum not present, thorax always with dorsal bristles, the abdomen usually with bristles, legs strong and bearing bristles. The larvae are varied in habit, most of them feed on decaying animal matter but many are parasitic on snails, caterpillars, grasshoppers, etc., some live in the nests of termites, others in the nests of bees and wasps. Some are of medical importance. The posterior spiracles are situated in a conspicuous cavity which may be closed in liquid media. The family is a very large one, and difficult taxonomically, the males are easily distinguished from each other by the structure of the genitalia, but the females of many can not be distinguished with certainty (See BLUEBOTTLE, FLESH FLY).

The Tachinidae, or tachinids, are separated from the related groups by the presence of a postscutellum, a strong convexity at the base of the scutellum on the undersurface. They are most variable in form and habits, the thorax is bristled, the abdomen usually so, hypopleural bristles are present, the wing venation varies but the apical cell is usually strongly narrowed or closed, arista bare or plumose, antennae variable in size and shape. The larvae are variable, the posterior spiracles flush with the body surface or produced. All are parasitic upon other insects. Many

kinds have been transported from one country to another to help control both imported and native pests. The family is a large one, with scores of new forms described each year. (See TACHINID FLY)

SUBORDER PUPIPARA

Generally flattened, leathery flies, the coxae widely separated, the legs attached toward the sides, wings present or absent, living on birds and mammals, mature maggots are produced by the females.

The Hippoboscidae are mostly bird parasites and sometimes occur in such numbers that they greatly weaken or kill their host. Some live on deer and disperse with their wings as soon as they locate a host, others live on camels. The sheep tick or ked is always wingless and is found wherever sheep are raised, it pupates in the wool, others usually pupate in soil. The adults are of a hard leathery texture and flattened, they are sometimes attracted to the feathers on millinery.

The Streblidae, or bat flies, are also flattened, usually of a yellowish colour and usually with wings, but these are sometimes reduced in size. They are parasitic on bats and often occur in enormous numbers in bat caves.

The Nycteribidae, or spider like bat flies, are only slightly flattened, and the head folds back into a groove on the front of the thorax, they are wingless and usually brown in colour. Thus and the preceding family are mostly tropical, and both families are quite small.

REPRODUCTION AND DEVELOPMENT

The eggs of flies are of diverse forms and are usually laid in large numbers, thus, a single housefly may deposit more than 2,000 eggs during her life, in masses of 75-150. Many other flies, particularly those that are aquatic or live on decaying matter, also deposit eggs in loose masses or in rows, in *Culex* mosquitoes they are laid in compact rows forming rafts which float on the surface of water. Other flies deposit eggs singly wherever there is sufficient food to nourish the larvae, some scatter hundreds over foliage to be eaten by caterpillars. Most parasitic species lay their eggs on or in other insects, in which they develop, the eggs of certain nematode flies are laid in cracks in fence posts or crevices in trees, and the larvae are carried on the wind and eventually seek out white grubs in the soil. Paedogenesis (reproduction in larval state) occurs in *Master*, the larva hatches from the egg and, when partly grown, many larvae develop within it, they bore their way out, destroying their maggot mother, and develop to maturity. Many kinds of flies give birth to living young, the eggs hatch in the body and maggots are deposited on suitable food, this occurs chiefly where the larvae feed on quickly decaying substances such as meat and excrement, in some cases the females may deposit both maggots and eggs. A further development occurs in certain Muscidae of the American tropics, the maggots are deposited at various stages of development, often being half grown, the final development of this nature is found in the tsetse flies and in the pupipara, the maggots are nourished by special cells in the mother's body until they reach maturity, they are deposited at rather long intervals and pupation takes place almost at once.

In most of the common flies there may be several generations a year, the number depending upon the length of the season and temperature, most flies, however, have but one generation a year, and some species require two or three years for development. The egg stage is usually of short duration, from a few hours to a few weeks. The larvae may mature in a few days.

Dipterous larvae are always without legs and many of them are awl-shaped and without a distinct head, in the Nematocera the head is distinct and often conspicuous, as in the mosquitoes. They usually bear an anterior and posterior pair of spiracles, but the latter only may be present. Because of their legless condition, most fly larvae pass a concealed life in the tissues of plants, burrowing in soil or decaying refuse and dung, in the bodies of other animals or in water. When full grown, the larvae transform to the pupal stage, sometimes casting off the larval skin, at other

times the change takes place within the skin, which adheres firmly to the pupa within and is called a puparium, very few hulk weak cocoons, but many construct cells in the soil. The winter is spent by most flies as larvae or pupae, but some carry over as eggs and some hibernate as adults.

One of the most remarkable life cycles is that of *Psilopa petrolea*, whose larvae inhabit crude petroleum pools in California, some larvae occur in the sea, one kind living in a round ball composed of grains of sand loosely held together by silk, others exist in the hot water of thermal springs. Flies exhibit an extremely wide range of food preference, probably the majority of their larvae feed upon decaying organic matter. A few families are exclusively plant feeders, but the numbers that are predaceous or parasitic are quite large. There are many structural adaptations to fit them to their mode of life. Most of the parasitic forms have only a single pair of spiracles situated at the caudal end, these either bore a hole through their host's skin or keep open the hole through which they entered and extrude the spiracles from it in order to breathe, some tachinid larvae work their spiracles into the tracheae and obtain air contained therein. Some of the botflies have two forms, the young migratory larvae obtaining their oxygen from the blood of the host until they take up their position under the skin, at which time they bore through and breathe the free air. Mosquito larvae have a similar disposition of the spiracles, projecting the siphon through the surface film of water when breathing, in their pupae the spiracles are situated on the thorax. The larvae of black flies build nets enabling them to live in fast-flowing water, while those of the blepharicercids have series of suckers beneath enabling them to cling to stones, the pupae of these rise to the surface, the adult emerges almost immediately and flies away.

Geographical Distribution.—It may be said briefly that all the important families of flies are very widely distributed but certain of the smaller groups are more restricted in their range. As a rule the largest and most striking members occur in the tropics where some of the most exaggerated developments of form are also found. Generally, however, the members of a given family have a very constant facies, whether they come from the tropics or from temperate regions. The housefly is practically cosmopolitan and is found wherever man has established himself, many other flies such as *Lucilia* (greenbottles), *Calliphora* (blowflies) and *Stomoxys* (stable fly) have also become very widely distributed through human agencies, while some of the curious bat parasites (*Nycteribidae*) have a wide distribution dependent upon that of their hosts. On the other hand, the tsetse flies (*Glossina*) are confined to Africa south of the Sahara and the extreme south western tip of Arabia, and the small family *Acanthomeridae* belongs to tropical America and the West Indies. Flies are also met with in very isolated situations. The curious wingless crane fly, *Chionea*, is found in Europe and North America on the surface of snow, while other wingless or semiwingless Diptera are found on the shores of Kerguelen and other far distant ocean islands.

Geological Distribution.—Diptera is one of the latest orders of insects to appear in geological time and is not met with until the Upper Liassic of Europe, where certain Nematocera occur. There appears to be no certain evidence of the existence of the higher families until the Tertiary period. In Baltic amber and in the beds at Florissant, Colo., numerous fossil flies occur.

Economic Importance.—No order of insects exceeds the Diptera in economic importance. A large number of flies in their larval stages are destructive to cultivated plants. Among the most important of these is the fruit fly (*Oscinella frit*) of Europe and North America, which is destructive to growing oats, while the closely allied gnat fly (*Chlorops taeniosus*) produces swollen deformations of the ear bearing shoots of barley. Leatherjackets, or larvae of certain crane flies, cause much damage to the roots of cereals and other crops, while the cabbage maggot (*Hyalemya brassicae*) and the onion fly (*Hyalemya antiqua*) entail losses to growers of those vegetables. The Hessian fly (*Mayetiola destructor*) is also a severe pest of cereals, both in Europe and North America. Mention must also be made of the Mediterranean fruit

fly (*Ceratitis capitata*) which attacks almost all kinds of succulent fruit in many tropical and warm regions, including south Europe.

There are other flies whose larvae are injurious to man and domestic animals, and the affections induced by their presence are included under the general term of *myiasis*. Included in this category are the Oestridae, especially the warble flies (*Hypoderma*) of Europe and North America, which cause immense losses through perforating the hides of cattle, the larvae of botflies (*Gasterophilus*) are parasites that attach themselves to the alimentary canal of horses and mules. The related sheep botfly (*Oestrus ovis*) troubles sheep, its larvae burrowing in the cranial sinuses. The screw-worm, or larva of *Chrysomya americana* occurs from the United States to Patagonia and infests sores and wounds in animals and even the nasal cavities of man. The sheep maggot flies of Australia and other countries include several species which cause immense losses on sheep farms, their larvae often puncture the skin, causing horrible infestations, accompanied by bacterial infection of the parts concerned.

There are also numerous flies of blood-sucking habits, whose larvae are not directly injurious. Certain kinds are irritating pests of man and domestic animals, while others of similar habits convey the pathogenic organisms of certain virulent diseases from one animal, or human being, to another. Thus, many species of *Anopheles* mosquitoes are the direct carriers of malarial parasites from man to man. Yellow fever is contracted only when the mosquito *Aedes aegypti* (formerly known as *Szegomyia fasciata*) sucks the blood of man after having previously fed upon an infected person. Another mosquito, *Culex fatigans*, is a carrier of the filaria worm which induces the disfiguring disease of elephantiasis, while the tsetse fly (*Glossina*) is a carrier of the pathogenic organisms (trypanosomes) of sleeping sickness in man and of nagana in domestic animals. The minute moth flies (family Psychodidae) include the blood-sucking genus *Phlebotomus*, the members of which are small enough to pass through the meshes of mosquito curtains. Sand fever or papillaria fever of southern Europe, North Africa, etc., is transmitted from man to man by a member of this genus. Menton must also be made of the horseflies (family Tabanidae), a species of which (*Tabanus stratus*) has been shown to transmit the pathogenic organism of surra among horses and other animals in the orient.

The housefly (*Musca domestica*), although innocent of blood-sucking habits, is a dangerous carrier of the germs of typhoid, infantile diarrhoea and other diseases. Being attracted to excrementous matter, often containing disease germs, the insect's mouth parts and body thus become contaminated and its faeces include ingested bacilli. Flies infected in this way readily contaminate food which consequently becomes a source of infection to human beings.

The economic importance of Diptera is not confined to their injurious activities, on the other hand, there are many species which are valuable auxiliaries to man. The majority of the predaceous and parasitic forms are beneficial, many larvae of the hover flies (family Syrphidae), for example, are important agents in reducing the excess multiplication of plant lice, while the parasitic larvae of the Tachinidae destroy vast numbers of other insects. The role of the latter flies as natural controlling agents has led to their practical utilization in several parts of the world. Thus, the sugar cane borer beetle (*Rhagoctenia obscura*) in the Hawaiian Islands is so successfully parasitized by the tachinid *Ceratomya spherocephala*, introduced into those islands from West Guinea, that it is largely under control. Other Tachinidae have been introduced from Europe and Japan into North America to assist in the control of the gypsy moth and other pests, and conspicuous success has attended the importation of the fly *Phrycanera remota* from Malaysia into Borneo, where it is parasitizing the caterpillars of the coconut moth.

Bibliography.—Although literature on flies is voluminous, there are few comprehensive works of a general nature. The partly reprinted work, edited by Dr. Erwin Lindner, *Die Insekten der Palaearktischen Region* (Stuttgart, 1926 et seq.) is most thorough, also the uncompleted series *Faune de France, Diptera* (Paris, 1926 et seq.) For British flies see W. J. Wiegman, "A Preliminary List of Durham Diptera," *Trans. Nat. Hist. Soc. Northumberland*, vol. 2 (Durham and Newcastle, 1906), also F. W. Edwards, H. Oldroyd and J. Smart, *British Blood-sucking Flies* (London, 1929). Two volumes by G. H. Verrill, *British Flies*, deal with the Syrphidae and other families, the *Diptera Americae*, in English, by W. J. Lundbeck, is most valuable but covers only certain families, the *Handbook der Palaearktischen Diptera* (Budapest, 1902-05) gives references to species known to that time, the *Catalogue Dipteronum* (Budapest, 1902-10) covers world species of all but the Muscidae. For the American species, J. M. Aldrich, *Catalogue of North American Diptera* (Smithsonian Misc. Coll., 46, 1905) is the latest available. *The Families and Genera of North American*

Diptera by C. H. Curran contains keys to genera from Panamá north, including the West Indies, and is useful for other parts of the world, covering all but a few families. *The Fauna of British India, Diptera* (London, 1912 et seq.) deals with many families of Indian flies.

Among the works on special subjects, the following will be found most useful: J. Smart, *Insects of Medical Importance* (London, 1943), C. G. Hewitt, *The House Fly* (1914), R. Newstead, A. M. Evans and W. H. Potts, *Guide to the Study of Tsetse Flies* (London, 1934), F. W. Edwards, "British Non-biting Midges, Chironomidae," *Trans. Entomological Soc. London* (1929), deals thoroughly with this family. Two volumes entitled *Flies and Disease*, by E. Handle and G. S. Graham-Smith, respectively, may be mentioned, references dealing with flies and disease will be found under the article *Entomology*, and various textbooks on medical entomology should be consulted. Other references dealing with specific subjects will be found under *Mosquito*, *Tachinid Fly*, etc. Among the few books of a popular character are L. C. Muir, *Natural History of Aquatic Insects* (1902) and J. H. Fabre, *The Life of the Fly* (English trans. from *Souvenirs entomologiques*) (1913). See also A. D. Imms, *Recent Advances in Entomology* (1931). (C. H. Cn., A. D. 1.)

DIPTERAL, the term applied to temples that have a double range of columns in the peristyle, as in the temple of Diana at Ephesus.

DIPTEROCARPACEAE, an important family of Palaeotropical trees, the fruits of most genera characteristically two- to five-winged, so as to give them a spiral motion in falling. All of the species are important timber trees, and many of them yield valuable resins. The timber of various Philippine representatives of the genus *Shorea* was extensively imported into the United States under the trade name Philippine mahogany. Twenty genera are usually recognized, with about 400 known species. The family is a characteristic one of the rich primary forests of India and Ceylon, but more especially the eastern peninsula of Asia and the Malay archipelago, there are two somewhat aberrant genera in Africa. The large genera are *Dipterocarpus*, 70 species, *Aussopter*, 20 species, *Hopoe*, 60 species, *Shorea*, 100 species, and *Vatica*, 50 species. *Sal (q v)* is an important timber tree in India (*Shorea robusta*).

For a consideration of the genus see E. Glig, "Dipterocarpaceae," in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, vol. 21, pp. 237-269, figs. 108-118 (1925). (E. D. M.)

DIPTYCH, (1) Two writing tablets hinged or strung together, used in the Roman empire for letters and documents, especially (made of bronze) for the discharge of time-expired soldiers, also (made of wood or ivory, sometimes of gold or silver, and containing the sender's name and portrait) for a token of a consul's, praetor's or aedile's entrance into a city, which he issued to his friends and the public generally (Gr. διπτυχον, two folding).

(2) In the early Christian Church the names of eminent members and benefactors, living or dead, were recorded on diptychs and read aloud from the ambo or from the altar, thereby securing the prayers of the church, especially, in each church, were the names of those who had been its bishops recorded. The reading of these names during the canon of the mass gave rise to the term *canonization*.

The diptych formed the germ of the elaborate system of festologies, martyrologies and calendars which developed in the church. It went by various names in the early church—mystical tablets, anniversary books, ecclesiastical matriculation registers or books of the living. According to the names inscribed a diptych might be a *diptycha eposporum*, *diptycha mortuorum* or *diptycha vivorum*.

The richly ornamented outsides of consular diptychs sometimes found their way into church treasures, where they were eventually used as covers for copies of the Gospels, or for liturgical prayers, and their tradition was continued in the use of the diptych or triptych form for works of Christian devotional art. (See *IVORY CARVING*.) (R. A. S. M.)

DIR, an independent state in the North-West Frontier Province of India, lying to the northeast of Swat. It commands the greater part of the route between Chitral and the Peshawar frontier. The trouble between the Khan of Dir and Umra Khan of Jandol were factors that led up to the Chitral campaign of 1895. During that expedition the Khan made an agreement with the British government to keep the road to Chitral open in return for a subsidy. Including the Bashkars, an aboriginal tribe allied to

the Torwals and Garhuis, who inhabit Panjkor Kohistan, the population is estimated at about 100,000.

DIRAC, PAUL ADRIEN MAURICE (1902—), British mathematical physicist in the field of atomic structure, was born in Bristol, Eng. He started as an engineering student at Bristol university, but soon shifted to physics and received his Ph.D. from Cambridge university. His pioneer work in the quantum mechanics of the atom won him the Nobel prize (jointly with Erwin Schrodinger) in 1933, at the age of 31. He was awarded the royal medal of the Royal society in 1939. In 1925, when the true quantum mechanics was first being developed by Werner Heisenberg, Louis Victor de Broglie and Schrodinger, he independently developed an equivalent mathematical form, which involved essentially a noncommutative algebra for calculating atomic properties. In his book *The Principles of Quantum Mechanics*, Dirac developed the so-called transformation theory of quantum mechanics which furnished a machinery for calculating the statistical distribution of certain variables when others are specified. He was codiscoverer of the Fermi-Dirac statistics and pioneered in developing the quantum theory of radiation. In his *Quantum Theory of the Electron* he replaced the conventional single second-order Schrodinger wave equation by four simultaneous first order equations. When these equations are solved, various properties of the electron, such as its spin and anomalous magnetic moment, make their appearance in an almost miraculous fashion. For a while, a rather mystifying property of the solutions of these equations was the existence of states of negative energy, which at first did not seem to correspond to physical reality, and hence had to be excluded arbitrarily. However, in a later paper, Dirac suggested that a deficiency of an electron in one of these states would be equivalent to a positively charged particle, of transient life because the state might later become occupied. This concept was confirmed in Carl David Anderson's discovery of the positron (J. H. V. V.).

DIRCE, in Greek legend, daughter of Helios the sun god, the second wife of Lycus, king of Thebes. After her death (see ANTIOPE) her body was cast into a spring near Thebes afterward called by her name.

DIRECT ACTION In a limited sense, the phrase is used to describe the methods of trade unionism as opposed to parliamentary action for the purpose of obtaining demands of labour for better working and living conditions. In its wider meaning, it refers to the use of trade union action not only for immediate economic and political ends but also for the overthrow of capitalism and the establishment of a socialist order. In this wider sense, direct action is an attempt to reconcile the Marxian idea of class struggle and the anarchist (Proudhonian and Bakuninist) opposition to the state in general and to parliamentary government in particular with the trade union idea that labour can improve its economic and social status only through the power of its professional organizations. For such larger purposes, direct action calls for the use of various forms of the strike (in one or several trades or industries), of the general strike, sabotage, the boycott, the trade-union label and of antiparliamentary and antimilitarist activities.

The idea of direct action was developed in France between 1900 and 1904 by the leaders of the French Confederation of Labour (C.G.T.) and by a group of allied intellectuals of whom the best known was Georges Sorel. Between 1910 and 1914 the idea was taken up by the British labour movement. It was the most powerful method of direct action. Considering the object for which they have been used in different countries, general

strikes may be divided into four classes: industrial general strikes, general strikes against war, political general strikes, and revolutionary or social general strikes.

Direct Action for Industrial Ends—Some general strikes for industrial ends were not inspired by theories of direct action but were the result of the forms of labour organization and of the methods of wage determination prevalent in the country. Such have been particularly the actual (1909) or threatened general strikes in Sweden. On the other hand, the large strikes conducted by the Industrial Workers of the World in the U.S. in the textile, lumber and other industries during 1911-14 were inspired by the idea of direct action.

Direct Action Against War—The French syndicalists during the decade before World War I were passionately opposed to war, devoted much of their time to antimilitarist and antiwar propaganda and claimed a war could be prevented by a general strike called at the same time by workers of all the countries involved. After 1910, as war began to seem possible in Europe, French and British socialists, among whom the most active were Edouard Vaillant in France and James Keir Hardie in England, urged the socialist international (the so-called second international) to adopt a resolution in favour of a general strike in case of war. The question was debated at great length at the international socialist congresses between 1910 and 1914, but did not receive support from the German Social Democratic party, strongest and largest socialist organization in Europe. The German socialists argued that adoption of such a resolution would make them an illegal party in Germany, and that a general strike under conditions of war would be tantamount to social revolution. No general strike, in fact, was called in any country to prevent the outbreak of World War I. After 1919, the idea of direct action against war gained support for a while. From 1937 to 1939 the majority of organized workers in western Europe and in the U.S. favoured armed opposition to Hitlerism and fascism.

Limited Political Direct Action—Even before the development of the theory of direct action, general strikes were used to force governments to grant limited political and economic concessions. In 1893, a general strike secured universal suffrage in Belgium. In 1902, the Swedish trade unions called a three-day general strike to destroy a reactionary government franchise bill, which was withdrawn. In fact, these successful strikes and the general strikes in France during 1902-06 (for the closing of the private employment bureaus, to secure state technical education and for the eight-hour day) which were wholly or partly effective, aroused much enthusiasm in labour circles for the general strike and strengthened the faith in its possibilities as a method both of social reform and of revolution.

During the turbulent years after World War I, general strikes were resorted to in a number of countries for various ends, and with various degrees of success. The general strike in Seattle, Wash., in 1919 failed because the workers, after gaining the upper hand in the city, had no clear program and were defeated by the aroused middle classes and the use of the police force. On the other hand, the Kapp Putsch in Germany in 1920, by which a group of monarchist officers overthrew the republican government, was expeditiously ended by a general strike called by the German trade unions with the assent of the deposed republican government. The British general strike of 1926 was organized in support of the British miners and because of deep resentment against the behaviour of the Tory government but was called off by the trade union leaders after a few days on the realization that it might lead to a decisive struggle of revolutionary scope.

The failure of the British general strike and of others which took place between 1919 and 1926 dampened the enthusiasm for the idea. Besides, the divisions and schisms in the labour movements of Europe during the following decade, the restrictions on the right to strike imposed in many countries and the rise of fascism and nazism made general strikes for limited political ends practically impossible. Only in some Latin American countries was it resorted to as a means of speeding a dictator out of power or of forcing constitutional changes.

An interesting use of the general strike during World War II

was made by the workers of Copenhagen in 1943 which forced the occupying German authorities to relax some of their impositions and evictions. However the most significant development was the resurgence of the political general strike in Europe after World War II. Thus, the Belgian trade unions staged a general strike early in 1945 to force the government, which returned from exile, to give greater recognition to the demands of the more radical elements of the "resistance." A strike threat later in the year helped to prevent the return of King Leopold to Belgium. General strikes in North Italy in 1945 were effective in forcing changes in political and economic administration. General strikes for a few hours or a day occurred in Italy and France during 1946 to demonstrate the solidarity of organized left wing labour against antisocialist and anticommunist groups.

Revolutionary Direct Action.—The syndicalists who developed the theory of direct action were primarily interested in its social-revolutionary aspects. The general strike, in this theory, was important as the method by which capitalism would be overthrown and socialism ushered in. Such a social or revolutionary general strike, it was claimed, might be peaceful since the workers by "folding their arms" and stopping all productive work, would force the employing class and the government to capitulate. Just when such a social general strike would or could take place in any country could not be foreseen, but it was the function of the trade unions to hasten the day by sharpening industrial and political conflicts.

A social general strike as conceived by the syndicalists was never called in western Europe or elsewhere, and it is now realized that the idea itself, in the words of Georges Sorel, is largely a "social myth." Under modern social economic conditions, a social general strike would inevitably lead to a violent revolutionary conflict in which the whole power of the state would be at stake. But experience has shown that a general strike can play an important, and sometimes decisive, part as a first step in a political revolution or even in a social revolution. But even in such cases, the final success of the movement depends on the capacity of the revolutionary forces to assume and hold power and organize the economic life of the country.

The most important case of revolutionary direct action before 1914 was the general strike in Russia from Oct 17 to Nov 7, 1905, in which not only the workers but many professional and middle class groups took part. The tsarist government was severely shaken and granted to the people extended suffrage and an effective constitution. But the government soon recovered from its first shock and tried to withdraw some of the concessions made. In reply, the St. Petersburg soviet, or Council of Workers' and Peasants' Deputies, which had become the recognized revolutionary authority, called a second general strike on Nov 14, 1905. The government this time merely stood aside and allowed the workers to feel the full brunt of the consequent hunger and disorganization. As the soviet had no troops and therefore could not extend the struggle, it had to call off the strike on Nov 19 without securing concessions. On Dec 20, 1905, as a result of the arrest of the whole soviet, another general strike was called, which in Moscow turned into an insurrection and was suppressed.

These general strikes had, however, the effect of giving Russia a limited constitutional government and a parliament (Duma) which played some part in resisting extreme tsarist oppression in Russia between 1905-17.

The general strike also played an important part in starting the revolution against the tsar in March 1917 and in the struggle between the moderate Socialist party of Kerensky and the Bolsheviks under the leadership of Lenin and Trotsky in the summer and fall of 1917. But this struggle, which ended in the greatest social revolution in Europe after the French Revolution, soon assumed the form of battles between opposing armies in the field and of battles for the control of the powers of the state (including the secret police) at home. The success of the Bolsheviks was not due to general strikes but to their military triumph over the other groups during 1918-20.

Both the force and limits of the revolutionary general strike

were demonstrated also in the case of Spain during 1933-36. The general strikes of these years were merely one of the methods used by the left groups (left republicans, socialists, communists, and anarcho syndicalists) in their struggle against the conservative government which they accused of tending toward fascism. The general strikes declared in Oct 1933 and again in Oct 1935 developed into violent fighting in the streets and into open revolts which were crushed by the government under Alcalá Zamora, president of the Spanish republic established in 1931. But they had some influence in bringing about the victory of the left in the national elections of Feb 16, 1936, and in the establishment of the leftist government of Azana.

However, the victory of the left was countered by the revolt of the right under General Francisco Franco, resulting in the civil war which lasted for nearly three years and in which Germany, Italy, soviet Russia and other countries became involved, thus giving the Spanish Civil War the character of a preliminary phase of World War II.

Importance of Direct Action.—Historically, the theory of direct action (as the central part of syndicalism) was the early 20th century phase of the struggle between revolutionary and reformist tendencies for the control of the labour and socialist movements of Europe. In national terms, it was a revolt of French socialist and revolutionary ideas which trace back to Louis Auguste Blanqui and Pierre Joseph Proudhon against the Germanic version of Marxism and the Anglo American views of capitalistic trade unionism. Direct action, in this historic role, was of greatest importance from 1910-14, but it also had considerable influence on the events of 1917-20, including the formation of the communist or Third International.

After 1920, the theory and practice of direct action ceased to be the focus of a distinctive social-revolutionary movement. To the extent to which labour movements in some countries were influenced by revolutionary ideas and aims, they followed the leadership of Russian communism. On the other hand, the labour movements which are reformist and practical in character have adopted some of the methods and slogans of direct action as part of their economic armour but without the original intellectual and emotional tinge. In national terms, revolutionary leadership shifted to soviet Russia with its Bolshevik interpretation of Marxism, while the reformist labour and social movements look for guidance and support to Great Britain and the U.S. The victory of the British labour party in 1945 was expected to strengthen the faith and hope of labour and socialist parties in many countries in the efficacy of parliamentary methods for social reorganization as against the general strike and revolutionary direct action.

Philosophically, the doctrine of direct action is an important strand in the varied texture of current theories as to the nature of class struggle and its relation to social change. The doctrine continues to influence political and sociological students concerned with problems of national sovereignty and the democratic state, with the question of violence as a factor of social evolution and with the impact of group interests on the dynamics of social-economic institutions.

See G. D. H. Cole, *The World of Labour* (1913), Louis Levine, *Syndicalism in France* (1914), R. W. Postgate, *The Bolshevik Theory* (1909), W. Mellor, *Direct Action* (1920), Lewis L. Lorwin, *Labour and Internationalism* (1939) and *Economic Consequences of the Second World War* (1941).

(L. L. L.)

DIRECT ADVERTISING, a type of advertising distinguished by the fact that it is conducted by delivering by post (mail), by person or otherwise the announcement of an advertiser directly to specific individuals instead of by publishing it in a newspaper or magazine to the public in general. Direct advertising commonly takes such forms as catalogues, sales letters, folders, circulars, broadsides, pamphlets, booklets, post cards, novelty pieces, house organs and package inserts. If any of such material is sent to individuals through the post, such advertising is called direct-mail advertising.

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Selling by Mail (1924), J H Picken, *Principles of Selling by Mail* (1927)

DIRECTIONAL ANTENNA, an antenna having the property of radiating or receiving radio waves in larger proportion along some directions than others. A directional antenna used as a transmitting antenna is sometimes called a "directive antenna." If the angle within which the radiation is substantially confined is a small one the antenna may appropriately be described as a "beam antenna." A type of antenna known as a "coil antenna," consisting of one or more complete turns of wire, has directional characteristics and has the property of radiating or receiving radio waves in larger proportion in angular regions 180° apart than in other directions. One type of directional receiving antenna used particularly at low radio frequencies consists of a comparatively low horizontal aerial having a physical length of the same order of magnitude as that of the signalling waves to be received. Such an antenna is known as a "wave antenna."

DIRECTOIRE STYLE, a loose term designating, in architecture, furniture, etc., the transitional work between the restrained classicism of the Louis XVI style (see LOUIS STYLES) and the Roman heaviness of the Empire style (q v), so called from the French directory which was in power 1795-99. The style is characterized by a gradual loss of the delicacy and grace of Louis XVI forms and a growing enthusiasm for purely Roman motives.

DIRECTOR, NAVAL see GUNNERY, NAVAL

DIRECTORS see COMPANY AND CORPORATION LAW

DIRECTORY, literally, that which guides or directs, and hence a book giving directions for public worship, e.g., the *directorium* or *ordo* of the Roman Church. The term now usually signifies a book containing the names, addresses and occupations, etc., of the inhabitants of a town or district, a list of the users of a telephone system or of the members of a particular profession or trade.

The name *Directoire*, or directory, was given to the body which held the executive power in France from Oct. 1795 until Nov. 1799. (See FRENCH REVOLUTION.)

DIRGE, a song or hymn of mourning, particularly one sung at funerals or at a service in commemoration of the dead. It is derived from the first word of the antiphon *Dirige, Domine, Deus meus, in conspectu tuo vocum meum* ("Guide, O Lord, My God, My Way in Thy Sight"), of the opening psalm in the office for the dead in the Roman Church.

The antiphon is adapted from verse 8 of Psalm v.

DIRICHLET, PETER GUSTAV LEJEUNE (1805-1859), German mathematician, was born at Duren on Feb. 13, 1805. He was educated at Cologne, and later held professorships at Breslau and Berlin, and in 1855 he succeeded Karl Friedrich Gauss at Gottingen. He became a member of the Berlin academy in 1832 and a foreign member of the Paris academy in 1854. Dirichlet's chief work was on the theory of numbers, he was the first to lecture on this subject at a German university. His researches on complex numbers were published in the *Berichte der Berliner Akademie* in 1841, 1842 and 1846, they were edited by Julius Dedekind in 1863. Dirichlet also wrote on the theory of potential, on equations of the fifth degree and on definite integrals. He wrote a number of memoirs on the work of Gauss, in order to make it more intelligible, but he did not live long enough to complete this work. He died at Gottingen on May 5, 1859.

DIRIGIBLE—see AIRSHIP

DIRIGIBLE BALLOON see AIRSHIP

DIRK, a dagger, particularly the heavy dagger carried by the Highlanders of Scotland. The dirk as worn in full Highland costume is an elaborately ornamented weapon, with carmings or other stones set in the head of the handle, which has no guard. Inserted in the sheath there may be two small knives. The dirk, in the shape of a straight blade, with a small guard, about 18 in. long, is worn by midshipmen in the royal navy. The origin of the word is doubtful. The earlier forms were *dork* and *durk*, and the spelling *dark*, adopted by Johnson, represents the pronunciation of the second form. The name seems to have been early applied to the daggers of the Highlanders, but the Gaelic word is *bodag*, and the Irish *durc*, often stated to be the origin, is only

an adaptation of the English word. It may be a corruption of the German *Dolch*, "a dagger." The suggestion that it is an application of the Christian name "Dirk," the short form of "Dieterich," is not borne out, according to the *New English Dictionary*, by any use of this name for a dagger, and is further disproved by the earlier English spelling. In Highland full dress, the *sheam dhù*, a small dirk, is carried in the stocking.

DIRSCHAU see TCEZW

DISABILITY, a term used in law to denote an incapacity in certain persons or classes of persons for the full enjoyment of duties or privileges. Thus, persons under age, insane persons, convicted felons, are under disability to do certain legal acts. This disability may be absolute or relative. In the latter case (e.g., drunken or insane persons), the incapable person can not rely on his condition if it was unknown to his contractor at the time the alleged obligation was contracted.

D'ISALGUIER, ANSELME (?-1380-1420), French traveller, sometimes considered the first European to have seen the Niger river. According to the *Historia chronologica parlamentorum patriae octavarum* attributed to Guillaume Bardin, he was a member of a noble family of Toulouse, he reached Gao in 1405, married a native Moslem princess there, then returned to Toulouse with his wife, their daughter, their two sons and some slaves (among them a physician who cured Charles VII of an illness). The Abbe Tricaud who, in his *Essais de littérature pour la connaissance des livres* (Paris, 1702), records this story, added that D'Isalguer wrote an account of his travels and produced a dictionary in Arabic, Tuareg and Songhai. The whole episode is considered as true by C. de la Roncière in *La Découverte de l'Afrique au moyen âge*, vol. 11 (Carro, 1927). But it was later demonstrated that Tricaud copied the *Annales de Toulouse* of Lafaille (Toulouse, 1687), an extremely unreliable work, which embellished the *Historia chronologica* (itself a forgery). Moreover, a thorough study of the vast documentation concerning the family Ysalguer did not reveal the slightest hint about Anselme.

See F. Galabert, "Le Toulousain Anselme Ysalguer est-il allé au Niger au XV^e siècle?" *Mém. Acad. Sciences Toulouse* (1933), P. Wolff, "Une Famille du XIII^e au XVI^e siècle, les Ysalguer de Toulouse," *Mélanges d'histoire sociale* (Paris, 1942). (P. Wo.)

DISARMAMENT. The word disarmament is used to cover three distinct conceptions: (1) the penal destruction or reduction of the armament of a country defeated in war, (2) the complete abolition of all military armament, and (3) the reduction and limitation of national armament by general international agreement. Disarmament in the first sense is by no means new, but it was enforced most strongly on countries defeated in World War II. Disarmament in the second sense has been advocated by individual thinkers. In the third sense disarmament did not come before an international assembly until The Hague conferences (q v) of 1899 and 1907. The failure of these disarmament talks showed how reluctant were the participating powers to reject war as an instrument of national policy.

Disarmament and the 1919 Settlement.—It was partly as a reaction against the conditions of the armed camp of pre-1914 Europe that disarmament was stressed in the making of the Versailles settlement. The fourth of President Wilson's fourteen points demanded "adequate guarantees given and taken that national armaments will be reduced to the lowest point consistent with domestic safety." Article 8 of the covenant of the League of Nations changed the word "domestic" to "national" and added to the point of "national safety" the further phrase, "and the enforcement by common action of international obligations." In this way the disarmament problem was linked more directly with the problem of security. The Versailles settlement began by applying the principle of disarmament to the defeated countries, and regulated the number of men, the equipment, transport and armament which they were allowed to maintain. These specific limitations, the results of defeat in war, were related to the general obligations set out in the preamble to part v of the treaty of Versailles, which expressly declared that "in order to render possible the initiation of a general limitation of the armaments of all nations, Germany undertakes strictly to observe the military, naval and air clauses

which follow" (See *VERSAILLES TREATY OF*).

Disarmament and the League of Nations—The attempt to secure agreement on general disarmament through the League of Nations (*qv*) fell into three phases. The first period of committee work and discussions lasted from 1920 to 1925. The second period from 1925 to 1931 was marked by the slow progress of the Preparatory commission for the Disarmament conference. The third period from 1932 to 1934 was that of the Disarmament conference itself. Although the conference was never formally brought to a close, by the beginning of 1935 disarmament had ceased to be a problem in practical politics and many countries had already embarked upon active rearmament programs.

At the beginning of the first period, the assembly of the League took the first step toward implementing article 8 of the covenant. A nongovernmental temporary mixed commission was set up and, after long deliberations, adopted four resolutions, which were in turn accepted by the assembly in 1922. They underlined the principle that disarmament, in order to be effective, must be general. "There can be no limitation without security," said Lord Robert (later Viscount) Cecil, "but there will be no security without limitation." It was on the basis of these resolutions that the commission proceeded in 1923 to draw up the draft treaty of mutual assistance. When this failed to secure adoption, it was replaced by the Geneva protocol of 1924, which set out to offer a threefold guarantee of security—a common definition of aggression, a general system of arbitration and a clarification of the enforcement measures to be taken against aggression—as a necessary preliminary to the calling of a disarmament conference, which, it was suggested, should meet in July 1925. The protocol was warmly welcomed by the assembly in 1924, but failed to secure support from Great Britain to bring it into operation.

In Dec. 1925 the council set up a Preparatory commission for the Disarmament conference, which met for the first time in May 1926. Germany and the United States became members at once, and the U.S.S.R. followed a year later. The Preparatory commission consisted of governmental representatives, assisted by two advisory technical bodies. Progress was slow. Its final session produced a draft convention, which was submitted to the council in Dec. 1930. Qualified agreement was reached on six main points: the acceptance of the principles of budgetary limitation of armament expenditure and of limitation of the period of service, the establishment of a Permanent Disarmament commission, the limitation of the number of effectives in land, sea and air forces, the acceptance of the method of naval limitations embodied in the London Naval agreement of 1910, and the renunciation of chemical and bacteriological warfare. But these six points were so subject to reservations that they provided little satisfaction even at the time. In Jun. 1931 the council agreed that the Disarmament conference should open on Feb. 2, 1932, and in May it appointed the then British foreign secretary, Arthur Henderson, as president elect. The interval between the signing of the draft convention and the opening of the conference offered little promise of a future solution. Germany had rejected the draft convention because it upheld the *status quo*. France on the other hand affirmed that respect for the disarmament obligations imposed on Germany in 1919 was the basis of all work for wider disarmament.

The conference was attended by the accredited representatives of 59 states, including five nonmembers of the League. Although the draft convention was accepted as a framework there was little real unity of purpose. The French emphasis was on international control, on the building of a powerful force to assist the League in its work. The British emphasis was on what was called qualitative limitation—the reduction of armament not by numbers but by categories, offensive armament being distinguished from defensive. In practice it proved impossible to secure a universally accepted distinction between the two types. It would be misleading, however, to trace the failure of the Disarmament conference to an inability to agree on a set of definitions. It soon became clear, as Salvador de Madariaga had written in 1920, that the solution of the problem of disarmament could not be found within the problem itself, but outside it in the wider problem of building an effective international organization.

The most important stages in the history of the conference were the acceptance in July 1932 of a limited agreement by 41 votes to 2 with 8 abstentions: (1) that air attack against civilian populations should be absolutely prohibited and the number of aircraft and civil aviation regulated, (2) that heavy artillery and tanks should in principle be limited in size, (3) that chemical warfare should be prohibited. Germany, along with the U.S.S.R., voted against this agreement and, insisting on equality of status as a condition of continued support, did not attend the second session of the conference, which began in October. It was not until Dec. 11, 1932, that an acceptable agreement was signed, whereby the governments of the United Kingdom, France and Italy declared "that one of the principles that should guide the conference should be the grant to Germany and to other powers disturbed by treaty, of equality of rights in a system which would provide security for all nations."

This attempt to reconcile French demands for security with German demands for equality contained no provisions for its practical application. Germany was brought back to the Disarmament conference, but the deadlock persisted. It was only broken in March 1933 when Ramsay MacDonald, the British prime minister, offered to the conference the so-called MacDonald plan, a five-year draft convention, which for the first time set out disarmament figures for most European countries. Although the plan was received with cordiality, there was continued disagreement in details, and the conference adjourned again in June 1933, without having reached any new understanding. A French plan, prepared during the recess of 1933, suggested that armament should be stabilized at the existing level for a four or five year period. It was accepted by Great Britain and Italy but was strongly opposed by Germany, now under the control of Adolf Hitler. On Oct. 14, 1933, Germany left the Disarmament conference and the League of Nations.

The conference now came to a standstill for six months, and diplomatic negotiations about disarmament produced no results. The publication of the German military estimates in March 1934 diverted attention to the problem of rearmament, and although the conference reassembled again in May 1934, it was in an atmosphere of unreality. Although four commissions were set up in June to deal with problems of regional security, air armament, guarantees of execution and the manufacture of and trade in arms, the central deadlock was complete. From 1934 onward there was a return to power politics, the prelude to World War II.

Naval Disarmament—Attempts were made between 1919 and 1920, largely on the initiative of the United States, to secure limited naval disarmament. At the Washington conference (*qv*) of Nov. 1921, a Five Power treaty was signed, fixing an arithmetic ratio for large battleships (Great Britain 5, United States 5, Japan 3). It was easier to secure quantitative disarmament in capital ships than in other types of vessel or land armaments (see *WASHINGTON TREATY*).

In June 1927, Pres. Calvin Coolidge, anxious to cut down U.S. expenditure on armament, called a conference at Geneva to consider the limitation of ships not included in the Washington ratios. France and Italy refused to attend, and the United States and Great Britain soon disagreed. The British delegates insisted that mathematical parity with the United States was not equivalent to practical parity, since British lines of trade and communication were longer, and absolute requirements, particularly in small cruisers, were greater. The conference broke down in August.

The London Naval conference (*qv*) of Jan. 1930 was more successful. The United States, Great Britain and Japan drew up an agreed tonnage table, and together with France and Italy accepted a five-year holiday in the construction of capital ships and a limitation of submarines and aircraft carriers. The international situation after 1931 did not permit any extensive discussion of general naval disarmament. Indeed, the Anglo-German Naval agreement of June 1935 recognized Germany's right to ignore the naval restrictions and prohibitions imposed upon it in 1919.

Disarmament After 1939—The experience of the breakdown of the disarmament negotiations of the interwar years and the parallel breakdown of collective security led to a more realistic approach to disarmament problems during and after World War II.

The eighth point of the Atlantic charter declared that all nations "for realistic as well as for spiritual reasons, must come to the abandonment of the use of force." It demanded as a first step toward a general system of security the disarmament of aggressor countries. The Moscow declaration of 1943 spoke of "establishing and maintaining international peace and security with the least diversion of the world's human and economic resources" but it also stressed, as did in increased detail the conferences of Yalta and Potsdam, the disarmament of Germany. The charter of the United Nations reflected the increased emphasis on security. The assembly by article 11 was empowered to consider and make recommendations concerning "the general principles of international peace and security, including the principles governing disarmament and the regulation of armaments," and the Security Council by article 26 was made responsible for drawing up specific plans with the assistance of the Military Staff Committee, created by article 47. A further step was taken in Jan. 1946, when the Atomic Energy Commission was set up and given full powers to make plans for controlling not only atomic weapons but also "all other major weapons adaptable to mass destruction." Despite these provisions, the record of achievement in disarmament in the postwar years was not impressive. A high water mark was reached in Dec. 1946, when notwithstanding open differences of approach a resolution was passed unanimously by the assembly, recognizing the necessity for "an early general regulation and reduction of armaments and armed force." The Security Council went on in Feb. 1947 to set up a Commission for Conventional Armaments, which had its first meeting the following month. Both this body and the Atomic Energy Commission failed to reach agreement, and in May 1948 the latter organization suspended its work on the grounds that "agreement on international control is dependent on co-operation in broader fields of policy." Although in Sept. 1948 the soviet delegate at the assembly proposed an all round cut of one third in armament, a long debate on disarmament merely sharpened differences between the Russian bloc and the rest of the powers. There was a virtual impasse in practical disarmament negotiations. It proved impossible to make the Atomic Energy Commission an effective working body, while a resolution passed by the Commission for Conventional Armaments in Aug. 1949, providing for receipt, verification and publication of information about national armament to be operated by an international organ of control within the framework of the Security Council, was vetoed by the soviet government in Oct. 1949. The fourth session of the general assembly of the United Nations, which opened in Sept. 1949, made little headway in its discussion of the problem of either atomic or general disarmament. The political issue overshadowed everything else. (See also OUTLAWRY OF WAR SECURITY.)

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DISCANT

see DISCANT

DISCHARGING ARCH, in architecture, an arch (*qv*) built over a lintel or square-headed opening, so as to take the weight of the wall above off the horizontal head of the opening. In the great pyramid of Giza (c. 3000 B.C.), the entrance passage is roofed with slabs of stone, but above these great blocks, set leaning against each other at the top so as to leave a triangular space beneath, form what is probably the earliest discharging arch extant.

Discharging arches of circular or segmental shape are frequent in Roman buildings, and by the time of Diocletian, the custom of decorating these arches with an architrave had arisen. This usage, which apparently was of Syrian origin, became rather common during a considerable part of the Byzantine period of

architecture.

DISCIPLES OF CHRIST or **CHRISTIANS**, an American Protestant denomination, founded by Thomas Campbell, his son Alexander Campbell (*qv*) and Barton Warren Stone (1772-1844). Stone had been a Presbyterian minister prominent in the Kentucky revival of 1801, but had revolted because the synod had condemned Richard McNemar, one of his colleagues for preaching (as Stone had done) counter to the Westminster Confession on faith and the work of the Holy Spirit in conversion. He had organized the Springfield presbytery, but in 1804 with his five fellow members signed "The Last Will and Testament of the Springfield Presbytery" giving up that name and calling themselves "Christians." Like Stone, Alexander Campbell had adopted (in 1817) immersion and, like him, his two great desires were for Christian unity and the restoration of the ancient order of things. But the Campbellite doctrines differed widely from the hyper-Calvinism of the Baptists whom they had joined in 1813 especially on the points on which Stone had quarrelled with the Presbyterians and after various local breaks in 1825-30 the Reformers were practically all ruled out of the Baptist communion (1832). The Campbells gradually lost sight of Christian unity, owing to the unfortunate experience with the Baptists and to the tone taken by those clergymen who had met them in debates, and for the sake of Christian union it was peculiarly fortunate that in Jan. 1832, at Lexington, Kentucky, the followers of the Campbells and those of Stone (who had stressed union more than primitive Christianity) united. Campbell objected to the name "Christians" as secularized by Stone, but "Disciples" never drove the name out of use.

During the Civil War the denomination escaped in actual crisis by following the neutral views of Campbell, who opposed slavery, war and abolition. In 1849 the American Christian Missionary society was formed, it was immediately attacked as a "luminous innovation," unwarranted by the New Testament, by literalists led in later years by Benjamin Franklin (secretary of the missionary society in 1857), who opposed all church music also. Isaac Errett (1820-1888) was the most prominent leader of the progressive party, which was considered corrupt and worldly by the literalists, many of whom, in spite of his strenuous efforts, broke off from the main body, especially in that territory embraced by the states of Indiana, Kentucky, Tennessee, Arkansas and Texas.

The main body appointed in 1890 a standing committee on Christian union, their aim was not for absorption, as was clearly shown by their answer in 1887 to overtures from the Protestant Episcopal Church regarding Christian unity. The credal position of the Disciples is simple: great stress is put upon the phrase "the Christ, the Son of the living God," and upon the recognition by Jesus of this confession as the foundation of His church, agreement with Baptists is only as to immersion, which is considered "the primitive confession of Christ and a gracious token of salvation" and as being "for the remission of sins"; they deny the authority over Christians of the Old Testament, and Alexander Campbell held this view so forcibly that he was accused by Baptists of "throwing away the Old Testament." The Lord's Supper is celebrated every Sunday, the bread being broken by the communicants. The Disciples are not Unitarian, but they urge the use of simple New Testament phraseology as to the Godhead. The church government of the Disciples of Christ is congregational in character.

See Errett Gate's *History of the Disciples of Christ* (N.Y., 1905), in "The Story of the Churches" series, and his *Early Relation and Separation of Baptists and Disciples* (Chicago, 1904); B. B. Tyler's *History of the Disciples of Christ in vol. xii of "The American Church History Series"* (N.Y., 1894), and article "Disciples of Christ" by H. L. Willett in Hastings, *Encyclopaedia of Religion and Ethics* vol. iv (P. A.)

DISCLAIMER, a renunciation or disavowal. In law the term is used more particularly in the following senses: (1) in the law of landlord and tenant, the direct repudiation of that relation by the tenant setting up a distinct title either in himself or some third party, (2) in the law of bankruptcy, where the trustee may "disclaim" onerous property (see BANKRUPTCY), (3) in the

law of trusts, the refusal or renunciation of the office or duties of a trustee, (4) in the law of patents, the renunciation, by amendment of specifications, of a portion of an inventor's claim to protection.

DISCONTINUANCE *see* PRACTICE AND PROCEDURE
DISCONTO-GESELLSCHAFT, BERLIN, established in 1851 as a co-operative credit association, carried on after 1856 in the form of a *commandite* joint stock company all lines of commercial and issuing banking business. By its promoting and issue activities its name was prominently connected with the domestic and colonial economic development. Numerous important German and foreign loans were in the past floated under its auspices.

After 1902 the Disconto Gesellschaft extended its technical organizations beyond Berlin throughout Germany. The taking over of the Norddeutsche bank in Hamburg and of the A. Schaaffhausen'scher Bankverein in Cologne carried its sphere of business also to overseas countries and the Rhenish Westphalian district. After the absorption of the Stahl und Federer A G in Stuttgart (Wurttemberg) and the Bank für Thüringen vorm. B. M. Strupp in Meiningen (Thuringia) the Disconto-Gesellschaft owned 127 branches and branch offices covering the whole of Germany. Participations were furthermore held in the Suddeutsche Disconto Gesellschaft A G, Mannheim, and in the bank *ing* firm of L. Pfeiffer, Cassel.

The expansion of the business of the Disconto Gesellschaft led to the establishment of subsidiary banks abroad and participation in other European banks: the Handelsmaatschappij H. Albert de Bary and company in Amsterdam, Kreditbank in Sofia and the bank's interest in the banking firm of Ephrussi and company in Vienna. In overseas countries the Disconto Gesellschaft founded in conjunction with the Norddeutsche bank in Hamburg the Brasilianische Bank für Deutschland, later Banco Brasileiro Alemão in Rio de Janeiro, with branches in São Paulo, Santos, Porto Alegre, Recife and Salvador, and, further, the Banco de Chile y Alemania, in Valparaíso, with branches in Santiago, Concepción, Temuco and Valdivia. In addition to the foregoing the bank also took an active and leading part in the foundation of the Deutsche Asiatische bank in Shanghai. In Oct. 1929 a merger was arranged with the Deutsche bank (*qv*), the capital and reserves of the Disconto-Gesellschaft then standing at about 180,000,000 reichs marks. (H. Fu.)

DISCOUNT AND DISCOUNT HOUSES In trade a deduction from the price of an article, allowed to a buyer who pays cash, is called a discount. In the money market, the word usually means the rate allowed to the buyer for cash of a bill of exchange due at some future date. For example, if the rate of discount for six months' bills is 4% per annum, the buyer on Jan. 1 of a bill for £1,000 due on July 1 will give £980 for it. The market rate of discount is, to a great extent, regulated by the rate officially announced by the Bank of England or by the central bank in other financial capitals.

Discount houses are companies and firms which specialize in the business of buying and selling the bills drawn on English banks, accepting houses, merchants and others. They make their profit by working with a capital which is small in relation to their total commitments and borrowing large sums from banks and other lenders, employing these sums in the purchase of bills which they either hold until maturity, or, more usually, sell later to the banks or to any other buyer who wants a short and liquid investment. Their rate of profit thus depends on the difference between the rate of interest that they have to pay for the money that they borrow and the rate of discount that they are able to charge to those from whom they buy bills, or which they normally have a large stock in hand.

In the early 1950s the London discount market comprised 1 dozen different houses, nine of which published accounts. The 6 had capital resources (including reserves) totalling £2,700,000 and held bills (treasury and commercial) to the amount of about £742,000,000 and government short term bonds amounting to about £311,000,000, making an aggregate portfolio of £1,053,500,000.

Before World War I, the bills handled in the money market consisted almost entirely of those created in the course of trade and private financial operations, but as the amount of treasury bills outstanding increased enormously and as trade was to an increasing extent financed by bank advances, an important part of the business of the discount houses came to be in treasury bills issued weekly by tender. In other centres, where monetary specialization has not been carried so far as in London, discount companies and firms are generally nonexistent or unimportant, but they were successfully developed in New York city, after the establishment of the federal reserve system.

(*See* MONEY MARKET.)

DISCOVERIES AND INVENTIONS *see* INVENTIONS AND DISCOVERIES

DISCOVERY *see* PRACTICE AND PROCEDURE

DISCUS THROWING, the art of throwing from a circle 8 ft 2½ in in diameter to the greatest distance, and so that it falls within a 90° sector marked on the ground, an implement weighing 4 lb 6¼ oz known as a discus. The sport was common in the days of Homer, who mentions it repeatedly. It formed part of the pentathlon, or quintuple games, in the ancient Olympic games and is fully described by Statius (*Thebais*, 646-721). Judging by specimens found by excavators, the ancient discus was a circular plate of stone, later of metal, about 8 in or 9 in in diameter, and weighed from 4 lb to 5 lb, although one of bronze, probably a trophy, preserved in the British museum weighs more than 8 lb. To the Greeks discus throwing was a splendid body building.

Throwing the discus was introduced as an event in modern athletics at the revived Olympic games first held at Athens in 1896, and in the same year was instituted as a Swedish championship. The Olympic victor at Athens was R. S. Garrett (US), 95 ft 7½ in, and the first Swedish champion, Helegesson, 97 ft 5½ in. Thereafter throwing the discus became a recognized event in the athletic championship meetings of all nations. The United States adopted the event in 1897, champion C. H. Henneman, 118 ft 9 in, and England in 1911, champion W. E. B. Henderson, 106 ft 11 in. After World War II the records improved considerably, being world's record, Adolfo Consolini (Italy), Milan, It. (1948), 181 ft 6½ in, Olympic record, Sam Iness (US), Helsinki, Fin. (1952), 180 ft 6½ in, US record, Robert E. Fitch, Minneapolis, Minn. (June 8, 1946), 180 ft 2½ in, English record, H. I. Duguid (1951) 155 ft 3 in. The advance in records resulted from an increasing number of competitors' employing improved technique. The Olympic contests, which set the world's standard, resulted as follows: 1896, R. S. Garrett (US), 95 ft 7½ in, 1900, R. Bauer (Hungary), 118 ft 2½ in, 1904, M. J. Sheridan (US), 128 ft 10½ in, 1908, M. J. Sheridan (US), 134 ft 2 in, 1912, A. R. Taipale (Finland), 148 ft 3½ in, 1920, E. Niklander (Finland), 146 ft 7½ in, 1924, L. C. Houser (US), 151 ft 5½ in, 1928, L. C. Houser (US), 155 ft 2½ in, 1932, J. F. Anderson (US), 162 ft 4½ in, 1936, K. K. Carpenter (US), 165 ft 7½ in, 1948, A. Consolini (Italy), 173 ft 2 in, 1952, Sam Iness (US), 180 ft 6½ in. A new world's record was achieved in Tavastehus, Fin., in 1949 when Fortune Gordien (US) made a throw of 186 ft 11 in.

A great deal of discussion has taken place as to the method of throwing the discus employed by the ancient Greeks. Theories have been based upon the description of the sport as given by Statius and upon a reconstruction of Myron's statue of a discus thrower (*discobolos*) which may be seen in the British museum. This statue portrays the thrower in the act of hurling the missile, and Norman Gardner holds that a wrong attitude has been adopted by the restorer R. Tait McKenzie calls the "Greek style," insisted upon at the first modern Olympic games, "absurd and ridiculous," and says it "could never have been in use among the ancient Greeks" (*see Exercise in Education and Medicine*, 1924). F. A. M. Webster (*see Athletics of To Day*), however, contends that the reconstruction is substantially correct and that the discus thrower is correctly posed in the attitude from which commences the turning movement that precedes the delivery of the missile in all modern forms of discus throwing.

The so-called "Greek style" of discus throwing was included at the Athenian celebration, 1906 (Jaervinen, Finland, 115 ft. 4 in.), and at the London Olympiad, 1908 (Sheridan, U.S.A., 124 ft. 8 in.), but without any great success, so that the event has been abandoned. In the Greek style the thrower places himself upon an inclined pedestal, stretches the arms above the head with the discus held between the hands. He then turns the trunk to the right, bends the body at the waist, allows the right hand holding the discus to swing up behind and places the left hand on the right knee, as in Myron's *Discobolos*. From this position the thrower straightens out his body, hurls the discus forward and leaves the pedestal in the instant of making the throw.

The modern style, which has now entirely superseded the Greek style, provides a more graceful and a more natural series of movements. The essence of this style is that the discus must be slung out and not really thrown at all, the athlete's difficulty lies in controlling an implement which can be retained under and against the hand and wrist only by centrifugal force and such slight pressure as the tips of the fingers are able to exert.

The discus, as used in modern competitions, is composed of a smooth metal rim, permanently attached to a wood body, brass plates set flush into the sides of the wood body, and, in the exact centre of the discus, a means for securing the correct weight, which must be not less than 4 lb. 6 oz. The brass plates, circular in form, may not be less than 2 in. nor more than $2\frac{1}{2}$ in. in diameter. The sides taper in a straight line from the beginning of the curve of the rim to a line at a distance of 1 in. from the centre of the discus. The largest dimension comprises a circle not less than $8\frac{1}{2}$ in., the thickness through the centre is not less than $\frac{1}{2}$ in., and $\frac{1}{4}$ in. from the edge, not less than $\frac{1}{4}$ in.

Method of Throwing the Discus.—Preparatory to making a throw the athlete holds the discus in the right (best) hand so that the edge rests against the joints of the fingers nearest to the tips. He takes up his position in the rear half of an 8 ft. 2 in. circle with the feet about 18 in. apart and his left side turned in the direction in which the throw is to be made. The discus is swung lightly back and forth in front of the body below hip level for balance. On the last of the preliminary swings the discus is allowed to follow its own rearward path. As the missile reaches the limit of backward swing the athlete transfers his weight to his left side, which lends the turning action, whereby the circle is crossed, drops his left shoulder to the left and, literally, "falls" into the turn. He makes a half turn upon the ball of the left foot, which is carrying his weight, puts down the ball of the right foot at, approximately, the centre of the throwing circle, transfers his weight to that foot and, on it, makes a further half turn. The arms are still swinging loosely, but the right (throwing) arm is kept well back and the weight of the body retained over the right leg, until the left foot has been placed down at an angle of about 20° to the proposed direction of the throw. So far, a whirl has been used as a contributory factor to the speed with which the actual delivery of the missile will be made. The turn, or whirl, has brought the athlete into the "set" position, which is the most important phase of the throw. From the "set" position the reverse is started by a pull on the discus accompanied by a strong turn of the trunk from the right to a facing-the-front position. The chest and hips are brought square to the front, by the athlete resisting with his left leg, while he turns on the ball of the right foot, so that the flexed right knee turns in and the raised right heel turns outward, until both are in the same direction. The delivery drive from both legs is so violent that the feet leave the ground in this co-ordinated action, and the reverse is so made that the right foot takes the place of the left. Simultaneously, the discus is put into flight over the forefinger (which usually shows a healthy callosity), and the snap of the throwing arm carries the right hand through in the follow-through to about the point of the left shoulder.

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DISINFECTANTS, substances employed to neutralize the action of pathogenic organisms and prevent the spread of infectious disease. Putting on one side sunlight, perhaps the best of all disinfectants, these agents may be divided into three classes—1st, volatile or vaporizable substances, which attack impurities in the air, 2nd, chemical agents, for acting on the diseased body or on the infectious discharges therefrom, and 3rd, the physical agencies of heat and cold. Among the first class, formal aldehyde takes foremost place. It acts more rapidly than equal quantities of sulphurous acid, and does not affect colours. It is non-poisonous,

though irritating to the eyes and throat. With the exception of iron and steel it does not attack metals. For destroying vermin sulphurous acid is more powerful than formal aldehyde. Camphor and some volatile oils have been employed as air disinfectants, but mask and do not destroy bad odours. In the second class all antiseptic substances may be reckoned, but the substances chiefly employed are oxidizing agents, as potassium permanganate ("Condy's fluid") and solutions of the so called "chlorides of lime," soda and potash, with the chlorides of aluminium and zinc, soluble sulphates and sulphites, solutions of sulphurous acid, and the tar products—carbolic, cresylic and salicylic acids. Of the physical agencies cold is not practically available by artificial means, heat is used for purifying and disinfecting clothes, bedding and textile substances generally, a temperature of about 250° being employed in the form of steam under pressure. For the thorough disinfection of a sick room all three classes of disinfectants may be required.

DISINTEGRATOR A term rather loosely used, but generally applied to a machine which breaks up and reduces materials by impact, as distinct from one which grinds between rollers, or amongst a mass of loose balls in a rotating drum. There are two

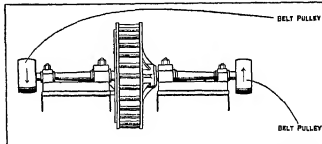
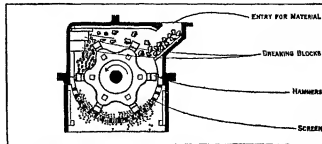


FIG 1—CAGE TYPE DISINTEGRATOR IN WHICH A CAGE OF STEEL BARS REVOLVES WITHIN A CAGE TURNING IN THE OPPOSITE DIRECTION. The cages are enclosed in a steel plate casing (not shown) so that material thrown in is violently hurled about between the bars and broken up into the desired state of fineness.

main classes of disintegrators: the cage or reel and the hammer types, the latter being the more powerful. Among the substances broken up and ground more or less finely in disintegrators are coal, coke, slag, sand, shale, chalk, limestone, pitch, plaster, starch, clay, shells, gypsum, barytes, rock salt, glue, bark, soap, bones, fertilizers, cattle foods, brick bats, stone, limestone, iron oxide, linoleum colours, printer's ink and other products. The more fibrous materials such as bark, rubber, asbestos, leather, herbs, etc., may be shredded up by a machine consisting of a set of revolving knives flying past a set of stationary ones, but in other cases pure



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FIG 2—HAMMER TYPE DISINTEGRATOR WHICH SMASHES THE MATERIAL INTO SMALL PIECES AGAINST THE BREAKING BLOCKS ANY LARGE CHUNKS UNABLE TO PASS THROUGH THE SCREEN ARE PICKED UP BY THE HAMMERS AND THROWN ONCE MORE AGAINST THE BLOCKS

impact is the disintegrating medium. The cage machines have a couple of cages, one within the other, composed of steel bars or beaters, which revolve in opposite directions (fig. 1). The figure shows the machine with the casing removed, when the stuff is fed through a hopper, it is thrown with great violence amongst the bars and broken up. The speed of revolution ranges in various machines from 300 to 2,000 revolutions per minute. For fine disintegration a machine with duplicated sets of cages is employed.

Hammer or blower which consist of a revolving set of swing-hammers which beat the material small within the casing. The disintegrating action may occur while the material is "in the air," or when it is smashed against steel blocks within the strongly built casing. Fig. 2 shows the latter action, as the hammers whirl round it about a thousand revolutions a minute they catch the stuff first into the hopper and hurl it against the blocks, the rebound being caught by succeeding hammers, and the material is finally reduced to the fineness required before it can pass through the screen. The inside of the machine is lined with steel plates which can be renewed when worn through. Some machines are built with a pocket into which fall any odd pieces of iron (termed *tramp iron*) which accidentally get in with the material. This safety device prevents serious damage to the various parts of the mill. A big crusher will break up 100 tons of limestone in the hour.

DISINTERESTED MANAGEMENT. A term historically associated with the regulation and control of the liquor trade, describing a system of management which has for its distinctive object the removal of private profit interest from the sale (in some cases from the manufacture also) of alcoholic beverages. It is not in any sense a prohibitionist system of control. Its object is rather to eliminate from liquor selling the financial inducements which in ordinary trading press for expansion of sales, to bring the motives of trading into harmony with the objects and aim of licensing laws.

In actual practice disinterested management has taken many forms which, although similar in aim, have differed greatly in scope and effect. The underlying principle in every case has, however, been the same. Disinterested management was first adopted on an extensive scale in Scandinavia. It received its earliest statutory sanction in the Swedish law of 1855, which, a few years later, gave birth to the "Gothenburg" system of drink regulation, which may be said to have inspired most of the schemes of disinterested management which have since been adopted in different parts of the world. The growth of the system was rapid and the example of Sweden was quickly followed by Norway and Finland. In 1920 the latter country adopted statutory prohibition, but in Sweden and Norway (both spirit drinking countries) disinterested management is now legally established as the sole method of sale for both spirits and wine. The principle has also received statutory recognition in a permissive form in the Danish law of 1924, and in Estonia.

In Great Britain the principle of disinterested management, although lacking explicit statutory sanction (save only in the case of the State management schemes which were organized during the World War), has been variously applied. The earliest experiments date from the late '70s of last century. They were isolated experiments, but notable as pioneer efforts. The first important attempt to apply the principle of disinterested management in Great Britain, was made by the People's Refreshment-House Association Ltd., which has now some 175 licensed houses (chiefly village inns and small country hotels) under its control. It was followed (1900-01) by the organization of Public House Trusts, of which the late Earl Grey was the founder. There are some 14 or 15 of these Trusts in the United Kingdom, of which three are in Scotland and one in Ireland. Most of them are affiliated to a Central Association but operate as separate companies on a county basis. These Trusts have 92 licensed houses under their management and control. In addition there is Trust Houses Ltd.—a separate and unaffiliated company which is not now organized on a county basis and has 180 houses under its control. All of these Trust houses—172 in number (exclusive of the 125 houses controlled by P. R. H. A.)—are managed on the principle of disinterested management.

There are, also, in the mining districts of Laneshire and in one or two other Scottish areas, a number of so-called "Gothenburg" houses, controlled by local registered companies, in which the principle of disinterested management is applied.

The Carlisle Experiment.—The most complete and important practical application of the principle in Great Britain is, however, represented by the three State management areas in Carlisle and

District, Gretna and Cromarty Firth. In these three areas the liquor trade is under direct Government control and the undertakings have statutory authorization. The Carlisle undertaking is far the most important of the three. It has (save for two hotels and one restaurant) a complete monopoly of the sale of alcoholic liquors in the city of Carlisle and in a large adjacent area, and a partial monopoly in other districts. It also owns and operates the breweries. The undertaking, established in 1916, is directed by a central advisory council, responsible to the Home Secretary, and assisted by a local advisory committee which includes representatives of the local authorities, licensing justices, magistrates, trades council, etc., in the management area. The undertaking is in a sound financial position. By March, 1917, it had repaid, with interest, the whole of the capital liabilities and charges (some £900,000) incurred in the acquisition and development of the properties, and is now a valuable revenue-producing asset, the property of the State, which receives the whole of its profits.

Elsewhere the principle of disinterested management in the form of State control has been adopted on a large scale. In Russia, the State vodka monopoly, founded by M. Witte in 1894, and repealed in 1914 by the late tsar's edict establishing prohibition, has been re-established by the Soviet Government, while in Canada, seven of the nine provinces have substituted Government sale for prohibition. In Poland the State monopoly principle was adopted for spirits in 1914. It applies in the main at present to the production and wholesale distribution of spirits, but includes sale arrangements also. Until 1934 spirits will be sold both in State premises and in private licensed premises. After that date in State premises only. In Germany there has long been a State spirit monopoly, but it is concerned only with the production and wholesale distribution of spirits (*See TEMPERANCE, PROHIBITION, GOETENBURG LICENSING SYSTEM, LOCAL OPTION*). (A. S. R.)

DISMAL SWAMP, a large marshland lying partly in south-central Virginia and partly in north central North Carolina. Now somewhat reduced by drainage, the original area was about 40 m. long and from 15 to 25 m. wide. The region in which the swamp lies is a slightly undulating plain, with an elevation of from 10 to 20 ft. above sea-level. The maximum elevation is in the heart of the swamp, whither the slope grades toward sea-level. Along the western margin a well-defined ancient sea beach, the Nansemond escarpment, rises from 5 to 50 ft. to constitute a natural boundary. Numerous waterways, most having their source in or near Dismal Swamp, traverse the region.

Drummond Lake, the interior pool, is about seven m. long, and five wide, and 15 ft. deep. Dismal Swamp is the major northeastern extension of the great palustrine forest which once dominated the landscape of much of the Coastal plain of the United States and of the lower flood plains of its southern streams, a forest characterized by cypress (*Taxodium distichum*), black gums (*Nyssa biflora* and *N. aquatica*), "juniper" (*Chamaecyparis thyoides*), swamp cotton gum (*N. uniflora*) and water ash (*Fraxinus caroliniana*). Not all the area is forest-covered, however, there being extensive bands and patches of marsh grassland as well. The whole area of the swamp may be drained, but the cost of reclamation would probably make it an unprofitable venture. The forest cover has been in large measure removed.

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DISORDERLY HOUSE, a house of prostitution, more generally, in law, a house in which the conduct of its inmates is such as to become a public nuisance, or a house where persons congregate to the commission of crime. In England, by the Disorderly Houses Act, 1751, the term includes common bawdy houses or brothels, common gaming houses, common betting houses and disorderly places of entertainment. Under that statute unlicensed places of public entertainment were deemed to be disorderly houses if within 200 ft. of the cities of London and Westminster. Brothels are now dealt with by the Criminal Law

Amendment Acts, 1885 to 1922, and charges can be dealt with summarily, but for a second or subsequent offence the accused can demand trial by a jury. The letting out for gain for indiscriminate prostitution of a room or rooms in a house will make it as much a brothel in law as if the whole house were let out for the purpose. Where, however, a woman occupies a house or room which is frequented by men for the purpose of committing fornication with her she cannot be convicted of keeping a disorderly house (see PROSTITUTION). Gaming and betting houses are prohibited and penalties are imposed by two Gaming Acts, 1845 and 1854, and the Betting Act, 1853.

DISPENSATION, a term with two main applications, (1) to the action of administering, arranging or dealing out, and (2) to the action of allowing certain things, rules, etc., to be done away with, relaxed. Of these two meanings the first is to be derived from the classical Latin use of *dispensare*, literally, to weigh out, hence to distribute, especially of the orderly arrangement of a household by a steward, thus *dispensatio* was, in theology, the word chosen to translate the Greek *οικονομία*, economy, *se*, divine or religious systems, as in the Jewish, Mosiac, Christian dispensations. Dispensation in law is, strictly speaking, the suspension by competent authority of general rules of law in particular cases. Its object is to modify the hardships often arising from the rigorous application of general laws to particular cases, and its essence is to preserve the law by suspending its operation, *se*, making it non-existent, in such cases. It follows, then, that dispensation, in its strict sense, is anticipative, *se*, it does not absolve from the consequences of a legal obligation already contracted, but avoids a breach of the law by suspending the obligation to conform to it, *e.g.*, a dispensation or licence to marry within the prohibited degrees, or to hold benefices in plurality.

1 *Ecclesiastical Law*.—In the theory of the canon law the dispensing power is the corollary of the legislative, the authority that makes laws, and no other, having power to suspend them. The dispensing power, like the legislative authority, was formerly invested in general councils and even in provincial synods, but in the West, with the gradual centralization of authority at Rome, it became ultimately vested in the pope as the supreme lawgiver of the Church. Subject, however, to the supreme jurisdiction of the pope, the power of dispensation continued to reside in the other organs of the Church in exact proportion to their legislative capacities, *se*, in provincial synods in respect of regional rules laid down by them, and in bishops in respect of rules laid down by them for their dioceses. In the earlier periods of the papacy the tendency was to disclaim all authority to make concessions and grant relief from traditional rules, but as time went on and the Church expanded, this rigid attitude proved impossible to maintain, and the principle of "tempering" the law when forced to do so "by the exigencies of affairs or of the times" (*rerum vel temporum angustia*), as laid down by Gelasius (494), was adopted into the canon law itself. The principle was, of course, singularly open to abuse. In theory it was laid down from the first that dispensations were only to be granted in cases of urgent necessity and in the highest interests of the Church, in practice, from the 11th century onwards, the power of dispensation was used by the popes as one of the most potent instruments for extending their influence. Dispensations to hold benefices in plurality formed, with provisions and the papal claim to the right of direct appointment, a powerful means for extending the patronage of the Holy See and therefore its hold over the clergy, and from the 13th century onwards this abuse assumed vast proportions (Hinschius, *Kirchenrecht*, II, p. 250). Even more scandalous was the almost unrestrained traffic in licences and dispensations at Rome, which grew up, at least as early as the 14th century, owing to the fees charged for such dispensations having come to be regarded by the Curia as a regular source of revenue (Woker, *Das kirchliche Finanzwesen der Päpste*, Nordlingen, 1878, pp. 75, 160). Loud complaints of these abuses were raised in the reforming councils of Constance and Basel in the 15th century, but nothing was done effectually to check them.

The actual practice of the Church is based upon the decisions

of the council of Trent, which left the mediæval theory intact while endeavouring to guard against its abuses. The proposal put forward by the Gallican and Spanish bishops to subordinate the papal power of dispensation to the consent of the Church in general council was rejected, and even the canons of the council of Trent itself, in so far as they affected reformation of morals or ecclesiastical discipline, were decreed "saving the authority of the Holy See" (*Sess. xxv cap. 21, de ref.*). At the same time it was laid down in respect of all dispensations, whether papal or other, that they were to be granted only for just and urgent causes, or in view of some decided benefit to the Church (*urgens iustaque causa et major quodammodo utilitas*), and in all cases *gratis*. The payment of money for a dispensation was *ipso facto* to make the dispensation void (*Sess. xxv cap. 18, de ref.*).

Church of England.—By an Act of Henry VIII (1534), it was enacted that neither the king, his successors, nor any of his subjects should henceforth sue for licences, dispensations, etc., to the see of Rome, and that the power to issue such licences, dispensations, etc., "for causes not being contrary or repugnant to the Holy Scriptures and laws of God," should be vested in the archbishop of Canterbury for the time being, who at his own discretion was to issue such dispensations, etc., under his seal, to the king and his subjects. The power of dispensation thus vested in the archbishops partly fell obsolete, partly has been curtailed by subsequent statutes, *e.g.*, the Pluralities Act of 1838. It is now confined to granting dispensations for holding two benefices at once, to issuing licences for non residence, and in matrimonial cases to the issuing of special licences. The dispensing power of bishops in the Church of England survives only in the right to grant marriage licences, *se*, dispensations from the obligation to publish the banns. Though, however, these licences and dispensations are given under the archiepiscopal and episcopal seals, they are actually issued by the commissaries of faculties and vicars-general (chancellors), independently, in virtue of the powers conferred on them by their patents. This has led, since the passing of the Divorce Acts and the Marriage with a Deceased Wife's Sister Act, to a curiously anomalous position, licences for the remarriage of divorced persons having been issued under the bishop's seal, while the bishop himself publicly protested that such marriages were contrary to "the law of God," but that he himself had no power to prevent his chancellor licensing them.

See article "Dispensation" and kindred topics in the *Catholic Encyclopedia*, in Herzog-Hauck, *Realencyclopädie* (by Hinschius), Wetzer and Welte's *Kirchenlexikon* (2nd ed.), also F. Lichtenberger, *Encyclopédie des sciences religieuses* (Paris, 1878), *se* "Dispense", and Phillimore, *Ecclesiastical Law*.

2 *Constitutional Law*.—The power of dispensation from the operation of the ordinary law in particular cases is, of course, everywhere inherent in the supreme legislative authority, however rarely it may be exercised. Divorce (in Ireland) by act of parliament may be taken as an example which still actually occurs. On the other hand, the dispensing power once vested in the crown in England is now merely of historical interest, though of great importance in the constitutional struggles of the past. This power possessed by the crown of dispensing with the statute law is said to have been copied from the dispensations or *non obstante* clauses granted by the popes in matters of canon law, the parallel between them is certainly very striking, and there can be no doubt that the principles of the canon law influenced the decisions of the courts in the matter. It was, for instance, very generally laid down that the king could by dispensation make it lawful to do what was *malum prohibitum* but not to do what was *malum in se*, a principle of the canon law, but one difficult to reconcile with English legal principles, since no act is legally *malum* unless forbidden by law. This was pointed out by Chief Justice Vaughan in the celebrated judgment in the case of *Thomas v. Sorrell*, when he rejected the distinction between *malum in se* and *malum prohibitum* as confusing, and attempted to define the dispensing power of the crown by limiting it to cases of individual breaches of penal statutes where no third party loses a right of action, and where the breach is not continuous, at the same time denying the power of the crown to dispense with any general penal law. This judgment, as Sir William Anson points out, only

showed the extreme difficulty of limiting the power ascribed to the crown in standing grievance from the time that parliament had risen to be a constituent part of the state. So long as the legal principle by which the law was "the king's law" survived there was in fact no theoretical basis for such limitation, and the matter resolved itself into one of the great constitutional questions between crown and parliament which issued in the Revolution of 1688. The supreme crisis came owing to the use made by James II of the dispensing power. His action in dispensing with the Test act, in order to enable Roman Catholics to hold office under the crown, was supported by the courts in the test case of *Godden v Hales*, but it made the Revolution inevitable. By the Bill of Rights the exercise of the dispensing power was forbidden, except as might be permitted by statute. At the same time the legality of its exercise was admitted by the clause maintaining the validity of dispensations granted in a certain form before Oct. 23, 1689.

See Sir William R. Anson, *Law and Customs of the Constitution*, pt. 1 "Parliament" 3rd ed., pp. 311-319, F. W. Maitland, *Constitutional History of England* (Cambridge, 1908), pp. 302, etc., William Stubbs, *Constitutional History of England*, 3d ed., 290, 291 (W. A. P.).

DISPERSION

see REFUGES AND THE EXCHANGE OF POPULATIONS

DISPLACEMENT TONNAGE. In shipping, a term used to describe the actual weight of the water displaced by a ship. It is measured by ascertaining the cubic space occupied by that part of the ship which is immersed and dividing this by 35, a ton of sea water measuring 35 cu ft. The term is used to describe the tonnage of warships. (See SHIPPING TONNAGE TERMS.)

DISRAELI, BENJAMIN see BEACONSFIELD, BENJAMIN DISRAELI, CARL OF

D'ISRAELI (or DISRAELI), **ISAAC** (1766-1848), English man of letters, father of the earl of Beaconsfield (q.v.), was born at Enfield in May 1766. His father, Benjamin D'Israeli, migrated from Venice to London in 1748 and belonged to the London congregation of Spanish and Portuguese Jews.

When Isaac D'Israeli was about 14 his father sent him to live with his agent at Amsterdam, where he worked under a tutor for four or five years. There he studied Bayle and Voltaire, and became an ardent disciple of Rousseau. There also he wrote a long poem against commerce, which he produced as an exposition of his opinions when, on his return to England, his father announced his intention of placing him in a commercial house at Bordeaux. Young D'Israeli was sent to travel in France, and spent some time in literary circles in Paris, returning to London in 1788. A poem printed in the *Gentleman's Magazine*, attacking Peter Pindar (John Wolcott) brought him the friendship of his opponent and of H. J. Pye, who helped to persuade his father that it would be a mistake to force him into a business career. D'Israeli dedicated his first book, *A Defence of Poetry*, to Pye in 1790. Thenceforth his life was passed in the way he liked best—in quiet and almost uninterrupted study. In 1802 he married Maria Basevi, by whom he had five children, of whom Benjamin (afterward Lord Beaconsfield and prime minister of England) was the second. He died at his seat at Bradenham house, Buckinghamshire, on Jan. 19, 1843.

Isaac D'Israeli is the author of the *Curiosities of Literature* (1793) subsequent volumes in 1793, 1817, 1823 and 1834. It is a miscellany of literary and historical anecdotes, of original critical remarks, and of interesting and curious information of all kinds, animated by genuine literary feeling, taste and enthusiasm. He also wrote *Miscellaneous, or Literary Recreations* (1796), the *Calamities of Authors* (1812-13), and the *Quarrels of Authors* (1814). Toward the close of his life D'Israeli projected a continuous history of English literature, three volumes of which appeared in 1841 under the title of the *Amenities of Literature*. But of all his works the most delightful is his *Essay on the Literary Character* (1795), which, like most of his writings, abounds in illustrative anecdotes. In the famous "Pope controversy" he supported Byron and Campbell against Bowles and Hazlitt by a defense of Pope in the form of a criticism of Joseph Spence's *Anecdotes* contributed to the *Quarterly Review* (July 1820). In

1797 D'Israeli published three novels, one of these, *Menajoun and Lala*, the *Arabian Petrarch* and *Laura*, was said to be the first oriental romance in English. His last novel *Devotion, or the Fall of the Jesuits*, appeared in 1811, but none of his romances was popular. He also published a slight sketch of Jewish history, especially the growth of the Talmud, entitled the *Genius of Judaism* (1813). He was the author of two historical works—a brief defense of the literary merit and personal and political character of James I (1816), and a learned *Commentary on the Life and Reign of King Charles I* (1828-31).

Of the amiable personal character and the placid life of Isaac D'Israeli a charming picture is to be found in the brief memoir prefixed to the 1849 edition of *Curiosities of Literature*, by his son Lord Beaconsfield.

DISS, a market town in the southern parliamentary division of Norfolk, England, near the river Waveney (the boundary with Suffolk), 95 mi. N.E. by N. from London by the L.N.E. railway. Pop. of urban district (1951) 3,505. The town lies pleasantly upon a hill rising above a mere, which drains to the Waveney, having its banks laid out as public gardens. The church of St. Mary exhibits Decorated and Perpendicular stone and flint work. There is a corn exchange and the agricultural trade is considerable, agricultural implements are manufactured. The poet and satirist, John Skelton (d. 1599), was rector there in the latter part of his life, and is doubtfully considered a native of Diss. Area 6 sq. mi.

DISSEMINATION, of seeds see ANGIOSPERMS *Disseminatio*

DISSENTER, one who dissents or disagrees in matters of opinion, belief, etc. The term, from Lat. *dis sentire*, to disagree, is, however, practically restricted to the special sense of a member of a religious body in England which has separated from the Established Church, and while it has included English Roman Catholics, who in the original draft of the Relief act of 1791 were styled "Protesting Catholic Dissenters," it is in practice restricted to the "Protestant Dissenters" referred to in sec. 1 of the Toleration act of 1689.

The term is not applied to those bodies who dissent from the Established Church of Scotland, and in speaking of members of religious bodies which have seceded from established churches abroad it is usual to employ the term "dissidents" (Lat. *disserere*, to dissent). In this connotation the terms "dissenter" and "dissenting," which had acquired a somewhat contemptuous flavor, have tended since the middle of the 19th century to be replaced by "nonconformist," a term which did not originally imply secession, but only refusal to conform in certain particulars (e.g., the wearing of the surplice) with the authorized usages of the Established Church.

Still more recently the term "nonconformist" has in its turn, as the political attack on the principle of a state establishment of religion developed, tended to give place to the style of "Free Churches" and "Free Churchman." All three terms are now in use. (See BAPTISTS, CONGREGATIONALISM, METHODISM, etc.)

DISSOCIATION, a separation or dispersal, the opposite of association but of wider application (see ASSOCIATION). In chemistry the term is given to chemical reactions in which a substance decomposes reversibly in such a way that, from a single molecule of the original substance, two or more smaller molecules are formed. Often these smaller molecules are of different kinds, but sometimes they are of the same kind. Thus the reactions $\text{NH}_4\text{Cl} \rightleftharpoons \text{NH}_3 + \text{HCl}$, and $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$ are instances of the first type, $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$ of the second. When this breakdown is effected by heating, the process is termed "thermal dissociation." Electrolytic or, as it is termed, ionic dissociation is the separation of a substance in solution into ions (see ELECTRICITY, CONDUCTION OF).

In psychology dissociation is an abnormal condition of the mind wherein the usual connection between various mental elements is lost. Ordinary lapses of memory represent dissociations, in normal minds, between the idea or object which cannot be called to mind and the clue or stimulus idea which formerly sufficed to recall the thing desired. Abrupt changes of mood, or change of

interest from one subject to another, in normal people may represent emotional dissociation. When large, combined groups of ideas and emotions (complexes) become dissociated from other similar groups, the resulting condition is known as dissociation of personality. Such dissociation is held accountable for many insane conditions (See DEFENCE MECHANISMS). In this condition a successful lawyer has been known to draw all his money from the bank, disappear without reason and subsequently open a small shop in a distant city without memory of his former life.

DISSOLUTION, the act of dissolving or reducing to constituent parts, especially of the bringing to an end an association such as a partnership or building society. A dissolution of parliament in England is the end of its existence (See PARLIAMENT).

DISTAFF, in the early forms of spinning, the "rock" or short stick round one end of which the flax, cotton, or wool is loosely wound, and from which it is spun off by the spindle. The "distaff" or "spindle" side of a family refers to the female branch as opposed to the "spear" or male branch. In 7 the day after Epiphany was formerly known as St. Distaff's day, as women then began work again after the Christmas holiday.

DISTEMPER. A distemper in its simplest form consists of whiting, glue (size) and water, and is sometimes called whitewash. The glue acts as a binder, preventing the coatings from rubbing off. Distempers so made are exceedingly cheap, cover well, and are quickly and easily applied with large brushes, but they will not stand washing. They are largely used for whitening ceilings and cheap interior decorative work. When, in course of time the coatings become dirty, it is quite an easy and inexpensive matter to wash them off and apply a fresh coating.

Distempers are sold in the form of a thick paste or jelly, or as a dry powder, and only require mixing with cold or warm water to make them ready for use. A good distemper can be made according to the following recipe. Take 14 lb of guilders' whiting and cover with water. Allow it to stand overnight. Next morning pour off the excess of water and work up well. A small amount of ultramarine blue mixed with water should be added to the whiting to improve the colour. Add about 5 lb of hot jelly size to the whiting and mix well. Strain through a sieve and it is then ready for use. If it is desired to keep the distemper for any length of time before use a small amount—about 1 oz—of alum or borax should be added as a preservative.

Coloured Distempers—By the addition of coloured pigments to the white distemper a large variety of beautiful shades may be obtained. The pigments used for tinting distempers must be permanent to light and perfectly fast to lime and alkalis. Since they are used largely on cement and plaster walls which contain free lime and alkali, such colours as Prussian blue, chrome yellow, Brunswick green, vermillionette, etc., cannot be used, as the alkali would quickly act on them and destroy their colour. In their place permanent pigments, which are fast to light and alkali, such as ultramarine blue, zinc chrome, Hansa yellow, lime green, Venetian red, etc., must be substituted. The following limeproof colours should, when mixed with 14 lb of white distemper, produce approximately the shades given in the right hand column.

| Colours | Tint Produced |
|------------------------|---------------|
| 6 oz Pale French ochre | Cream |
| 6 oz Lime yellow | Primrose |
| 1 lb Venetian red | Salmon pink |
| 1 lb Venetian red | Terra cotta |
| 1 lb Yellow ochre | |
| 1 lb Venetian red | French gray |
| 1 lb Lime blue | |
| 2 oz Bright lime red | Lavender |
| 2 oz Lime blue | |
| 4 oz Pale lime blue | Bluebell |
| 8 oz Lime blue | Light blue |
| 1 lb Lime green | Sage green |
| 4 oz Yellow ochre | |

4 lb Lime green }
8 oz Lime yellow }
5 lb Bright lime red }

Apple green

Pompeian red

Water Paint or Washable Distemper—Although the terms "distemper" and "water paint" are often used synonymously, it is generally accepted that the word "distemper" should be limited to the nonwashable compositions made according to the directions indicated. These simple distempers contain sufficient binder to prevent their rubbing off, but not enough to enable them to stand washing.

The term "water paint," on the other hand, denotes a superior type of modern distemper which contains—in addition to the usual distemper ingredients—a proportion of oil or varnish, which acts as an additional binding agent. With these additional ingredients a good water paint should give insoluble coatings on drying and the coatings should adhere so firmly that they can be washed a few days after application. This property is very valuable as walls coated with these washable sanitary distempers, which have become dirty in course of time, can be easily cleaned and freshened up by simply sponging over with clean cold water.

Water paints have also much better covering and hiding power than the ordinary distempers, because, in addition to whiting, a proportion of lithopone, zinc white or other strong pigment is incorporated, which increases their body or opacity, and gives more solid coatings. Since they contain oils, varnishes, etc., these water paints are sold in paste form only. The paste is of a soft jellylike consistency which only requires mixing with cold or warm water to thin it to a suitable consistency for use.

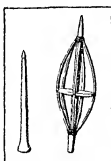
Water paints are largely used as flat wall paints for interior decoration. They are comparatively cheap and can be obtained in a large variety of beautiful shades. They dry very quickly after application, with a pleasing mat or flat finish, and because of the firmness of adhesion and insolubility of these paints it is possible to apply a second coat a few hours after the first coat has dried, without working up the first coat. This property is very useful in those cases where two or more coats are necessary in order completely to hide the surface which is being painted, and give what is known as a "solid" effect.

Flat distempers are often "stippled" or dabbed while still wet with a special flat soft hair brush known as the "stippler." By this process all brush marks that might otherwise be in evidence are removed, and the surface is given a beautiful mat velvetlike finish.

When painting large wall areas, as in town halls, council chambers, schools and so on, these water paints are often applied by means of a spraying machine, in this way very large areas can be quickly and successfully covered with the distemper.

Water paints are manufactured as follows. About 10 lb of strong glue or size powder are put in a steam pan, covered with 10 gal of water and left to soak overnight, steam is then passed through till all the glue has gone into solution. The steam is turned off and about 1 gal of linseed oil, copal varnish or mixtures of these is then added, and the whole well beaten until an emulsion is formed. A small proportion of carbolic acid, formaldehyde, or other preservative is added to the emulsion, otherwise it would mould if kept for any long period. This medium—usually known as petrifying liquid—is then mixed while hot with roughly its own weight of white base consisting of whiting, lithopone, blanc fixe, or mixtures of these, and ground through stone mills. The resultant thin paste is then packed in kegs or tins where it sets on cooling to a soft jellylike consistency. The coloured distempers are obtained by adding the necessary quantity of lime fast colour to the white base during the grinding process. There are some paste distempers on the market which are made by using casein—an insoluble white product obtained from skimmed milk—in place of glue or size. In these varieties the casein is dissolved in water with the aid of some alkali, such as carbonate of soda, ammonia or borax, which is added to the water in order to render the casein soluble. The procedure is then carried on in the way already described.

Outside Distempers—For outdoor use only those distempers



BY COURTESY OF THE METRO POLITAN MUSEUM OF ART. FLAX WHEEL, DISTAFFS USED IN A COLONIAL HOUSEHOLD

should be employed which have been specially made for the purpose. Even when so manufactured these outside distempers although largely used will not last more than a year or two and they do not possess the same durability and wearing properties as an ordinary paint.

Outside quality distempers contain more oil than is generally used in the preparation of distempers for indoor use. This helps to bind them better and serves as a protective agent against weathering influences. They should be thinned ready for use with a medium—known as petrifying liquid—which is specially made for this purpose and is of a similar composition to the medium in which the pigments are ground in making the paste distemper.

Powder Distemper—Dry distempers (called calcimines in the U.S.) consist of whiting or carbonate of lime with either finely powdered glue or casein as their binding agent. They are manufactured by grinding the whiting and powdered glue or casein in special grinding and sifting machinery in order to get a thorough incorporation of all the ingredients. Great care must be taken to see that all the materials are thoroughly dry before mixing as even a small amount of moisture present would make the powder clike and set up hard, and of course render it useless. A little borax, sticlic acid, alum or other dry preservative is added to keep the dry powder sweet and prevent any decomposition that might take place on standing.

In the case of coloured distempers, sufficient lime fast pigments are incorporated during the mixing process in order to give the desired shade.

These dry distempers are very largely used in both Great Britain and the U.S. on account of their comparative cheapness. The following recipes will give a general idea as to their composition.

| | | |
|---|--------------------|--------|
| 1 | Whiting | 100 lb |
| | Fine powdered size | 8 lb |
| | Powdered slum | 2 oz |
| 2 | Whiting | 100 lb |
| | Dry slaked lime | 5 lb |
| | Soda carbonate | 2 lb |
| | Casein | 5 lb |
| 3 | Whiting | 100 lb |
| | Dry slaked lime | 14 lb |
| | Powdered borax | 1 lb |
| | Casein | 12 lb |

These white dry distempers may be tinted to any desired shade by adding lime fast colours. (J. G. Be.)

DISTEMPER IN ART

Distemper is one of the earliest known mediums of painting. It was used extensively by the Greeks and Egyptians. It consists of a mixture of powdered colour with size and it differs from tempera in which process egg is the medium used. The French call all such mixtures *detrempe* but in England the egg mixture is known as tempera and the size mixture as distemper.

The colours are first ground in water and then mixed at the moment of use with size kept liquid in a *bain marie*. This practice is necessitated by the fact that the proportion of the size required varies according to the nature of the powder used.

The method is useful for quick work as it is fluid and dries rapidly. It is durable though soluble in water. It is used chiefly by scene painters but certain French artists, such as Degas and Jean Edouard Vuillard, made good use of it.

DISTEMPER see CANINE DISTEMPER

DISTICH, a couplet consisting originally of a hexameter and pentameter line, containing a single idea, as exemplified in the Greek Anthology. Modern examples are to be found in the works of Goethe and Schiller. (See VERSE.)

DISTILLATION, an operation involving the conversion of a substance into vapour which is subsequently condensed to the liquid form. It may also be thought of as a process for separating liquid mixtures which depends on the difference in composition between a liquid and its vapour. The process is exemplified in its simplest when steam from a kettle plays upon a cold surface

producing drops of distilled water. The natural cycle by which the water of the oceans passes into the air and later condenses and falls as rain is an example of distillation. The term, which was originally applied to the separation of alcoholic liquors from fermented materials, now has a far wider application, and distillation is an integral part of many chemical manufacturing processes. It has for its object the separation of liquids from non-volatile solids as pure water from the salt in sea water, or the separation of two or more liquids, as gasoline, fuel oil and lubricating oil from crude petroleum.

Simple Distillation—This term is used to distinguish the simplest distillation operations, as illustrated in fig. 1, from the

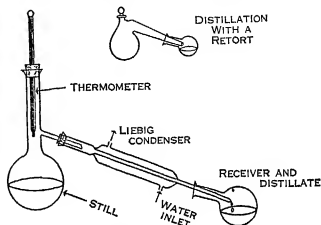


FIG. 1—TYPICAL LABORATORY DISTILLATION APPARATUS OF SIMPLEST TYPE. THE VAPOUR PASSES FROM THE STILL TO THE LIEBIG CONDENSER WHERE IT IS CONDENSED BY COLD WATER CIRCULATING IN THE WATER JACKET. THE DISTILLATE IS COLLECTED IN THE RECEIVER. RETORTS ARE NOW SELDOM USED.

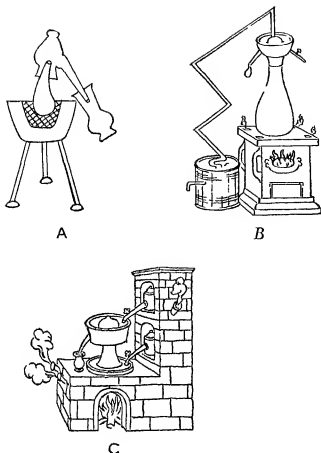
many possible modifications and elaborations. The basic apparatus consists of three parts: the still or retort in which the liquid is heated, the condenser, to cool the vapours, and the receiver to collect the distillate. On distilling a mixture of substances, the most volatile or lowest boiling distils over first, and the others subsequently or not at all. The simple apparatus described is entirely satisfactory for the purification of a liquid containing nonvolatile material, and reasonably satisfactory for separating liquids of widely divergent boiling points. For laboratory use, the apparatus is commonly made of glass and connected with corks or rubber bungs or ground glass joints. Simple distillation is also used frequently in technology, and for such purposes larger equipment of metal or ceramic ware is used. (See *Distillation in Technology*, below.)

A laboratory distilling flask may be heated by direct gas flame or indirectly through a sand tray or wire gauze, or by electrical means. A thermometer is often used to indicate the progress of a distillation. Its bulb is placed just below the side arm where the vapour leaves the still, so that the thermometer reading approximates the temperature of the vapour. Exact boiling points are best determined in a special apparatus.

An air-cooled elongated side tube is adequate as a condenser with substances boiling above 170° C. For lower boiling substances a Liebig single surface condenser (fig. 1) is used. Many varieties of glass condensers are available, but the chief differences between them are in the ingenuity with which the internal members are designed to give maximum cooling effect.

Historical Note—Distillation appears to have been used by the earliest experimentalists. Aristotle (384–322 B.C.) mentioned that pure water is made by the evaporation of sea water. Pliny the elder (A.D. 23–79) described a primitive method of condensation in which the oil obtained by heating rosin is collected on wool placed in the upper part of the still. The Alexandrians added a head or cover to the still, and prepared oil of turpentine by distilling pine resin.

The Arabians improved the apparatus by cooling the tube lead-



FROM *BULLOFF IN CHEMICAL AND METALLURGICAL ENGINEERING* (1904 LAW HILL PUBLISHING CO. INC. (1928))

FIG 2—EARLY DISTILLATION APPARATUS (A) 4TH CENTURY STILL (B) EARLY STILL WITH LARGE REFLEX AREA CONSTANT TEMPERATURE STILL HEAD AND FRACTIONAL CONDENSATION (C) EARLY STILL WITH COOLED HEAD AND PREHEATER

ing from the head, or alembic with water (fig 2). They discovered a number of essential oils by distilling plants and plant juices.

The alchemists used such apparatus to prepare hydrochloric, nitric and sulphuric acids in a relatively pure state.

Early in the 1800s large scale continuous stills for the recovery of alcoholic liquors were devised by J. B. Cellier Blumenthal and Louis Charles Derosne in France, and by Aeneas Coffey in Great Britain. Their bubble plate towers are basically identical with many modern industrial stills. Laboratory practice owed much to the introduction about 1850, of the condenser named (incorrectly) after Justus von Liebig (fig 3).

In the early 1920s the theory of distillation developed earlier by Ernest Sorel was reduced to engineering terms. This stimulated a series of theoretical and practical investigations resulting in such improvement in the efficiency of both industrial and laboratory distillation that separations formerly considered impractical became commonplace. This made distillation one of the most widely used operations in laboratory research analysis and chemical engineering.

Fractional Distillation and Rectification—Fractional distillation was developed because simple distillation is not efficient in the separation of liquids whose boiling points lie close to one another. Originally the term meant the collection of the distillate in successive fractions or cuts. It was also applied to the systematic recombination and redistillation of such cuts in order to improve separation. In modern usage, fractional distillation represents the whole of any process or method whereby the fractions from a distillation are made as different in properties as possible. Especially important in this connection are still heads, columns and condensers (fig 3) that permit the return of some of the condensed vapours toward the still. The whole aim is to achieve the closest possible contact between rising vapour and descending liquid, and so to allow only the most volatile vapour to proceed to the receiver while returning the less volatile material as liquid toward the still. The purification of the more volatile component by contact between such countercurrent streams of vapour and liquid is referred to as enrichment or rectification. The descending liquid is known as reflux.

In modern apparatus reflux is produced by a condenser at the top of a column (fig 3) which is preferably insulated or otherwise made nearly adiabatic and filled with packing or plates (fig 12) or some other device for achieving good contact between vapour and liquid. The most common packings (fig 4A and B) are glass beads, metal chain, Lessing and Raschig rings, Berl saddles, Stedman screens and single and multiple-turn helices of thin wire or glass. A choice among these depends on the diameter of the column and on a balance between cost and efficiency. The Bruun column (fig 4C) is an example of a superior laboratory bubble plate column, but this type reached its greatest development in large-scale technological distillation operations. Other devices involve passage of the countercurrent liquid and vapour streams through the narrow annular space between a tube and a rotating cylinder within the tube.

Either partial or total condensers may be used to produce reflux. In the former, which is also called a dephlegmator, the temperature of the condenser is controlled so that only part of the vapour is liquefied and used as reflux, while the remainder passes on to a second condenser and is collected as product. In total condensers, all the vapour is liquefied. Some of the condensate is removed through a side tube just below the condenser (fig 3) while the remainder supplies reflux. The greater the ratio of reflux liquid to final product (reflux ratio), the better the separation of the various components, but at a corresponding increase in the time and cost of the distillation. Infinite reflux, or total reflux operation, involves no withdrawal of product, and return of all condensate down the column as reflux liquid. Since no distillate is produced, this type of operation is of interest only for testing and for theoretical purposes.

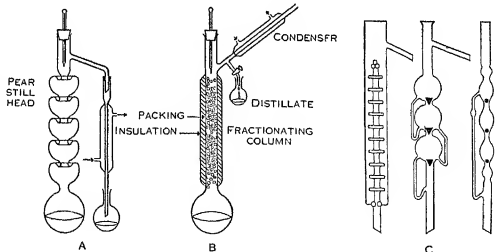
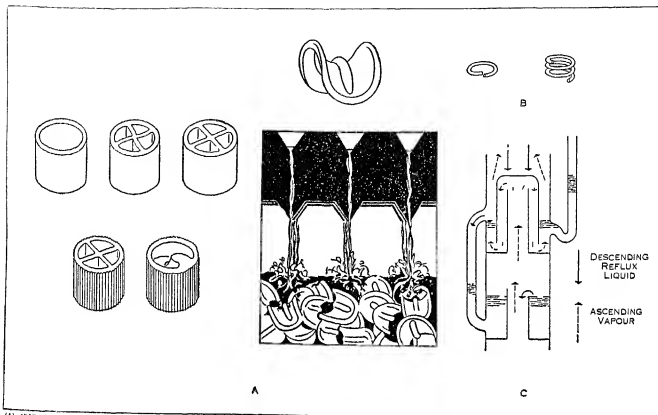


FIG 3—FRACTIONAL DISTILLATION STILL HEADS AND FRACTIONATING COLUMNS (A) FRACTIONAL DISTILLATION WITH PEAR STILL HEAD (B) FRACTIONAL DISTILLATION WITH INSULATED COLUMN AND TOTAL CONDENSER (C) TYPICAL STILL HEADS



(A) FROM PHOTO BY COURTESY OF WALBRIDGE KNIGHT CO

FIG 4—COLUMN PACKING MATERIALS AND LABORATORY GLASS BUBBLE CAP (A) RASCHIG RINGS PARTITION RINGS SPIRAL RINGS BERL SADDLES (B) WIRE HELICES SINGLE TURN AND MULTIPLE TURN (C) LABORATORY GLASS BUBBLE CAP (BRUUN)

Theory of Distillation—Every liquid or liquid mixture will evaporate into a closed space until the pressure of the resulting vapour reaches a characteristic or equilibrium value. This vapour pressure is a measure of the volatility of the liquid. It has a fixed value for any one liquid at a particular temperature, but always increases with rising temperature. At any particular pressure, a sample of pure liquid will distil completely at a fixed temperature, but constancy of boiling point does not prove that the material being distilled is a pure substance. Most liquid mixtures distil over a range of temperatures, but certain compositions of particular mixtures (azeotropes) pass over without change in composition or boiling point. These relations are summarized by the boiling-point curves of fig 5, in which the boiling point of the distillate is plotted against the percentage of the charge that has been distilled. The mixture of liquids with widely divergent boiling points gives a curve with a break at the point where most of the lower boiling component has distilled over. The

sharpness of the break in the distillation curve is determined chiefly by the difference in volatility of the materials being distilled, by the inherent separating power of the column or still head, and by the reflux ratio.

The general theory of distillation is quite complex. For the sake of simplicity the succeeding discussion will be confined to mixtures of two components. Three situations can be distinguished according as the components are (1) quite insoluble in each other—completely immiscible mixtures, (2) soluble only within limits—partly miscible mixtures, (3) soluble in all proportions—completely miscible mixtures.

The first case is illustrated by benzaldehyde and water as discussed under *Steam Distillation*, below. Both components distil together at a temperature below the normal boiling point of either, and in constant proportion until one disappears, after which the other distils alone at its normal boiling point. Partly miscible systems behave similarly as long as two immiscible layers are present, but when one disappears, they behave like a completely miscible mixture.

Three varieties of completely miscible mixtures occur. They are (see fig 6) (A) systems in which an azeotrope has a boiling point greater than that of either pure component—maximum boiling point mixtures, (B) systems in which an azeotrope has a boiling point less than that of either pure component—minimum boiling point mixtures, (C) systems in which all boiling points are intermediate between those of the pure components. Nitric acid (b.p. 56° C) and water (b.p. 100° C) provide an example of (A), the maximum boiling point is 120.5° C for an azeotropic mixture containing 68% of the acid. If a mixture with any other percentage composition is heated, both components pass off in varying amounts until the still contains the azeotropic mixture of maximum boiling point, which then distils unchanged in composition at constant temperature. Propyl alcohol and water furnish an example of (B). On heating this kind of mixture, the azeotrope distils over first, until only one component is left in the still. Thus as a result of their inherent properties, it is impos-

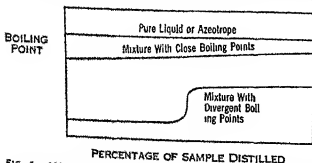


FIG 5—BOILING POINT CURVES FOR TYPICAL LIQUIDS. IF PRESSURE IS CONSTANT THE BOILING POINT RISES AS THE DISTILLATION PROGRESSES EXCEPT WHEN PURE LIQUIDS OR AZEOTROPES ARE BEING DISTILLED. IF THE PRESSURE IS INCREASED OR DECREASED ALL THE BOILING POINTS ARE RESPECTIVELY RAISED OR LOWERED AND THE AZEOTROPE DISTILLING AT THE NEW CONSTANT TEMPERATURE WILL BE OF DIFFERENT COMPOSITION.

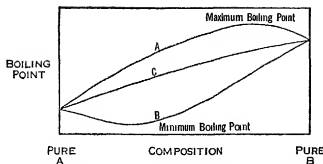


FIG 6—THE THREE VARIETIES OF COMPLETELY MISCIBLE BINARY MIXTURES (A) MAXIMUM BOILING POINT MIXTURES (B) MINIMUM BOILING POINT MIXTURES (C) MIXTURES IN WHICH ALL COMPOSITIONS HAVE BOILING POINTS INTERMEDIATE BETWEEN THOSE OF THE PURE COMPONENTS

ble to separate mixtures of (A) and (B) into their pure components by distillation. The difficulties of separating mixtures of (C) are of a different order. Methyl alcohol and water constitute a pertinent example. On distilling any mixture of the two, the distillate always contains a greater proportion of methyl alcohol (the lower boiling component) than the residue in the still. The completeness of the separation of the methyl alcohol from the water depends only on the number of redistillations and the efficiency of the fractionating column.

Theoretical Plates and Plate Efficiency—Fractionating columns are rated according to the number of theoretical plates, and, in the case of plate columns, also according to plate efficiency. A theoretical plate may be defined as one that produces the same difference in composition as exists at equilibrium between a liquid mixture and its vapour. Thus, for example, any portion of a column that produces an improvement in composition from *a* to *b* or *b* to *c*, etc. (see fig 7), is a theoretical plate. On simple distillation of a liquid of composition *a*, the first drop of distillate should have composition *b*. This would be a theoretical or perfect simple distillation. These terms are used since this operation is difficult to achieve in practice because of condensation on the upper walls and neck of the distillation flask. Specially designed apparatus is used to obtain the data for constructing vapour liquid equilibrium curves such as that of fig 7.

The number of theoretical plates is determined from the compositions obtained experimentally at the bottom and top of a

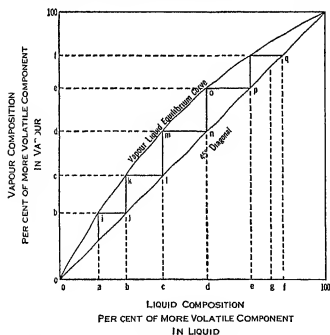
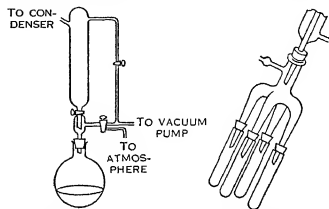


FIG 7—VAPOUR LIQUID EQUILIBRIUM DIAGRAM AND THEORETICAL PLATES

column or a section of column. A common example involves operation at total reflux and use of a vapour liquid equilibrium curve, as may be illustrated by reference to fig 7. Stepwise construction is commenced at the point *a* corresponding to the composition at the still or bottom of the column and continued (along *h*, *i*, *j*, *k*, *l*, *m*, *n*, *o*, *p*, *q*) to the top or distillate composition (*g*). The number of steps required in this construction (four and a fraction in this example) is the number of theoretical plates in the column. The height of the column divided by the number of theoretical plates is called the HETP or height equivalent to a theoretical plate. The more fundamental HTU



FROM A. WORTON, LABORATORY TECHNIQUE IN ORGANIC CHEMISTRY, MCRAW HILL BOOK CO. INC. (1939)

FIG 8—DEVICES FOR COLLECTING FRACTIONS IN VACUUM DISTILLATION

(height of a transfer unit) is determined in a somewhat similar fashion. Practical applications often involve use of more complex graphical procedures and formulas in order to estimate the type and height of column needed to secure a desired separation or purification.

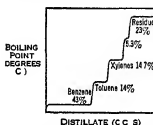
Plate efficiency may be defined as the ratio (in per cent) of theoretical plates to actual plates. Plate efficiencies vary from 10% to more than 100% but with common mixtures having normal viscosities the value is usually between 50% and 75%.

Reduced Pressure or Vacuum Distillation—Distillation under reduced pressure is adopted when dealing with substances which normally boil at inconveniently high temperatures or that decompose when boiling under atmospheric pressure. Vacuum distillation is also sometimes used because it is more economical. The apparatus differs little from that already described except that the distillate receiver must be connected to a vacuum pump and preferably also to a gauge and automatic pressure regulator.

The collection of fractions under reduced pressure is best managed by an arrangement of stopcocks and connecting tubes or by a specially designed multiple receiver which permits removal of one fraction after another without interrupting the distillation or breaking the vacuum (fig 8).

The volume of vapour from a given volume of liquid is 750 times as great at one millimetre pressure as at standard atmospheric pressure (Boyle's law). Hence vacuum distillation is subject to the disadvantage that reduction of the pressure to ten millimetres or less greatly reduces the distilling capacity because of the resistance offered by ordinary apparatus to the easy flow of the very great volumes of vapour. Distillation at pressures below one millimetre is usually carried out in molecular stills (see *Molecular Distillation*, below).

Steam Distillation—This is an alternative method of achieving distillation at temperatures lower than the normal boiling



FROM FODDRIER, IN INDUSTRIAL & ENGINEERING CHEMISTRY, ANALYTICAL EDITION, 5TH AMERICAN CHEMICAL SOCIETY (1955)

FIG 9—ANALYTICAL DISTILLATION OF AROMATIC MIXTURE

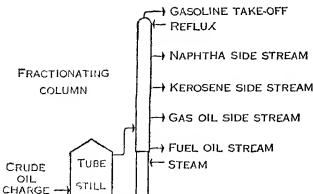


FIG. 10 SIMPLIFIED DIAGRAM OF CONTINUOUS DISTILLATION. THE PORTION OF THE COLUMN ABOVE THE POINT AT WHICH THE CHARGE IS INTRODUCED IS CALLED THE ENRICHING SECTION AND THE LOWER PORTION IS THE EXHAUSTING SECTION.

point. It is applicable when the material to be distilled is immiscible and chemically nonreactive with water. The usual procedure is to pass steam into the liquid in the still to supply heat and cause evaporation of the liquid. The steam will condense at the start and form a river of water. In fact steam distillation is sometimes carried out by simply adding liquid water to the charge and supplying heat in the usual way. For instance, impure benzaldehyde (oil of bitter almonds) may be purified either by adding water and heating or by passing in steam. As the mixture becomes warm, each liquid vaporizes as if the other were not present; the total pressure of the two vapours is the sum of the individual pressures of the water and benzaldehyde (Dalton's law of partial pressures), as indicated in the accompanying table.

| Temper- ture (°C) | Vapour pressure (in mm) | | | Remarks |
|-------------------------|-------------------------|-------|-------|---|
| | Benzaldehyde | Water | Total | |
| 40 | 4 | 26 | 30 | |
| 60 | 8 | 31.5 | 39.5 | |
| 80 | 10 | 40 | 50 | |
| 90 | 12 | 50 | 62 | |
| 100 | 14 | 60 | 74 | |
| 110 | 18 | 70 | 88 | Mixture boils |
| 120 | 21 | 76 | 97 | Boiling point of water |
| 140 | 31 | 91 | 122 | |
| 160 | 44 | 107 | 151 | |
| 180 | 61 | 133 | 194 | Approximate boiling point of benzaldehyde |

Since any liquid boils when its vapour pressure equals or slightly exceeds the atmospheric pressure (760 mm), the mixture of water and benzaldehyde will boil slightly below the boiling point of pure water and far below that of pure benzaldehyde. The volumes of the two vapours in the vapour mixture will be in the proportion of the vapour pressures, i.e. about 66 of benzaldehyde to 707 of water. The relative weights may be found by multiplying the relative volumes by the corresponding molecular weight. Thus for benzaldehyde, $66 \times 106 = 7000$ and for water, $707 \times 18 = 12726$, it follows, therefore, that benzaldehyde will distil with about two times its weight of water.

Distillation with steam is merely a particular case of the general principle of steam distillation above. As originally applied it is other than steam that is used in the vapour carrier. Thus in the industry can be distilled such kerosene to produce a kind of pure indene without the usual loss of overheads, and distillation composition during the distillation.

Steam distillation of mixtures that are partly soluble in water is entirely different and the complex principles involved in it are of extractive distillation. In the

low. It has proved very useful in separating organic compounds with high and nearly identical boiling points, such as the *ortho* and *para* nitrophenols.

Azeotropic and Extractive Distillation—When separation by distillation is especially difficult, because the components of a mixture have almost identical volatilities, improvement can often be achieved by addition of a properly chosen new component. In some instances the choice is a substance which is soluble in the mixture to be distilled and which forms a constant boiling or azeotropic mixture with one or more of the original components. If the volatility of the azeotrope formed from the added component and one substance of the mixture is markedly different from the volatility of the other materials present, ordinary distillation will separate the azeotrope from the remaining components. A familiar example is the preparation of pure anhydrous ethyl alcohol by the addition of benzene to ethyl alcohol containing a small proportion of water. On distillation, an azeotropic mixture containing all the benzene and water passes over with a small amount of alcohol and leaves a residue of anhydrous alcohol. Azeotropic distillation is not practical if the component desired enters into the formation of the azeotrope, and cannot easily be recovered from it.

Extractive distillation is a somewhat similar method. In this process a liquid which is relatively nonvolatile is added near the top of a fractionating column in order to increase the relative volatility of one of the original components and to allow it to distil in a comparatively pure state. Normal butane may thus be separated from butene 2 by addition of acetone, even though the normal volatilities of the hydrocarbons are nearly the same. This separation is of importance in producing raw materials for synthetic rubber and high octane gasoline.

Distillation of Gases—Gaseous mixtures may be distilled after liquefying them through use of high pressures or low temperatures or both. Once liquefaction is accomplished, distillation may be carried out as usual except that the apparatus must be such as to withstand the abnormal temperature or pressure. Oxygen, nitrogen, neon and the other rare gases are separated from air by liquefaction and distillation at low temperatures. Liquefied petroleum gases are separated and purified by distillation under pressure.

Distillation of Solids—Sublimation—When solid substances are heated to give gaseous or liquid products, the operation is termed dry distillation. If the procedure involves a breakdown of complex materials into simpler substances (elementary or compound), the process is described as destructive distillation. (See COAL TAR, TARS, LOW-TEMPERATURE.) Sublimation is a related process in which a solid distils to give a solid without the intervention of a liquid phase.

Analytical Distillation—A mixture of substances of the same chemical class is often difficult to analyze by conventional chemical methods. Such a mixture may sometimes be analyzed by distillation. Sharp separation between components is essential so that a curve such as that in fig. 9 may be obtained to indicate relative amounts. Analytical distillation has been most useful in studying the composition of petroleum.

Batch and Continuous Distillation—In most of the previously described varieties of distillation, the material to be distilled (the charge) is introduced into the apparatus at one time before the start of the distillation, and distillate is removed at one point only. All such operations are referred to as batch distillations. In con-

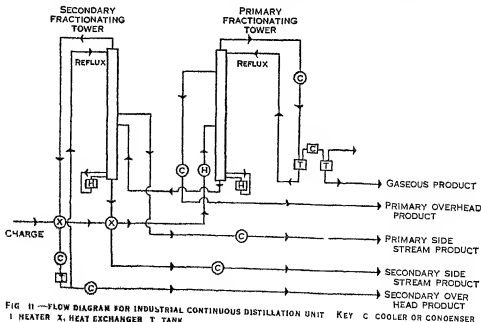
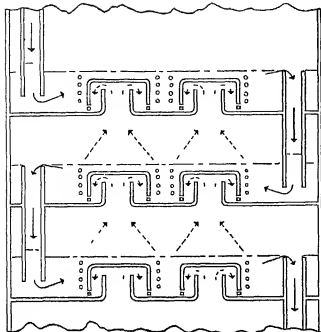
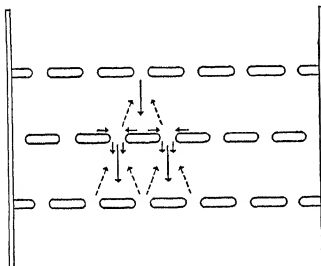


FIG. 11—FLOW DIAGRAM FOR INDUSTRIAL CONTINUOUS DISTILLATION UNIT. KEY: C, COOLER OR CONDENSER; H, HEATER; X, HEAT EXCHANGER; T, TANK.



A



B

↓ DESCENDING
REFLUX
LIQUID

↑ ASCENDING
VAPOUR

FIG 12—SECTIONAL DIAGRAMS ILLUSTRATING PLATE CONSTRUCTION AND INTERACTION OF LIQUID AND VAPOUR IN (A) BUBBLE PLATE COLUMN AND (B) PERFORATED PLATE COLUMN

In continuous distillation, the charge is introduced in a constant stream into the side of the column, where part of it descends with the reflux and the remainder is vaporized by the heated vapours rising from the still (fig. 13). The most volatile product is concentrated in the overhead product that is removed continuously at the top of the column and the least volatile similarly removed from the bottom. Intermediate fractions are sometimes withdrawn from various levels of the column through side streams. Continuous distillation is seldom used on a small scale, but it is of major importance in industrial operations, particularly in the manufacture of alcohols and petroleum products and in the technology of liquid air.

Distillation in Technology—In addition to the last-mentioned substances, distillation in various forms is used in the processing or production of liquefied fuel gases, coal tar and its products, turpentine, glycerine, fatty acids and a host of other chemical and pharmaceutical

products. These range from butadiene and styrene for synthetic rubber manufacture to formaldehyde, phenol, camphor, etc. The type of apparatus used varies with the nature of the mixture to be distilled, the product, the difficulty of the separations involved, and the means of heating required or available. Equipment is identical in principle with laboratory equipment already described (see figs. 11). All varieties of construction materials are used, including particularly cast and wrought iron, copper, mild steel, stainless steel, nickel, monel and aluminum. Lead-lined stills, glass-lined stills, fused silica, glass, structural carbon and stoneware are used where special purity or resistance to corrosion is required.

Stills for batch distillation are usually cylindrical shells. In addition to an outlet to carry away vapours, a cylindrical still is often fitted with (1) a bottom outlet and valve, (2) an agitator for stirring the charge to prevent local overheating, (3) a pressure or vacuum gauge, (4) an inlet and outlet for closed steam coil, (5) a tube reaching to the bottom to introduce live steam, (6) closed tubes to carry thermometers or thermocouples, (7) manholes for charging or cleaning, (8) inspection ports, and (9) a safety valve. In many cases the still has a double bottom and double side walls, forming a jacket for circulation of heating fluid. Steam is most frequently used. It may be passed through the jacket or a coil (closed steam), or sent directly into the liquid to be distilled (open steam). The still may also be heated directly by an open fire of coal, coke, oil or gaseous fuel, but such direct methods have a tendency to local overheating and have been largely superseded.

Indirect heating with steam is subject to close control. In continuous distillation, pipe stills are most used. The material to be heated is pumped rapidly and continuously through coils or pipes that pass through a furnace. The rapid flow inside the pipes allows higher temperatures and more rapid heating without damaging the pipes or decomposing the charge.

Many industrial distillation set ups consist only of still, vapour line, condenser and receiver, because the liquid mixtures involved are easily separated. A growing number of installations equipped with fractionating towers have come into use. The more efficient towers are either packed or fitted with perforated plates or bubble plate arrangements (fig. 12) to give more intimate contact between descending reflux and ascending vapour. Perforated plate towers are particularly useful when the feed material contains solids, as in the distillation of alcohol from fermentation mash. The bubble plate design is by far the most widely used construction. Another device causes descending

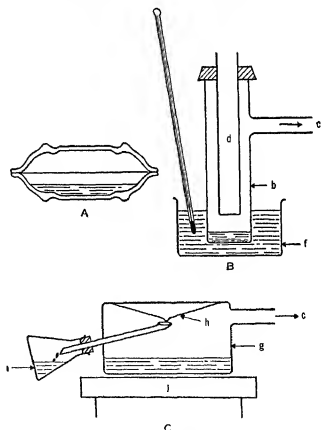


FIG 13—(A) PAIR OF SAUCERS (B) MICRO POT STILL (C) BODY OF STILL (D) CONDENSER (E) OIL BATH (F) ONE PIECE POT STILL (G) BODY OF STILL (H) REENTRANT SURFACE SERVING AS CONDENSER (I) DISTILLATE RECEIVER (J) HOT PLATE FOR HEATING

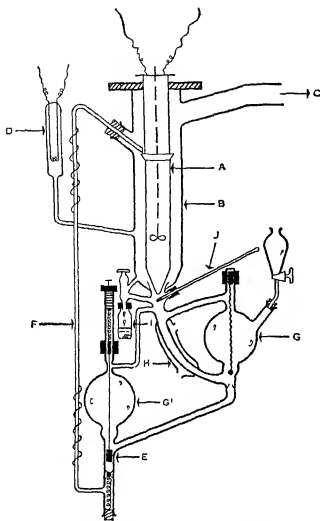


FIG. 14.—CYCLIC BATCH FALLING FILM STILL. (A) EVAPORATOR (B) CONDENSER (C) VACUUM CONNECTION (D) ELECTRICAL VACUUM GAUGE (E) MAGNETIC PUMP (F) PREHEATING TUBE (G) UPPER RESERVOIR (G') LOWER RESERVOIR (H) COOLING LABYRINTH (I) DISTILLATE RECEIVER (J) THERMOMETER

liquid to cascade over a wall, while rising, vapour forces its way through the cavities.

Large industrial columns may have as many as 200 bubble plates, and diameters up to 3 ft. Two towers may be connected in series to obtain the desired number of plates. There is no theoretical limit to the number of plates, but practical difficulties usually restrict the number in any one unit.

Condensers may be open surface tubular or worm. In the first type, cooling is effected by trickling water over a bank of tubes through which the vapour is passing. A tubular condenser consists of a group of parallel vapour tubes within a shell, through which cooling water flows. A worm condenser involves spiral vapour tubes. Proper choice and design of condensers depends upon rates of heat transfer from the condensing vapours to the cooling water, as well as knowledge of the probable condenser water temperatures and the quantity and character of the vapour to be liquefied.

The cost of distillation operations has chiefly in the need for continual heat at the still and cooling at the condenser. The pump and ranging means of large continuous units are often quite complex because of the economy of exchanging heat between hot and cold streams, the water and cold materials entering it.

Distillation of Water.—Water free from dissolved salts is unobtainable in many scientific and industrial operations. Laboratory stills consist of a boiler, fed by warm water from the condenser, and suitable devices for eliminating contamination. The condenser and receivers are usually of tin, or at least tin plated. Odimers (also sea suitable for condensing or storing highly purified water. Double distillation is frequently used to ensure removal of traces of impurities. The preparation of very pure water is a laboratory operation requiring greatest care.

The problem of the economic production of potable water from sea water is very old. In 1681, Fitz Gerald patented a process for the

"sweetening of sea water." S. Hales (1739) gives a history of the earlier attempts in his book *Philosophical Experiments*. The modern plant consists of an evaporator, distiller and condenser. Condenser tubes may be oval, crescent shaped or indented. The latter are self-scaling. For shipboard use, emphasis is on compactness, whereas multiple effect evaporation of high economy is favoured for use on land.

Compressive Distillation.—During World War II pure water was produced by compressive distillation characterized by very high fuel economy (175 lb distillate per 1 lb of fuel). The steam from boiling sea water is slightly compressed and circulated through a coil in the still. The compression raises the temperatures of the steam sufficiently to allow it to maintain the charge of sea water at its boiling point. The temperature loss to the still cools the steam and condenses it to distilled water. No separate condenser or cooling water is required. The principle is applicable to distillation of substances other than water.

BIBLIOGRAPHY.—Laboratory distillation is discussed in *Methods of Organic Chemistry*, 4th ed. (1950), takes up the application of the principles to the problems of industrial design and operation. The standard older text is S. Young and collaborators, *Distillation Principles and Processes* (London, 1924). Section 25 of vol. 2, pp. 1541-1670, of *The Science of Petroleum* (London 1938) is devoted to a discussion of distillation. Descriptions of industrial procedures and equipment can be found in the technological literature of particular substances. (A. R. E.)

MOLECULAR DISTILLATION

When the high-vacuum still is constructed so as to impose no hindrance to the passage of vapour from evaporator to condenser, a device known as the molecular still is achieved. Distillation occurs in this still at the lowest temperatures believed possible. Unstable substances which can be purified by no other means of distillation can often be treated without harm in the molecular still. The apparatus takes many forms but the simplest, which typifies the action of all the others, is little more than a flat vessel, like two saucers sealed together, which is held under high vacuum. The material to be distilled is heated in the lower saucer and the vapour condenses on the upper, cooled saucer. The saucer arrangement and two practical molecular pot stills for laboratory use are shown in fig. 13.

The names of many inventors are associated with the origins of molecular distillation. The first record of a truly molecular apparatus, where the evaporating and condensing surfaces were separated by a distance less than the free path of most of the vaporized molecules, is the mercury still of J. N. Bronsted and G. von Hevesy (1904, *J. Am. Chem. Soc.*, 26, 1922). The first truly molecular still for the separation of heavy organic substances was described by C. R. Burch (*Nature*, 1928). Early molecular distillations were performed by H. I. Waterman (1909) in the Netherlands, by E. W. Washburn at the Bureau of Standards in Washington, D.C. (1919), and by K. C. D. Hickman (1919) in Rochester, N.Y. The potentially immense value of molecular distillation in processing of natural oils, fats and waxes which could not be distilled by any other known means was pointed out by Burch, and was adopted and implemented by other workers. The three categories of distillates—heavy oils, glyceride fats and natural waxes—accounted for production amounting to more than 5,000,000,000 lb annually in North America, but of this enormous quantity, commercial molecular stills handled only little more than 0.1% at mid 20th century, the capacity however, was expanding rapidly.

The vacuum required for molecular distillation ranges from one to ten one-millionths of an atmosphere which is equal to a pressure of residual air of 0.0075-0.0075 mm mercury, or three quarters to seven and one half microns (one micron = 10^{-6} mm mercury). Small laboratory stills operate at pressures as low as one half micron, but not nearly so low as pressures erroneously recorded in the literature. Commercial stills operate at about three microns, the advantages of lower pressures being offset by the higher cost of pumping.

The time factor is very important in molecular distillation since the degree of destruction of labile substances is proportional to the duration of exposure in the hot still. All kinds of devices have been employed in reducing the time to the minimum. Early stills exposed the distilland in shallow trays. Then came the falling film still, where the distilland is allowed to tumble down a heated surface contained within an evacuated condenser. The evaporator is generally a vertical polished metal tube heated by electricity, the condenser a large glass tube or ball jar which surrounds and encloses the evaporator. Individual cyclic batch falling-film stills, constructed chiefly of glass, are in use in research laboratories for the multiple recycling and distillation of natural oils. A diagram is shown in fig. 14.

Industrially, the falling film still has been superseded by the centrifugal evaporator. The distilland, generally a natural oil, is fed into the centre of a rapidly rotating metal cone which is warmed on the outside by an electrical radiant heater. The entire assembly is housed within a tank which is maintained under high vacuum by a

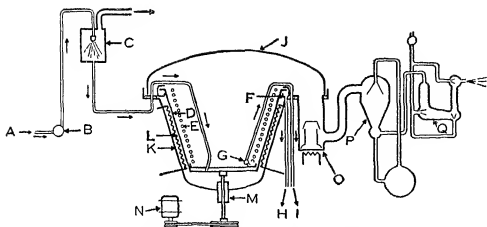


FIG 15—CENTRIFUGAL EVAPORATOR (A) DISTILLAND IN (B) METERING PUMP FOR INCOMING DISTILLAND (C) DEGASSING CHAMBER (D) ROTOR (E) CONDENSER COILS (F) DISTILLATE COLLECTING GUTTER (G) DISTILLATE WITHDRAWAL PUMP (H) DISTILLATE OUT (I) DISTILLATE OUT (J) DOME (K) HOUSING (L) HEATER ELEMENTS (M) BEARING HOUSING (N) MOTOR (O) OIL DIFFUSION PUMP (P) OIL BOOSTER PUMP (Q) STEAM EJECTOR PUMPS

train of fast pumps (fig 15). The oil climbs up the inside of the cone under a centrifugal force of 10-100 times gravity and is flung from the upper rim into a stationary gutter whence it flows to a pump which discharges it from the still. The total time of exposure in the hottest zone is about one second. The time of exposure in a high speed laboratory centrifugal still is about 0.03 sec. The reduction in both time and temperature of exposure is so drastic in the latter apparatus that the thermal hazard is diminished about 1,000,000,000,000 times from that of an atmospheric distillation lasting an hour. The improvement over the best industrial flash distillation done at 1 mm mercury is about 1,000,000 times. The improvement factor for the large commercial molecular stills is about 100 times poorer than these figures.

The molecular still requires the service of fast vacuum pumps. Since no economical pump is known that will reduce the pressure a million fold in one operation, it is necessary to employ a number of different kinds of pumps in series. The fastest pump, operating at the lowest pressure is always an atmospheric condensation pump of the type invented by J. Langmuir (1916) and improved by Burch (1928). It may have self conditioning features introduced by Hickman (1936). The condensation pump pulls residual gases at one to five microns from the still and compresses them 10 to 20 times, discharging them at 0.75 to 15 mm into a fore pump which may be, variously, a large oil-sealed mechanical pump or another oil-vapour booster pump. This latter then discharges into a mechanical pump or steam ejectors.

Uses of the Molecular Still—The falling film still found commercial use on a small scale in 1935 for the distillation of vitamin A alcohol prepared by the saponification of fish livers. The apparatus came into extended use in 1937 for distilling vitamin A esters from dogfish liver oils and shark liver oils. Centrifugal stills were intro-

duced in which the term is most frequently used in its legal significance. The power of distress appears to have been derived from the feudal law and to have been substituted for a forfeiture of the tenant's holding. Until the statute 2 and 3 Will. 4 sess. 1 c. 5 the chattels distrained remained only in the pledge of the hands of the landlord and could not be sold.

Rents at common law are of three kinds: rent service, rent charge and rent seck and at common law distress was incident to rent service and by special reservation to a rent charge. A rent reserved by a lease is rent service. Distress was not incident to rent seck until the Landlord and Tenant act 1730. That statute also extended the remedy of distress

to rents of assize and chief rents and thereby in effect abolished the most material distinction between them. But a right of distress is not incident to an obligation to pay provided for in an agreement, which is only a licence and does not create the relationship of landlord and tenant between the parties.

All personal chattels are distrainable with the following exceptions: (1) goods absolutely privileged, (2) things in actual use, (3) fixtures (qv), (4) goods delivered to a person in the way of his trade, (5) perishable goods, (6) goods in the custody of the law (e.g., goods already taken in execution by the sheriff), (7) animals *ferae naturae* (dogs and tame deer and deer in an enclosed park may be distrained), (8) crown property, (9) goods of an ambassador or his servants on the premises of an embassy, (10) certain articles exempted by special acts of parliament (e.g., gas or water meters), (11) hired agricultural machinery and breeding stock in circumstances coming within the provisions of the Agricultural Holdings act, 1933, (12) goods of an undertenant or lodger (Law of Distress Amendment act, 1908), (13) wearing apparel and bedding of the tenant or his family and the tools and implements of his trade to the value of £5 (Law of Distress Amendment act, 1888), (14) goods conditionally privileged, i.e., privileged if there are sufficient goods of other kinds on the premises to satisfy the distress, (15) implements of trade not in actual use, (16) beasts of the plough and sheep, (17) agisted stock if the Agricultural Holdings act, 1933 applies.

In order to obtain the protection afforded by the Law of Distress Amendment act, 1908, it is necessary for the undertenant or lodger, who seeks protection to make a declaration in writing and serve it on the landlord, his bailiff or agent, employed to levy the distress after (not before) the landlord has levied the distress or authorized it to be levied. The declaration must be set out (1) that the tenant has no interest in the goods in question and that they are the property of the person making the declaration, (2) the rent then due by the undertenant or lodger, (3) the rent payable in future and (4) an undertaking to pay all such rent to the landlord until the arrears then distrained for have been paid off. An inventory of the goods in question must be annexed.

A distress for rent may not be made after sunset and before sunrise, nor on a Sunday. It may not be made till rent is in arrear. At common law a distress could not be made after the expiration of the lease, but since the Landlord and Tenant act, 1709, it may be made at any time within six months of the termination. By the National Health Insurance act, 1924, s. 102, where an insured person is receiving sickness benefit under that act and a medical practitioner certifies that the levying of a distress would endanger the insured's life, the levy must be postponed during the currency of the certificate. The certificate is of no effect until it has been sent to the insurance committee and recorded in a special register. It operates for one week but may be renewed

DISTOMUM *see* PLATYHELMINTHES, TREMATODES

DISTRESS, pressure, especially of sorrow, pain or ill fortune, as a legal term, the action of distraining or distraint: the right of a landlord to seize cattle or goods of his tenant for nonpayment of rent, or the right of a person upon whose land cattle stray to seize the cattle "damage feasant" (doing damage). The cattle or goods so seized are taken without legal process as a pledge to compel the satisfaction of a demand or the redress of an injury. They can be retained only until the owner makes satisfaction. "Distress damage feasant" is also applicable to inanimate things on the land, if doing damage thereto or to its produce. Such distress must be made during the actual trespass, and by the person aggrieved by the damage. Distress for rent, however, is the sense

weekly for three months but not longer. The register may be inspected without fee. In the cases of premises to which the Rent and Mortgage Interest Restrictions Acts apply distress cannot be levied without leave of the court.

Five years arrears are recoverable in ordinary cases but if the Agricultural Holdings Act applies only one year's arrears are recoverable.

If the tenant becomes bankrupt the right of distress is limited to six months' rent prior to the adjudication. If more be due that must be provided for in the bankruptcy (Bankruptcy Act 1914, s. 57). If a company is wound up its goods cannot be distrained without leave of the court (Companies [Consolidation] Act 1908 ss. 147 and 211).

The distress for rent must be made on the land demised except in the case of the king or queen regnant and except in the case of fraudulent removals and certain rents for quarries in the Forest of Dean. Chattels clandestinely or fraudulently removed from the premises may be followed within 30 days after their removal, unless in the meantime they have been sold bona fide and for valuable consideration. Again if a landlord or his agent come to distrain cattle which he sees upon the land, and the tenant or any other person drive the cattle off the land the landlord or his agent may follow them, but this does not hold if the landlord or his agent does not see the cattle on the land or the cattle stray from the land of their own volition.

A distress may be made by the landlord himself or a certified bailiff (Law of Distress Amendment Act, 1888, s. 7). This certificate is granted by a county court judge. He may be removed by the judge for extortion or misconduct. He should have an authority in writing from his employer called a "distress warrant." This warrant does not require a stamp. The outer door of the tenant's house cannot lawfully be broken open in order to make a distress but if the outer door be open an inner door may be broken open if necessary.

The chattels distrained must be impounded. By the Protection of Animals Act, 1911, s. 7, a person impounding any animal must supply it with a sufficient quantity of wholesome and suitable food and water. The landlord cannot sell the chattels distrained to himself. Before any sale takes place inquiry should be made if the county court registrar is office to ascertain whether the goods have been replevied (see REPLEVIN), if that is not so and the rent due and charges for the distress remain unpaid at the end of 5 days (which must be extended at the request in writing of the tenant to 15 days) the goods should be sold for the best price which can be obtained for them (see AUCTIONS AND AUCTIONEERS). The overplus, if any, must be repaid to the tenant.

Duties and penalties imposed by act of parliament (e.g., payment of rates and taxes) are also sometimes enforceable by distress.

(A. S. P.)

In the United States, the process is recognized by most of the states for the taking of a personal chattel from the person to secure satisfaction for a demand.

DISTRIBUTION. In economics, the manner in which the income of a community, won by its own production or gained in fruitful exchanges with other communities, is divided up among its members. The national output, or aggregate of services and material goods produced by the capital and labour of a nation, is a continuous stream, which is always flowing and which is divided up among the agents of production in certain shares. The lenders of physical goods take rent, the lenders of capital take interest; management takes profit, labour takes wages or salaries. The national and local governments levy taxes upon all these for the expenses of government, and in so doing change to some extent, large or small, the nature of the distribution among private claimants, as when the taxation of the well-to-do is used to pay an old-age pension. See WEALTH AND INCOME, DISTRIBUTION OF. For distribution in trade see MARKETING.

DISTRIBUTION IN TRADE: see MARKETING.

DISTRIBUTION OF ANIMALS. A solution of the problems of zoogeography, which attempts to explain the distribution of animals on the earth, may be sought in two directions. We may investigate the distribution of related groups of animals in

the separate regions of sea and land and from this seek to draw conclusions as to former connections between the present habitats of related forms, the historical aspect or we may inquire what animal forms dwell together in places showing certain conditions of environment and by what characters they are adapted to existence under these conditions, the ecological aspect, which is considered here.

For animals to succeed at all, certain general conditions must be fulfilled, if but one is lacking, animal life also is absent. One of these primary conditions is water. No active animal can live permanently in places such as extremely arid deserts, where water supply and dewfall fail completely for long periods.

To many animals light is not immediately necessary. In subterranean caverns, and in the greater depths of the ocean (below 1,700 m.), sunlight is absent, yet animals live in these places provided they can find food. Light is indispensable, however, to green plants since it supplies the energy for the manufacture of organic substances. Animals are dependent on organic food, and so ultimately, upon plants. Light, therefore, is indirectly necessary to animals.

All life is confined within certain limits of temperature. Protein, an important constituent of protoplasm, coagulates at about 70° C. Protoplasm, too, cannot live if its fluid content is frozen, i.e., at temperatures below about -5° C. Thus animal life is absent in the hottest springs (some lower animals, such as Protozoa, rotifers, snails, can live in hot springs of 45°-52° C.), while no animals are present in the perpetual snows of mountains.

Food is absolutely essential to all animals. In addition to organic materials (protein, carbohydrates, fats), oxygen is needed, to combine with the products of the breaking down of organic food, and thus liberate energy. There are some places where oxygen and therefore animal life is sparse or absent, in the depths of some seas and in volcanic places where carbon dioxide (CO₂) escapes from the ground, e.g., the floor of the Grotto del Cane at Pozzuoli, near Naples.

The quantity of moisture, warmth and oxygen required by an animal varies in different species, some are able to manage with little, others need much, while others again are frequently indifferent. Animals requiring amounts of moisture, warmth or oxygen (whether great or small) not varying beyond narrow limits are termed stenohygrous, stenothermic or stenoxenobiont, respectively, those having wide limits, euryhygrous, eurythermic or euryxenobiont. Animals in all respects indifferent are euryoekous, those requiring definite quantities stenoeukous. Euryoekous animals generally have a wider distribution than stenoeukous.

The different regions of the earth occupied by living beings, the sea, fresh water and dry land, are fundamentally different in the conditions they offer and in the demands they make.

Sea.—The sea is the home of life. In it are represented all the structural types in which animal life manifests itself. Echinoderms, tunicates, Cephalopoda, many groups of worms, Radiolaria and Foraminifera are confined to the sea. Myriapoda and

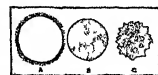


FIG. 1.—MARSHALL RED BLOOD CORPUSCLES IN SALT SOLUTIONS. A 0.2% B 0.75% C 1.0%

Amphibia only are not represented there. Salt water of the concentration of sea water is the optimal medium for protoplasm. Sea water has the same osmotic pressure as the fluid in protoplasm. For that reason it withdraws no materials from the protoplasm neither does it give up any to it. If human blood is examined in salt solutions of strengths such as 0.2%, 0.75% and 1%, the fate of the red corpuscles differs greatly in each case (fig. 1 A-C). In 0.75% NaCl they remain unchanged, this solution is isotonic with the fluid they contain. In 0.2% NaCl the corpuscles give up colouring matter to the salt solution, swell and ultimately burst. (A) In 1% NaCl they shrivel (C), water having been withdrawn from them. Animals living in the sea are situated similarly to the corpuscles in the 0.75% salt solution; they need not isolate their inner medium from the environment.

In the sea, too, the conditions of life undergo least change

All seas communicate with one another, and their waters are continually mingled. The salinity, therefore, is about the same in all regions, the temperatures are similar, and vary much less than in fresh water, or in the atmosphere. The amount of oxygen present is very constant. Exceptions are secondary seas having only a narrow connection with the ocean, such as the Mediterranean and Baltic.

Fresh Water—Fresh water, on the contrary, is dangerous to living organisms on account of the small amount of salts contained in solution. As in the red corpuscles in 0.2% NaCl, water is continually passing into the protoplasm. The inward permeation of water may be prevented either by strong armour, as in water insects, the animal body shutting itself off from the environment, or, more frequently, the water that passes in is constantly discharged. Thus all fresh water Protozoa possess a contractile vacuole that contracts rhythmically and discharges water to the exterior. In multicellular fresh-water animals the same result is reached by the action of the kidneys (fig 2).

Fresh water animals, however, have less competition, for only relatively few marine animals are able to counteract the ill effects of fresh water, an advantage that is offset by the invasion of fresh water by many land animals, especially insects.

Land—Terrestrial life offers a number of favourable conditions. Oxygen is present in much greater quantities than in water. Further, dry land, in contrast to the sea, offers abundant vascular plants as food. These advantages, however, are not easily obtained. The amount of moisture in the air is generally far from saturation point, and puts the animals in danger of desiccation. The outer skin, and, above all, the respiratory organs, with their large permeable surfaces, must be protected from excessive evaporation. Only members of three groups of animals can survive life in a dry atmosphere, gastropods, arthropods and vertebrates. The shells of gastropods protect them against desiccation, they emerge only when there is sufficient moisture. Terrestrial arthropods have their chitinous armour. Among the vertebrates, the horny epidermis lessens evaporation. In all three groups the respiratory organs have been removed to the interior of the body. Snails have a pulmonary cavity, millipedes, insects and spiders have internal air tubes (tracheae), air breathing vertebrates have lungs. In all these animals the processes of life take place in the inner albuminous salt solution, not in the atmosphere.

The air also offers a new condition in its lesser density. Water supports the animal body, leaving little work for muscles and supporting organs. In the air, on the contrary, the body must be supported and compact to retain its form. Most terrestrial animals therefore, have skeletons, snails their shells, arthropods their chitinous armour and vertebrates their bony skeletons, various worms, slugs and insect larvae lack skeletons. Further, water supports, or retards the sinking of much floating matter, such as small plants or animals and the disintegration products of organisms (detritus), and this is carried as food to the animal population. For this reason fresh animals may be present in water in great numbers. In terrestrial life, animals must search for their food and fixed forms, except some parasites (e.g., scale insects), do not occur.

Most terrestrial plants cannot be utilized by animals without

undergoing further processes because the protein, fat and starch are all enclosed in a cellulose envelope. Animals, except some protozoans like those that live symbiotically with termites and except further certain annelid worms and some snails (e.g., *Hydrobia*), possess no ferment in their gastric juice that will dissolve cellulose. The resistant membrane must therefore be broken up to liberate the food. Thus snails tear the cells to small pieces by their radulae, arthropods fragment vegetable food with their jaws, mammals chew with their teeth, and birds grind up food in their gizzards. The numerous herbivores render possible the existence of carnivores, many insects, almost all amphibians and reptiles, and many birds and mammals are insectivorous or predatory.

One particular difficulty to which terrestrial animals are generally exposed is the great variation of temperature. In the sea, the temperature of the water over large areas is subjected only to slight and gradual variations. The daily variations are also slight. In fresh water the temperature does not sink below zero, in deep water it is unusual for it to sink below 4° C. Only in summer in the shallowest basins or in hot springs, does it reach 25°–30° C. On land also there are regions with only slight diurnal and seasonal temperature variations, e.g., tropical forests. The difference between diurnal and nocturnal temperatures, however, is usually considerable and the extreme difference at different seasons at certain places is very large. In central Europe it amounts to 90° F., in Verchjansk (eastern Siberia) it even reaches 180° F. During the winter, life in the sea and in fresh water goes on unchecked, although isolated species hibernate. On land, in the temperate and frigid zones, all life becomes torpid under the influence of winter cold, even the nightly cooling of the air makes many animals sluggish. The organization of terrestrial animals is profoundly influenced by variations of temperature, muscles become stiff, glandular activity ceases. If, however, an animal can produce inside itself by metabolic processes a favourable temperature, and can maintain this through nervous control, it is freed from these temperature variations. Such animals are termed homoiothermal (warm blooded animals). Homoiothermal animals have, nevertheless, to pay a price for this advantage, they become slaves to their increased food requirements. Poikilo-thermal (cold blooded) animals can fast for long periods, a snake or frog can go without food for six months and aestivating snails for four or five years. Hibernators excepted, homoiothermal animals on the contrary, quickly succumb to lack of food.

The Conditions of Dispersal—In the various regions inhabited by living organisms the sea, fresh water and dry land, animal dispersal is influenced in different ways and the barriers opposed to it differ. The seas are in communication with one another in all parts of the earth, though the present connections between the Indo Pacific and the Atlantic are in polar and subpolar regions and on that account are impassable for warm stenothermal animals. For most marine animals, however, dispersal depends on their powers of movement or their capacity for flotation. Sedentary animals can extend their range only during the short free-living larval life, but powerful swimmers like sharks and mackerel are found in all warm seas. Isolation, however, is an important factor in transformation of species. The great variety of marine animals is therefore astonishing, when we consider the similarity of conditions of life in the various seas.

In inland waters conditions are quite different. This region is divided into innumerable small sections such as streams, rivers, lakes and ponds separated by insurmountable obstacles in seas and land. Standing waters in particular are very varied in the materials they hold in solution in conditions of light and temperature, in the fertilizing matter they receive and therefore in their plant life. This wide spread isolation under the influence of environment might give rise to the development of numerous different species, and to great variability within the limits of each species, but actually the fauna of fresh water is very rich in cosmopolitan genera and species and over the whole earth, shows great similarity. The reason for this is the transitory nature of fresh waters. Even in historic times rivers have changed their courses, dwindled and dried up. Small standing waters and even large lakes are

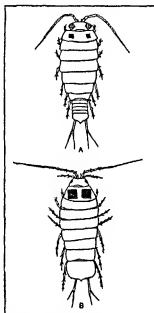


FIG. 2.—A MARINE AND B FRESH WATER ISOPODS. THE BLACK SQUARES SHOWING THE RELATIVE SIZES OF THE NEPHRIDIA (MAXILLARY GLANDS)

gradually filled with sediment. The existence of enclosed basins is not of sufficient duration for a thorough transformation of the species dwelling in them. Newly arisen waters become populated from those already in existence by organisms that can either fly from one body of water to the other, or be carried by winds or water birds. It is only in deep and therefore ancient basins that a characteristic fauna has been able to develop, as in Lake Baikal (1706 m deep) and Lake Tanganyika (1135 m).

Dry land is divided into mainly small, more or less isolated, sections by seas, mountains, deserts and rivers. But terrestrial animals have very variously developed organs of locomotion, and therefore the effect of isolation varies. The great environmental differences have a similarly isolating effect. The transformation of species is thus exceedingly favoured on dry land but is confined to those animals able to live there (mainly gastropod molluscs, arthropods and vertebrates). The sea is a much more extensive arena for living organisms. Nevertheless, 1 of all animal species are terrestrial. We are acquainted with about 3,000 living species of Coelenterata and Echinodermata, animals confined to the sea; on the other hand, nearly 1,000,000 species of insects have been described. But the range of variation among echinoderms and coelenterates is much greater than in the insects.

Prolonged isolation gives a striking character to the animal life of a district. The variety of the fauna in the different biotopes arises through transformation of the stock originally present. For that reason the interrelationship of the members of the fauna is much greater than in districts where continual intermixture is possible with forms which wander in from the surrounding regions. Such differentiation is found in the Caspian sea in Lake Baikal, in Madagascar and in South America. In Lake Baikal more than 200 species of planarians (Turbellaria) are found more than half the known species. A third of all the fresh water fishes in South America belong to the family Characimidae and include mud- and plant-eating, and even voracious forms. Among mammals the numerous adaptations shown by rodents of the family Hysticomorpha is most remarkable.

Area of Distribution.—The region occupied by a species is known as its area of distribution. The size of the area varies in the different species, it depends on the presence of suitable dwelling places, on the barriers limiting dispersal, on the powers of migration of the species and the facility with which it may be transported on its ecological value and on its history.

Species with restricted range are termed stenotopic, those with wide range, eurytopic. Species becoming extinct, or newly arisen often have a restricted range, examples of the former are the primitive lungfish, *Neoceratodus* (Murray river Australia), and the lizardlike, *Sphenodon* (New Zealand), of the latter, the moth *Cymatophora* or *var. albigena* in the industrial districts of England and Hamburg. A closely confined habitat also hinders dispersal, such are Lake Baikal and the Hawaiian Islands, with their many endemic species. Chiggers in the case of a species may take place before our eyes, the jigger flea (*Sarcoptysylla puertrans*) first arrived in Africa in 1872, and since that time has spread from the west coast to the east. The lower limit of size of an area varies with the size of the animal and the nature of its food. Large animals are not to be expected on small islands. Carnivores require a larger range than herbivores of the same size. Cosmopolitan species are those present generally over the whole earth wherever they can find suitable dwelling places (A cosmopolite, however, is not found in all the regions supporting life, i.e., the sea, fresh

water and dry land.) As examples may be mentioned the edible mussel (*Mytilus edulis*), found in all the seas of the world, the brine shrimp (*Artemia salina*) universally present in salt marshes. Broad areas, with other conditions equal, tend to have a richer fauna than occurs in small, circumscribed islands or oases. This is evident when the amphibian and reptilian faunas of various large islands with similar climates are compared.

Animal Communities on a Geographic Scale.—Three main plans exist for the orderly consideration of animal geography on a global scale. The oldest and most generally accepted scheme is the division of the world into faunistic realms, with subdivisions known as regions that are further divided into sub-regions and provinces. The groupings are determined by taxonomic relationships and the whole emphasis is on the fauna, especially birds and mammals historically (i.e., geologically) considered. This is the method of classical zoogeography (see ZOOLOGICAL GEOGRAPHY).

The other two major plans are more ecological in nature. One is based on the distribution of "biotopes" and their associated animal communities. A biotope is a district that shows uniformity in environmental conditions, it is the equivalent of an animal habitat broadly considered. Biotopes are distinguished by physiographic and climatic features and by vegetation. Thus a stretch of rocky coast, or a cave, is a biotope, so also is a pine forest, a savannah or a desert. Biotopes are subdivided into facies and into still smaller environmental niches. They are also grouped into larger units, the largest of which are the three main habitats of living organisms, namely sea, fresh water and land. Though the emphasis in the biotope system is on the environment of animals, its claim for validity in animal geography lies in the fact that regions, uniform in environmental conditions, tend strongly to support a uniform and characteristic animal community. This scheme is outlined in some detail by R. Hesse, W. C. Allee and Karl P. Schmidt (1937).

The third general plan has the biome as its major unit. A biome is based on the concept that the plants and animals associated together in the same area have a certain unity. The biome is thus a plant-plus-animal formation that is composed of a plant matrix together with all associated animals. The larger and more influential animal species may range over the entire area occupied by a biome—including its subdivisions called associations—and its developmental stages, sometimes these larger animals give unity to the biome, more often the unity is furnished primarily by the vegetation.

On land, biomes coincide with the great landscape types of vegetation. Among the major terrestrial biomes, the following are always recognized: tropical rain-forest, tropical savannah, tropical grassland, temperate deciduous forest, temperate grassland or steppe, desert, coniferous forest and tundra. Inland water and marine biomes are also recognized. The biome of the coral reef is an especially closely knit unit. The general concept is discussed by F. E. Clements and V. E. Shelford (1939), together with a somewhat detailed discussion of the grassland biome of North America.

Whether biomes or their subdivisions are under consideration, the emphasis is on the entire complex community of plants and animals rather than on the habitat—as in the biotope—or on the historic geographic and taxonomic relations of the flora and fauna.

ANIMAL DISTRIBUTION IN THE SEA

The distribution of life in the sea is dependent on factors partly physical, partly chemical. Density and viscosity are the primary factors governing the floating of organisms in the water (See PLANKTON). The pressure of the water increases with the depth. A column of sea water of average density measuring 107 m exerts a pressure of one atmosphere per sq m of surface, so that in the greatest known depths of the ocean (10,793 m), a pressure of almost 1,072 atmospheres prevails. The pressure of the water, however, has no perceptible influence on the distribution of the animals. Animal life is present at great depths, and the plankton and fishes of the open sea may undertake, in one night, vertical

| Island | Area, sq km | No of Species of Amphibians | No of Species of Reptiles |
|-------------|-------------|-----------------------------|---------------------------|
| Borneo | 715,100 | 86 | 241 |
| Madagascar | 591,600 | 88 | 181 |
| Sumatra | 443,200 | 61 | 199 |
| Celebes | 200,100 | 22 | 106 |
| Java | 131,700 | 38 | 157 |
| Ceylon | 65,900 | 37 | 67 |
| Cuba | 118,800 | 21 | 66 |
| Haiti | 77,100 | 14 | 28 |
| Jamaica | 10,900 | 12 | 28 |
| Puerto Rico | 9,100 | 11 | 30 |



THE LIFE OF A WEST INDIAN CORAL REEF

- | | | |
|---|--|--|
| 1. Rook Beauty (<i>Holocanthus tricolor</i>) | 5. Butterfly Fish (<i>Chaetodon ocellatus</i>) | 8. Buffalo Trunkfish (<i>Lactophrys trigonus</i>) |
| 2. Black Angelfish (<i>Pomacanthus arcuatus</i>) | 6. Queen Moray (<i>Lyodontis Junebris</i>) | 9. Cowfish (<i>Lactophrys triognus</i>) |
| 3. Four eyed Fish (<i>Chaetodon cyprastratus</i>) | 7. Sea Fan (<i>Gorgonia flabellum</i>) | 10. Squirrel Fish (<i>Holocentrus saccinensis</i>) |
| 4. Queen Trigger Fish (<i>Balistes vetula</i>) | | 11. Pork Fish (<i>Anisotremus virginicus</i>) |

migrations of 300 m and more without being injured by alteration of the pressure by about 30 atmospheres. The brittle star, *Ophiothrix sericeum*, is present in depths varying from 6 to 4,370 m, it is eurybathic. Species confined to particular depths are termed stenobathic, e.g., the reef building corals, which flourish only to a depth of 30 m.

Waves.—The movements of the water, which at different times and places undergo many changes, are of particular importance to animal life. Waves reach to depths of several hundred metres. Currents may reach similar depths. The breakers make a heavy demand on coastal animal life, in the North sea the strength of their impact averages 15 tons per sq m. Animals dwelling on rocky coasts within the region of the breakers must protect themselves from injury. This is often accomplished by the animals attaching themselves to the substratum, and by the formation of strong shells. As examples of fixed animals the barnacles (*Balanus*) may be mentioned, others which adhere by a strong foot are the gastropods (*Patella*, *Littorina*), the mussel *Mytilus* anchors itself by its byssus threads. In the deeper layers where movements are felt, sessile animals are able to bend, and have some elasticity of movement, in still waters they are rigid, e.g., the bryozoan, *Cobelia boryi*, in the North sea. Marine currents are very important for the distribution of fixed animals, since they serve as means of transport for the free living larvae.

Temperature.—Temperature is very important. The temperature of the surface water decreases, in general, towards the poles, but this is modified by warm and cold currents. The temperature decreases, also, with depth, and at the bottom is down to about zero centigrade. Owing to the great surface currents, more water is carried towards the poles than away from them, and, as the cold water at the poles is heavier than the water of the equatorial regions, there is a steady shifting of the deeper layers towards the equator. These cold, deep currents cannot penetrate secondary seas, like the Mediterranean, separated from the main ocean by ledges not far below the surface.

Related animals show marked variations under the influence of differences of temperature. Frequently the size of individuals of the same species increases with decreasing temperature towards the poles and in deep water layers. The shell of the gastropod *Nassa clausa* reaches a height of 12.7 mm in the Skagerrak, at Spitzbergen it measures 3.8 mm. Similarly, the isopod, *Serolis bromleyana*, measures 16 mm at depths of 730 m, and at 3,600 m 54 mm. Giant species, e.g., species greatly exceeding related forms in size, are found comparatively frequently in polar seas and in deep water. This may be ascribed to the influence of temperature. The hydriopolyp, *Brachyocerosanthus imperator*, which attains a height of 2 m in depths of more than 3,000 m, is an example. Other effects of low temperature are the greater amount of yolk in the eggs, and the frequent occurrence of brood-nursing. The multitude of brood nursing forms in all classes of echinoderms in the Arctic and Antarctic is remarkable. It is noteworthy that the annelid *Cirratulus cirratus*, which in temperate seas deposits its eggs, at the Falkland Islands practices brood-nursing.

The cold waters of the Arctic and the Antarctic are sharply divided from one another by warmer seas. To many cold-stenothermal animals this barrier is insuperable. Eurythermal animals may however, be distributed through all seas, notwithstanding the variety of temperature. The fact that many species present at both poles are absent in the intervening regions has attracted particular attention. Since, in general, the area of a species is continuous, this bipolarity requires explanation. Bipolarity of species is by no means common. Some apparently bipolar species are found in the intervening regions in the cold deep strata, e.g., *Calanus finmarchicus*. In other instances the two polar forms are also related to a species found in the intermediate region. Thus, the bipolar foraminiferan, *Globigerina pachyderma* is related to *G. dutertrei* of warm seas. Bipolar species, therefore, are derived from cosmopolitan through parallel modification of peripheral forms under the influence of environment.

Chemical Composition.—The chemical composition of the sea is very uniform, in consequence of the general mingling of

the waters. The salinity at a depth of 300 m is about 3.5% but is lower in surface water in estuaries, and in polar regions when the ice is melting. Considerable variations in salinity are found only in secondary seas shut off from the general mixture of the waters. These have a higher or lower salinity according to the ratio between the amount of river water received and the amount of evaporation taking place. The Red sea has a high salinity (over 4%), so has the Mediterranean (3.8%), the Baltic has a low salinity, decreasing towards the east and north. In the Baltic the influence on the animal population of the decrease in salinity is very striking. The number of species decreases in proportion to the decrease in salinity, in an easterly direction (see TABLE).

| Salinity | Marine fishes | Acidants | Lapellæ branchiobranchs | Gastropods | Oryctho branches | Amphipods | Decapods |
|----------|-----------------|----------|-------------------------|------------|------------------|-----------|----------|
| 3.5% | Kattegat | 20 | 88 | 85 | | 113 | 55 |
| 3.4% | Rud. Bay | 5 | 23 | 17 | 23 | 18 | 9 |
| 3.3% | Middle Baltic | | 6 | 3 | 2 | 11 | 2 |
| 0.4% | Gulf of Bothnia | 23 | 4 | 1 | | 5 | |

The size of the species also decreases in the same direction. The edible mussel (*Mytilus edulis*) at Kiel attains a length of 110 mm, further in the Baltic, it measures over 50 mm, in the Gulf of Finland 27 mm, in the Gulf of Bothnia, 21 mm.

The quantity of carbon dioxide, nutritive salts and other materials necessary to plants in the water of any lighted region is particularly important in determining the amount of life. If these materials are abundant, plant life flourishes and consequently animals find plenty of food. The sources of this food are, first, the products of animal metabolism and of the disintegration of dead organisms. Carbon dioxide and nutritive salts are only of use, however, in the upper, illuminated strata of the water, where the light is sufficient to supply energy for the assimilation processes of plants. The dead bodies of organisms that inhabit the open sea sink to the bottom, and, in great depths of the ocean, are withdrawn from the metabolic cycle. Their disintegration products can be used only in shallow seas where mixture of the water takes place right down to the bottom. In deep seas they may be returned to use in places where rising currents bring water from the depths to the surface. It happens, therefore, that coastal regions, shallow seas like the North sea, and shoals such as the Dogger and Newfoundland banks, show great wealth of life. Rising currents are found chiefly on the west coasts of continents where the surface water is driven away from the coast, and a compensating current from the depths flows towards it. No sea water is so teeming with life as those areas with up-welling water in such regions, e.g., off the coasts of Portugal and Chile. A quantity of fertilizing matter for plants is brought down to the sea, particularly by rivers. The region most richly supplied with river water is the Atlantic Arctic, into which more than half the earth's surface is drained. The Pacific is poorest in this respect, particularly in its eastern portion. Thus, with its great depth, accounts for the poverty of its pelagic life compared with other oceans.

Dissolved oxygen is present everywhere in sufficient quantity in the surface waters of the open sea. In the depths, the influx of currents of polar surface water brings sufficient aeration and, since the disintegration of dead organisms goes on very slowly in the cold water of these depths, oxygen is not used up in the process. In secondary seas where such currents are absent matters are different. In the eastern Mediterranean, the deeper layers of the water lack oxygen, and have a large quantity of carbon dioxide, on this account they contain hardly any life. This also applies to the greatest depths of the Baltic. In the Black sea, some Norwegian fjords, and in Walsfjæ bay on the west coast of Africa, the bottom water contains hydrogen sulphide produced by the disintegration of organic remains.

The Zones of Life in the Sea.—In the major habitat "the sea" two principal regions may be distinguished. These differ com-

pletely in their conditions of life, and, therefore, in their animal population (fig. 3). They are the "benthic region" (floor of the sea) and the "pelagic region" (open sea). The benthic fauna consists of animals attached to the sea bottom. Pelagic animals are not attached to the bottom, and maintain themselves floating or swimming in the water. Benthic and pelagic regions can be subdivided into two areas, that penetrated by light (on an average from the surface down to 200 m) and a dark or abyssal region

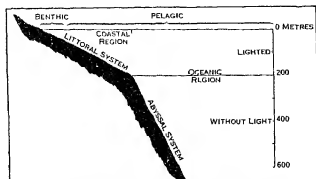


FIG. 3—ZOOLOGICAL DIVISIONS OF THE SEA

The illuminated portion of the benthic region is termed the "littoral zone."

Littoral Zone—In the littoral zone the bottom may be firm or shifting. A shifting bottom shows a flat surface, and varies according to its constituents, gravel, sand or mud. Rocks form a hard bottom, and the coast in such places is generally precipitous. The kinds of animals found in the littoral are determined by the type of bottom and by the movements of the water. The littoral is divided into four zones: (1) the spray zone above high tide; (2) the tidal zone between high and low tide marks; (3) the shallow water zone, or region affected by the waves; and (4) the still water zone, which extends from the shallow water zone to the upper limit of the abyssal region, where the benthic region is not reached by effective light.

A pebbly shore in the tidal zone is almost entirely without life, all organisms being killed by friction of the stones against one another. In shallow water, sandy bottoms that are often disturbed are not habitable for many animals. In places, however, where plants (*Zostera*, *Pandanus*) flourish, the sand is bound together, and animals find hiding places under the leaves and among the roots, sessile animals can find places for attachment, food (mud, detritus) is present, so that here a characteristic fauna is established. In deeper water, and in the shelter of projecting islands and sandbanks, a rich fauna may develop also near the surface, on sand and ooze. Sessile animals, certainly, are not often found on shifting bottoms, owing to the danger of being buried, but oysters settle on the shells of molluscs, or on stones, and the edible mussel (*Mytilus*) attaches itself by its byssus to the floating branches of *Fucus*. On the other hand, shifting bottoms teem with animals that burrow under the surface, and so render themselves invisible to enemies.

In the coastal waters of northern Europe these include the lug worm (*Arenicola*), and other annelids, *Balanoglossus*, the hemichordate, the heart urchin (*Echinocardium*), numerous bivalves, which usually have smooth, flat shells for digging, and which obtain food and oxygen from the surface by siphons (fig. 4). These are preyed on by starfishes and the predatory snail *Natica*. Crustaceans, amphipods, shrimp and the lancelet, *Amphioxus*, also burrow in the sand. Flat fishes, the stargazer (*Uranoscopus*), the weaver (*Tachinus*) and blenny (*Blennius*) work themselves in

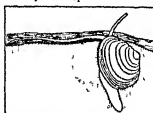


FIG. 4—PEPPER MUSSEL (*SCROBICULARIA PIPERATA*) IN SAND

On the left, the inhalant siphon on the right, the exhalant one, clear of water

just beneath the surface, gazing upwards with eyes situated on the upper surface of the head. The sand also shelters minute animals, which find room for movement between the sandgrains—acoelous turbellarians, Archi Annelida, Tardigrada and Gastrotricha. The principal animals found on the sand are the ophiuroids, some snails, annelids and crabs.

Rocky coasts, in contrast to flat, shifting bottoms, offer a firm substratum for plants (particularly *Laminaria* and *Fucus*), and for sessile animals. Clefts, holes and caves offer shelter from the force of the waves. Sessile animals fix themselves by preference to the kelp and to its places of attachment. Some construct hiding places by boring holes in the rocks, e.g., the boring sponge, *Von*, the boring bivalves *Pholas* and *Lithodomus* and sea urchins such as *Strongylocentrotus*. Those animals, however, which dwell upon the rock surface, are armoured and protected against attack by hard shells. Sponges have spicules of silica, echinoderms are armoured, and snails and bivalves have strong, often spiny shells. Many crustaceans on rocky bottoms have spiny cuticles. Animals dwelling within the region of the breakers require protection against the battering of the waves, and so are firmly attached (see above). Selection is rigorous in this environment, only a few species can withstand the force of the waves, but this affords them protection from enemies. Thus the edible mussel (*Mytilus*) has a wide distribution in the littoral region, but usually is represented by solitary individuals, in the region of the breakers, however, where they are not exposed to attack, mussels are packed together in large numbers. Softer, more fragile animals—hydroids, worms and small crustaceans among them—live in the interstices, between animals with shells.

Coastal reefs may be compared to rocky coasts. These reefs are raised structures, extending from sea bottom to low tide level, formed by living coral animals and consisting of their calcareous skeletons. These reefs are confined to a belt in the tropical seas, extending about 30° latitude north and south of the equator, since the coral polyps require a temperature of at least 20° C. This accounts for their reduced development on the west coasts of Africa and America, where cold currents narrow the tropical seas. Calcareous algae, Bryozoa, some gastropods and other organisms take part with the corals in the formation of the reef. Reef building corals cannot live below a depth of about 50 m., since they live in symbiosis with algae (*Zooxanthella*), which inhabit the walls of the interior of the polyp, and require light for assimilation. The delicate colours of corals are obtained from the algae. Many reef-dwelling animals have vivid colours (see Plate). The numerous species of corals of which a reef is composed are so arranged that in the zone of the breakers, strong, resistant forms are found. In deeper water, and in places where there is shelter from the waves, the delicately tinted, branching forms occur. Many kinds of animals find retreats in the numerous holes and cavities of the reefs, among them worms, crustaceans, gastropods and fishes. Some fishes feed on the coral polyps, and bite the ends of the branches with their beak-like jaws (Pomacentridae and Plectognathidae).

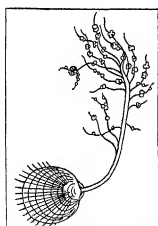
Pelagic Zone—The inhabitants of the open water or pelagic region have in common peculiarities connected with floating. Living matter is somewhat heavier than sea water, therefore, to float, animals must possess special adaptations. The rapidity with which a body sinks varies in proportion to its weight. It decreases with increased form resistance (such as expansion of the under-surface). The weight of a living organism is lessened by the sparing use of skeletal material (lime, silica), and by the accumulation of lighter substances (fat, air) in the body. The shells of floating animals, therefore, are small and thin, as in pelagic Foraminifera. The phosphorescent animal *Noctiluca*, many free-swimming crustaceans, the eggs of pelagic fishes (e.g., cod, flat fishes) contain fat globules, further, the accumulation of fat in the liver of many fishes, and the blubber of penguins, seals and whales lessens the effective weight. Air bladders are a highly proficient means of diminishing weight, and are found in many Siphonophora and in bony fishes (Teleostei). Form-resistance is increased by enlargement of the under surface. The most usual way is by absorption of sea water into the body. This does not increase the

weight, but distributes it over a greater area. Thus arises the gelatinous tissue frequent in pelagic animals. Water forms 96% of the jelly fish, *Aurelia aurita*. In small animals, the under-surface may be increased by flattening the body, or by horizontally disposed processes which serve as floats, e.g., pelagic nemertines (flattened like lakes), the *Phyllosoma* larvae of crustaceans, copepods (*Sapphina*). If such means do not suffice, movements are made to assist in the prevention of sinking, as the lashing of the cilia of pelagic larvae, the beating of the ciliated plates of Ctenophora, the muscular movements of crustaceans and fishes. Swimming occurs when the muscular movements are sufficiently strong to render the animal's path independent of the movements of the water. Swimming is almost entirely confined to fishes, some cuttlefishes, and animals not primarily marine, such as turtles, penguins, whales and seals.

Those living organisms that float free in the water are termed the plankton (*q.v.*). The constitution of the plankton of the open sea differs from that of the coastal regions, or of shallow seas. The oceanic plankton consists entirely of forms which pass their whole life floating in the water (holoplanktonic). Examples are Siphonophora, Ctenophora, Chaetognaths, some crustaceans and gastropods, salpas and the ascidian, *Pyrosoma*. In coastal regions, in addition to such holoplanktonic forms, there are numerous animals pelagic only at some period of their life (meroplanktonic), in particular, the larval forms of benthic animals. The composition of the coastal plankton is therefore much more changeable than that of the oceanic plankton. The coastal plankton has its lower limit at a depth of about 200 m, but it may be driven beyond this by storms or currents. Coastal waters are much richer in life than oceanic. In the open ocean, however, the amount of life is not the same in all parts. In the Atlantic, the polar regions are much richer than the tropical. A catch in the tropical Atlantic contained 763 organisms per litre of water, and a comparable catch in cold waters 76,915. There are, however, stretches of tropical seas which have a rich plankton, such as parts of the Indian ocean. The plankton forms the food of many fishes, such as herrings.

Abyssal Region.—The deep, unilluminated, abyssal region of the ocean is not without inhabitants, but plants naturally are absent. Since no building-up of organic substances can take place, the basic food of abyssal animals consists of the dead organisms which sink from the surface. The greater the depth, the less food reaches it. The number of species of the various groups of animals decreases with the depth, the following examples are taken from the crabs in the collective tow-nets of the "Challenger" Expedition.—

| | | | | | | |
|-------------------|------|--------|---------|---------|----------|------|
| Depth, in metres | 0-36 | 36-180 | 180-360 | 360-900 | 900-1800 | 1800 |
| Number of species | 190 | 75 | 28 | 21 | 3 | 3 |



FROM CHUN "WISSENSCHAFTLICHE BEZUG
KIZSE DER DEUTSCHEN TIEF SEE EXPEDITION
FIG. 5.—DEEP SEA BRACHIOPOD
STALK WITH OUTGROWTHS TO
WHICH FORAMINIFERA ADHERE

Benthos.—The benthos is composed partly of those animals, which, by setting up eddies in the water, waft food towards themselves, and partly of those feeding on ooze. Echinoderms are particularly numerous among the latter. The soft ooze of the deep sea, which is about the consistency of soft butter, forms a very unstable substratum. For this reason, sessile animals have either long stalks (glass-rope sponges), or their basal end spreads out into root-like processes (horny corals, ctenoids brachiopods) (fig. 5). Deep water sea-urchins and sea cucumbers (Holothurra) are frequently flattened. Bottom-dwelling crustaceans have elongated legs, the lower surface of which is often broadened by rows of bristles (setae). The power of emitting light is frequently found in animals inhabiting the dark abysses though

it occurs also in the illuminated water layers. Sea pens, horny corals, star fishes and many others emit diffuse light. More than 95% of bathypelagic fishes possess light-producing organs. Nevertheless, light in the depths is scanty. For this reason, the eyes of deep sea crustaceans and fishes are often enlarged, or otherwise made more sensitive. Deep sea animals are of one colour (monotonic), usually violet, dark brown, red or black. The uniformity of temperature conditions and the slight degree of movement of the water favour wide distribution of animals in the deep sea. Many are cosmopolitan, but there are also local species.

THE DISTRIBUTION OF ANIMALS IN INLAND WATERS

While in many respects conditions of life in the ocean are equal, owing to the general intermingling of the waters, those in inland waters show great differences in the various regions. This results from the splitting up of these waters into many larger or smaller sections, and is reflected in the variety of their populations.

The chemical composition of inland waters is very changeable, particularly as regards lime salts. In granite and porphyry regions (total dissolved solids may be as little as 16 mg per litre, while in limestone regions they may rise to about 300 mg per litre). Some animals, such as the water flea *Holopedium gibberum*, avoid lime-rich water. Others require it, e.g., most molluscs. The salinity also is very varied. In the Rhine, the water contains 0.14 g NaCl per litre. When the salinity rises above 0.3 g we speak of "salt" water. Lake Balack near the Caspian sea has a salt content of 28.5% and still supports a varied animal community as does Great Salt Lake whose waters are about 23% salt. The lack of life in the Dead Sea results from other factors than the high salinity since its waters contain only 23.75% salt. In bog water, the large quantity of humus is unfavourable to life. The amount of oxygen in inland waters varies with time and place. It is highest in the eddying waters of mountain torrents, and in shallow ponds with dense plant growth when exposed to the sun, as this causes the plants to give off much oxygen. On the other hand, in later summer, the oxygen at the bottom of some lakes is completely used up, so that animals like fish that particularly require it cannot live there.

The temperature of inland waters undergoes much greater variations than that of the sea. Inland waters are usually shallow, they are seldom more than 300 m deep, while the majority are not deeper than 10 m. In ponds and pools, the depth is considerably less. There is, therefore, a high ratio of surface to volume, heating and cooling take place rapidly. In temperate regions, a constant temperature is found only in springs welling up from great depths, in deep parts of lakes and in waters in caves, cold-sterothermal animals are found only in such places.

Light does not penetrate so deeply in inland waters as in the sea, on account of their more turbid condition. Usually, it penetrates only 30-40 m, the lower limit of plant life is often at only 7 m or less. In general, shallow waters have more plant life and therefore more animal life than deep ones.

The movements of the water are particularly important to aquatic animals. Flowing water and standing water make quite different demands on their inhabitants, and have therefore different types of population. They differ in chemical composition, thermal conditions, depth and extent. The currents of rivers and other streams prevent the accumulation of matter in solution. Flowing water takes longer to warm, and cools more rapidly than standing water, and the difference of temperature between the surface and the depths is lessened by intermingling. There are, however, intermediate conditions. The rapidity of the current depends on the fall of the land. The Rhine, at its source, has a fall of 2.5% (2.5 m in 100), the upper Rhine from Basle to Bingen about 0.05%, the lower Rhine, 0.12%. The Volga, in its whole course, has a fall of only 0.007%, and the lower Amazon only 0.001%, they show conditions resembling those of standing water.

Flowing Water.—Flowing waters are almost always connected with the sea. Their animal life, apart from forms not primarily aquatic such as insects and pulmonate gastropods, was originally

derived thence. A continual slow immigration still takes place. Some fishes ascend rivers from the sea only at spawning time (anadromous fishes) e.g., the sturgeon (*Acipenser*) and salmon (*Salmo salar*), others ascend the rivers as young animals and descend to the sea to spawn e.g., the common eels (*Anguilla*). There are katastomous fishes. Lurlyhalme, marine invertebrates (e.g. copepods, amphipods, oysters) penetrate estuaries, and there mingle with the fresh water inhabitants.

The velocity of river currents may be classed as sluggish, average and rapid, according to the degree of the fall. In sluggish

river erosion is minimal, and deposition of sediment material. Fine mud sinks down and forms a nutritious ooze on the bottom. This supports many detritus eaters, such as worms, molluscs and insect larvae. At the average rate of flow, erosion and sedimentation maintain a balance, and the bottom is covered with gravel. In rapid streams erosion prevails, and deposition of sediment is minimal, the bottom is formed of large stones, which, by their movements, would crush to pieces any living organisms among them. The inhabitants must be adapted to this movement of the water. The different stretches of rivers harbour different animal populations. As regards fishes, rivers, from mouth to source, have been divided into the region of carp, of brybel of grayling and of trout. Sharp delimitation, however, is not possible. In slowly flowing waters various kinds of fishes may be present, good swimmers and poor, with rounded bodies or with flat, provided the temperature and amount of oxygen are suitable. The stronger the current, the greater the swimming powers a fish must possess to resist it. In such places, we find fishes predominating which are found in transverse section, and so are not spun round on their axes by the whirling of the waters (fig. 6). The number of species of fish decreases as we approach the source, the continually increasing demands made by currents and falling temperature have a selective influence. This is illustrated by the distribution of fish according to height above sea level in Colorado. Below 1500 m there are 44 species, between 1500 m and 2,100 m, 47, this number decreases to 24 between 2100 and 2750 m, only 13 species go higher and seven of these are salmonids.

The mountain stream affords the best instance of a characteristic fauna. The animals here take on a certain general stamp, since none can live except those able to accommodate themselves to the severe conditions of temperature and current. All have adaptations which prevent them being swept away by the current. Some are flat, and creep under stones (*Gammarus*, insect larvae), others adhere firmly by a broad sole or sucker (turbellarian worms, gastropods), or with special kinds of suckers (larvae of the gnat *Blépharocera*, fishes and tadpoles of tropical mountain streams), others spin threads which form a strong attachment to the bottom (larvae of the blackfly *Simulium*, pupae of mayflies). They are often flat and depressed to offer the least possible hold to the current. Since they are not strong swimmers, their power of movement is limited compared with that of related forms, e.g., the water-mites of mountain streams do not swim and have limbs without swimming bristles (fig. 7). The inhabitants of mountain brooks are generally eurythermal or cold stenothermal. Animal communities which require a constant low temperature are found chiefly in springs (the turbellarian *Planaria alpina*, the gastropod *Bythinella dunkeri*).

Standing Inland Waters.—In these regions the absence of currents gives rise to special conditions. An inland basin becomes rich in food material for animals, and in fertilizing matter for plants, brought down by winds and rain. Thus lakes having no outlet are richer in life than those which possess one. In shallow basins, where the bottom is greater in proportion to the water mass than in deep ones, and where, in all parts, light penetrates

from top to bottom and permits plant-life, the mass of living organisms is generally greater than in larger and deeper basins. Of 20 Swedish lakes in which this has been studied, the smallest has the largest proportion of fish (113 kg per hectare), the largest (Lakes Wener and Maelar) only 27 kg per hectare.

In shallow basins circulation of the water takes place through winds, and thus the lower layers are aerated, as in Lake Balaton in Hungary. In deeper lakes, where no such complete mingling of the water is possible, the lower layers are aerated by convection currents set up by the cooling of the surface water in the cold season. In summer thermal stratification divides many such lakes into three layers: (1) an upper stratum of warm, aerated water, (2) a narrow transition stratum in which the temperature falls rapidly, usually at the rate of 1° C per m, or even faster, (3) the bottom stratum of cool water in which, in lakes rich in organic life, much oxygen is used up in the disintegration of the dead organisms which sink to the bottom, so that the amount of oxygen becomes scanty, or absent. This excludes many animals from such depths and gives a definite character to the composition of the fauna.

Larger basins of such depth that the greater part of the bottom is free from vegetation are described as lakes, in contrast to these are the ponds, pools and puddles, termed collectively small water basins. In lakes we distinguish a shore region (paralimnion), a deep water zone and a region of open water.

The outer portion of the paralimnion, which in summer is occasionally left dry, is poor in life. On the other hand, the deeper paralimnion region where there are plants for food and hiding places is the richest in living organisms.

The open water is populated by plankton, and by fishes that feed on it, e.g., *Alburnus*, *Coregonus*. The bottom fauna is varied. Three types of lakes are distinguished, eutrophic, oligotrophic and dystrophic. The eutrophic type, with flat shores overgrown with vegetation, and with a rich plankton, has its deep layers filled up with putrifying ooze composed of the disintegrating bodies of plankton organisms or detritus. Only animals able to make use of the smallest quantities of oxygen are able to live there, e.g. oligo chætes (Tubificidae), larvae of the midge *Chironomus*. Both these have haemoglobin in their blood, apparently enabling them to use fully whatever oxygen is present. In oligotrophic lakes with steep banks and little vegetation, the plankton is scanty, and the bottom therefore has less ooze, other insect larvae are found here (*Tanytarsus* larvae). In spite of the greater supply of oxygen, the number of organisms is less because of the smaller amount of food. Dystrophic lakes are those with bog water, in which the acidity caused by humus is unfavourable, and the deficiency in lime also excludes many animals. The plankton in them is chiefly animal, and consists mainly of rotifers and small crustaceans, which feed on colloidal matter in the humus.

In ponds and pools the fauna is similar to that of the overgrown shore zone of eutrophic lakes. Decaying vegetable matter is present in sufficient quantity to provide food and oxygen for the growth of plants and only the great variations in temperature are unfavourable. In pools and puddles there is often a rich fauna of small rotifers, crustaceans and insect larvae. In waters liable to dry up periodically a particularly characteristic fauna is found. In temperate regions these waters are small, but in subtropical steppe areas (South African pans) they are sometimes of much greater extent. In such places animals must pass through stages of development quickly, and therefore must be small, and they need some protection against desiccation. Many produce hard-shelled resting ova (*Hydra*, rotifers, Cladocera) or spores (gemmules of sponges, statoblasts of Bryozoa), others are able to surround themselves by a capsule formed by a glandular secretion (the small annelid *Aelosoma*, some copepods), and some burrow into the ooze and form a capsule of mud around themselves.

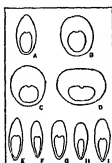


FIG. 6.—DIAGRAM OF SECTIONS THROUGH FISHES
A Brown Trout B Minnow C Loach D Miller's Thumb E Bream F Prussian Carp G Common Carp H Blüthling, I Rudd



FIG. 7.—LEGS OF WATER MITES GENUS LEBERTIA
A From brook (L. complens) B From pond (L. insignis)

(phyllopod crustaceans, fishes such as *Protopterus*). Lastly, there are animals that can dry up into a cyst without losing their power of living, such as many rotifers (*Philodina*) and Nematoda (thread worms). These groups can live also on the mossy growth on rocks and tree trunks.

In salt lakes and pools the number of species decreases with increasing salinity. Those able to endure the greatest salinity are the brine shrimp (*Artemia salina*), and a number of fly larvae, but even the brine shrimp suffers changes with increasing salinity, the bristles become stunted, the size of the animal decreases, it becomes enfeebled, and finally disappears.

THE DISTRIBUTION OF TERRESTRIAL ANIMALS

The environmental conditions that influence the distribution of terrestrial animals are much more complicated than those brought to bear on aquatic animals. The chemical composition of the air is not important, as complete intermixture can take place very quickly. More important is the physical condition of the atmosphere, that combination of conditions called climate, and which is not present in water in such complexity. Such climatic factors are atmospheric moisture, temperature, atmospheric movements and solar radiation, some of which change periodically.

Moisture—The amount of atmospheric moisture varies with time and place. Where the air is saturated, as in tropical rain-forests, even soft skinned animals (planarians, leeches) can live out of water without danger of drying up. In such places a rich fauna and flora is found. Life is scarcest in regions where atmos-

perature of air varies to a much greater degree than that of water and does so more rapidly and more extensively. In sea water the lower limit of temperature is about -1.9°C , in fresh water, it is 0°C (32°F). Air temperature may sink to -67.8°C (-80°F) at Verkhoyansk (Verkhoyansk) just north of the Arctic circle in eastern Siberia. The greatest difference between the highest and lowest mean monthly temperatures is also at Verkhoyansk where it amounts to 66.3°C . Daily variations of 31.5°C have been measured at Tucson, Arizona, where the soil surface may reach 71.5°C . Recorded temperatures in Indiana dunes range from 64°C at the surface of the sand in summer to an air temperature of -28°C in winter. Such extremes are characteristic of continental as opposed to oceanic climates.

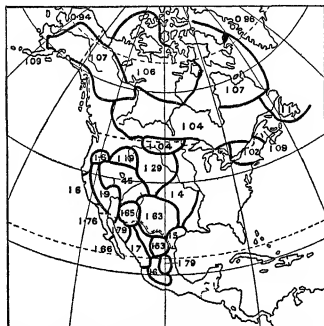
The distribution of animals, therefore, is determined by the degree of warmth they require. Animals limited to a uniformly high temperature, *e.g.*, warm stenothermal animals, in temperate regions live only in particularly warm localities, especially on chalk soil. As examples may be mentioned the green lizard (*Lacerta viridis*), and the praying mantis (*Mantis religiosa*), when found north of the Alps. Cold stenothermal animals, on the other hand, inhabit places with a lower temperature, *e.g.*, snails of the genus *Vitrina* are found on the summits of the Alps, on Mt. Kilimanjaro and in the Cameroons, but are absent in warm parts.

Homiothermal (warm blooded) animals are not immediately influenced by their surrounding temperature. The temperature of the surroundings, however, by its variations renders difficult the regulation of internal heat. The problem of the limitation of the amount of heat given off is solved in various ways. Thick coverings of hair or feathers, or the deposition of fat beneath the skin are the most important, in many birds air sacs assist in maintaining a protective warmth round the internal organs. It is important, also, that the surface area of the body, where heat radiation takes place, should be lessened.

Birds, as compared with mammals, have a very small surface in proportion to mass. Among mammals the external ear and the tail are parts where much heat is given off, and for this reason they are smaller in animals dwelling in cold regions than in their relatives in warmer parts. For instance, the ears of the Arctic fox are small, those of the common fox are larger and those of the desert fox largest (fig. 9).

The length of the ears in comparison with that of the skull in North American hares (*Lepus*), is shown in fig. 8.

Since large animals have a relatively smaller surface area than small ones, this implies in them a diminution of the giving-off of heat. Of two dogs weighing 20 kg and 3.2 kg, having surface-areas of 7,500 and 2,423 sq cm respectively, the larger had a surface area of 375 sq cm per kg of body weight, the smaller 757 sq cm, *i.e.*, about double the area, the larger produced in 1 unit of time from 1 kg of mass 45 calories, the smaller 88 calories, the amount of heat given off, therefore, rises in proportion to the surface area. It is worthy of note that warm-blooded animals in cool regions usually attain a larger size than the corresponding species in warmer climates (Bergmann's rule). The coldest parts of a faunal region tend therefore to be centres of maximal forms, while the warmest parts are centres of minimal forms. In the Palaearctic region warm-blooded species have a minimum size on the south coast of the Mediterranean, while in northern Siberia they reach their maximum size. In North America, Alaska is a centre of maximum size, for example—among mammals the bear (*Ursus gyas*), the fox and the moose (*Alces gyas*), among birds, the great horned owl (*Bubo virginianus*), the Alpine lark (*Otocoris alpestris*) and the pine grosbeak (*Pinicola enucleator*), all being larger than normal. Smaller forms are in Florida and Lower California. It should be noted that this rule holds only in a general way, and that there are numerous exceptions and various types of deviation from it.



Peculiarities of Tropical Fauna—A uniform climate is found chiefly in some tropical regions of the Americas, Africa, India and the East Indies, particularly in tropical forest areas. These are distinguished by the absence of seasonal changes, and by offering optimum conditions of moisture, warmth and light. The abundant vegetation permits rich development of animal life. Poikilothermal animals enjoy almost the same favourable conditions as have been established internally as the optimum in homeothermal animals. Such animals require considerably less food than in temperate regions. Many classes of poikilothermal animals attain a considerable size in the tropics, e.g., numerous insects, millepedes, spiders, snails. There are amphibians and reptiles at an minimum size. Brilliant colours and clearly defined markings are characteristic of tropical animals. The number of living organisms is enormous. Development takes place quickly, generation following generation in rapid succession. The butterfly *Danaus chrysippus* in the northern parts of its area of distribution is represented by one generation a year, but in the Philippines it requires only 13 days for complete development. Among mammals also development is accelerated. The widespread belief that puberty in man, as shown by the age at menarche, is reached earlier in southern latitudes holds only in a general and rather indirect way, there are many exceptions.

The number of species in the tropics is astonishing. South America has 4,560 species of Lepidoptera, while the whole of the Palearctic region (Asia north of the Himalayas, Europe and North Africa) has only 716. The Brazilian states of Para and Amazonia have 1,117 species of birds, i.e., almost as many as the whole Palearctic region (1,218). The number of individuals of a single species, however, is usually limited, of insects and spiders it is often easier to collect 100 different species than 100 individuals of one species. The absence of seasons causes reproduction to go on during the whole year, one may find at any time of the year eggs, larvae, pupae and fully developed animals.

Temperate Regions—On the other hand, in regions where periodical changes of temperature give rise to seasons, animals are subjected to conditions varying from times of plenty to times of need. It is immaterial whether the changes be between summer and winter, or between rainy season and dry. Summer and the rainy season bring the most favourable conditions, winter and drought the least favourable. Animal life languishes under unfavourable conditions, lack of warmth in one place bringing about a state similar to lack of moisture in another. When, however, the bonds are loosed, the awakening of the animal world is often the more crowded owing to the simultaneous appearance of many species. Most species immediately set about reproduction, the chirping of crickets, the croaking of frogs, and particularly the songs of birds, together with the awakening of plant life, is in sharp, refreshing contrast to the desolation of winter and the dry season. In winter, or the dry season, many terrestrial animals cease their vital activities. Aestivation in time of drought is common among insects, spiders and snails; frogs and toads creep into holes in the earth or other hiding places, and remain there in a deathlike sleep. Crocodiles dig themselves into the mud of pools which are drying up, and rest beneath the hardened crust. This habit of sleeping through the dry season is also found among mammals, e.g., the armadillo (*Ormycteropus*) in Africa. In winter, poikilothermal animals hibernate in a similar way; this may also occur in warm blooded animals, which undergo a drastic fall of temperature and a slowing-down of the rate of metabolism. Such are hedgehogs, bats, ground squirrels and marmots. Among birds, however, we find neither hibernation nor aestivation, many withdraw from the reach of unfavourable seasons by migrating. Many mammals also migrate as a result of seasonal changes of weather. It occurs among South American antelopes, subarctic reindeer and diverse birds. Among birds of tem-

perate regions, we may distinguish a general resident population which dwells the whole year in the same locality, migratory birds present only for the breeding season (summer visitors) or only in the nonbreeding season (winter visitors) or occurring on passage between their summer and winter habitats. According to the climate of the habitat the same species may be resident in one locality and migratory in another. Thus in England birds such as starlings and song thrushes remain throughout the winter, in central Europe they migrate. Some birds travel great distances, the summer and winter quarters of *Sterna paradisaea* are 17,700 km apart. The change from rainy season to dry causes migration, as in Africa.

The nature of the soil of a locality is important in determining the composition of its population. Among mammals the two legged jumping animals require a hard substratum which offers a firm foothold. These are found in all the steppe regions of the earth. Such are jerboas, the jumping hare *Pedetes* and the kangaroo group of marsupials. Running animals, such as carnivores that go upon their toes, and ungulates, which place only the tips of the toes on the ground, thrive best on a hard soil with little friction. Ungulates living on sand—the desert antelope, *Gazella loderi*—on bog, as does the moose, or on snow, like the reindeer or caribou (fig. 10), have the surface of the hoof expanded to prevent sinking, they have three or four toes (pigs and tapirs), or two toes bearing elongated hooves, which can diverge widely. The toes of lizards that live on loose sand sometimes have fringes along the sides.

A DESERT COMMUNITY

The American desert in bloom, as painted for *Encyclopaedia Britannica* by Walter A. Weber

Deserts are developed under the climatic influence of small annual rainfall (among other factors), the vegetation over wide areas being so reduced that bare soil appears between the individual plants, while the species, genera and families composing the flora are radically and characteristically modified by evolution toward adjustment to dry conditions. The associated animals are often equally characteristic. The deserts of the world accordingly present one of the major types of biotic formation.

When a desert has been in existence for a long period of time, as in south western North America, a rich and remarkable flora with an equally rich and well associated fauna may result. When the desert is more recently established, as on the coastal plain of Chile and Peru, vegetation and attendant animal life may be almost wholly lacking. This is the case also where there are large areas of moving sand, which vegetation is able to bring to a halt only when there is sufficient rainfall.

The variety of plant life in the United States desert becomes the more conspicuous when it bursts into bloom after rain, whether in spring or at another season. The desert vegetation then belies its reputation for grayness and dullness of tone, and presents the rich greens and bright flowers of the accompanying plate. The visitor to the Big Bend of western Texas or to the giant cactus region of Arizona who is so fortunate as to arrive a week after a rain will be charmed by the brilliant reds and yellows of the cactus blooms, and by the bright green fringes of the spiny acacia stems, with their flaming terminal flower spikes.

The more abundant animals of the U S desert are often nocturnal, and there is a great variety of small and medium sized rodents, together with the long limbed and long eared hares. Even the smaller mammals, in most deserts, include a great variety of hoppers. Most notable of the larger mammals origin only native to the intermediate deserts of North America, and found even under the most extreme desert conditions, is the prongbuck, the so called "antelope" of western America. One of the primary adjustments of desert herbivores to sparse vegetation is the development of great powers of locomotion. This is notably the case with the prongbuck. Notable also is the white flank marking of the butlocks of this animal, in which the coarse white hairs are erectile and are spread in a pomlike form that catches the sun and is dazzlingly conspicuous even at great distances. This is a most distinctive adaptation to open country and to life in gregarious herds. It apparently functions as a warning signal from herd to herd and as a recognition and herd integrating mark from individual to individual.

The development of especially large ears is to be seen in the kit fox (shown in the plate opposite) and this likewise is a characteristic of many desert mammals, reaching an astonishing extreme in such forms as the jack rabbit of south ern Arizona or the fennec foxes of Africa and southwestern Asia.



FIG. 10.—TOES OF FORE FOOT OF REINDEER (RANGIFER)

poikilothermal animals hibernate in a similar way; this may also occur in warm blooded animals, which undergo a drastic fall of temperature and a slowing-down of the rate of metabolism. Such are hedgehogs, bats, ground squirrels and marmots. Among birds, however, we find neither hibernation nor aestivation, many withdraw from the reach of unfavourable seasons by migrating. Many mammals also migrate as a result of seasonal changes of weather. It occurs among South American antelopes, subarctic reindeer and diverse birds. Among birds of tem-





Soil—Of the chemical constituents of the soil calcium merits the first consideration. Animals which require much lime for building up their bodies thrive better on chalky ground than on soil poor in lime. Among mammals this is particularly noticeable in deer, which require lime for the annual renewal of their antlers. Roebuck in limestone regions have stronger antlers than those in sandstone districts. Further, the body weight of the roe deer is greater in limestone districts. In Württemberg the weight of the carcase of the roe deer in limestone regions exceeds 14 kg., but in districts with little lime in the soil (sandstone moorland) it is below 14 kg. The amount of lime in the soil and, therefore, in the drinking water, affects mankind also, thus showing itself particularly plainly in the teeth. The number of decayed teeth in school children is much higher in regions poor in chalk than in those rich in it. Snails are more numerous in limestone regions, both in species and in individuals, owing to the chemical composition of the soil and to the greater warmth of the calcium rich soil. Lime also reduces soil acidity and increases soil aeration.

Other animals require a large amount of salt in the soil and are widely distributed on sea coasts, inland, they are found only on salt ground, as at Stassfurt and in similar localities. This applies particularly to the small beetles (Staphylinidae, Carabidae) and other insects. Salt is sought after by mammals also, particularly by herbivores, places where it crops up are much resorted to by ruminants, and in primeval forests they have paths converging to them from all directions.

The Fauna of Forests—Large forests are found only in regions where, during the summer vegetative season, a minimum temperature of 10° C prevails, a minimum rainfall of 50 cm. and an atmospheric humidity of more than 50% saturation. The dense covering of the tree tops hinders penetration of heat rays, evaporation of moisture and air currents. For this reason, temperature, humidity and air currents vary much less than in open country. The density of forests, moreover, varies greatly, all grades are found from the tall, hot, impenetrable, dripping rain-forests of the tropics to the light pine forests near the tree limit on mountain slopes and in the subarctic

region. The peculiarities of forest animals are seen most plainly in the tropical rain forests, which form an immense zone round the earth at the equator, and include the Congo forest region the forests of southern Asia and the islands of that region and the selvas of the Amazon.

Orientation is possible only for short distances, eyes and organs of smell, but not much use, the sense of hearing is the most useful. The gregarious forest animals, therefore, such as birds and monkeys, are noisy, in contrast to those of open country. The light is subdued and much reflected brilliant colours do not show up the value of protective coloration is lessened by the restriction of the outlook. Flying and running are hampered, the true forest birds are usually poor fliers, but are good at climbing and climbing. Some forest animals, such as elephants and large swine, are able to force their way through, others are small and slender, stand lower in front than behind, carry the head low and are able to squeeze through narrow places, e.g. forest antelopes (*Cephalophus*, *Tragelaphus*), forest deer (*Moschus*) and agoutis (*Dasyprocta*). Many birds and mammals are equipped with sharp claws (woodpeckers, squirrels, marmosets), others have gripping feet (pinots, monkeys, arboreal marsupials), some have prehensile tails (many South American monkeys), the porcupine (*Erethizon*), the anteater, various marsupials.

Climbing animals in forest regions include also many reptiles and amphibians, such as the litrally compressed tree Agamidae of the old world, and the tree iguanas of the new world, the long, slender tree snakes and numerous tree frogs. Panchelians, some forest animals, are confined to forests such as frogs of the genus *Rhacophorus*, the flying lizard (*Draco volans*), the flying phalanger (*Petaurus*, *Petaurus*, *Acrobatis*), the flying squirrel (*Monomachus*, *Petaurus*, *Glaucocoma*) and the flying lemur (*Galeopithecus*). Some tree frogs have become so adapted to arboreal life that they have forsaken the ground even for reproduction, laying their eggs in the collections of water on the epiphytic Bromeliads, or the eggs are carried until they hatch in dorsal pouches, or in the expanded vocal sac. A number of active animals use the forest only as a dwelling place, and seek their food in open country, e.g. birds of prey, wolf, fox, buffalo and stag. The conditions of the forest are uniform, the food supply is poor and therefore the population is sparse, on the other hand, the borders of forests and forest glades where there is plenty of light swarm with life, since there is room for free movement and an abundance of vegetable food combined with protective shelter.

The more a forest departs from the extreme type of the tropical rain forest, the more the characteristic peculiarities of its inhabitants are effaced. In the forests of temperate regions the characteristics of the fauna are mostly determined by the nature of the forest. The forests have a different animal population from coniferous forests, while mixed forests have an intermediate type of population. In deciduous forests gastropods are represented by many species, in pine forests they are almost absent. Many forest insects are restricted in diet either to deciduous or to coniferous trees. Deciduous forests in Europe are inhabited by the black grouse (*Tetrao tetrix*), numerous songbirds and by the dormouse (*Myodopus*). In the forests of mammals in North America the characteristic birds include the ruffed grouse (*Bonasa umbellus*), a great variety of thrushes and the small mammals include a variety of squirrels and deer mice (*Peromyscus*), and the cottontail rabbit (*Sylvilagus*). Coniferous forests in Europe are inhabited by the capercaillie (*Tetrao urogallus*), great black woodpecker (*Picus marinus*), nutcracker (*Nucifraga*), crossbill (*Loxia*), siskin (*Carduelis spinus*) and kinglet (*Regulus*). The corresponding forest in North America has related *Loxia* and *Regulus*, and a host of nesting birds, such as the wood warblers unknown in the old world. The characteristic mammals, like the moose, tend to exhibit circumpolar relations.

Fauna of Open Country—Open country is in every respect in contrast to forest regions. Forests are not found where moisture and warmth are insufficient, in such places only grass and shrubs are present. Such lack of moisture is often found in great plains, both elevated and low lying. But there are numerous grades of open country, from savannahs and steppes to pre-desert (shrub steppe), and desert. The gradations depend on the degree of precipitation, this is greatest in subarctic grasslands, in arid steppes it is confined to the rainy season, and in waterless deserts it may be absent for years. In the rainy season, such regions show a very diverse appearance, the forest animals are there much more alike. All have an absence of protective foliage and, on this account, variations of temperature and humidity are great, and atmospheric currents are strong.

In general only animals that can endure a dry atmosphere are able to exist in open country, those requiring moisture in the air, such as gastropods and amphibians, are rare, though there may be a wealth of them in the water. An enormous number of animals seek shelter in holes and burrows in the ground from storms, enemies and variations of temperature. Here we find ants and other brood-nursing Hymenoptera and termites. Among reptiles there are swift moving snakes, like the American racers (*Coluber*) or the African *Psephenophis* as well as many burrowing types. Among mammals, rodents show the greatest number of burrowing forms, such as the marmots (*Marmota*), prairie dogs (*Cynomys*), soilkiss (*Spermophilus*), rats, voles, hamsters (*Cricetus*), jerboas, porcupines, the South American *Uromys* (*Uromys*), *Dolichotis*, *Viscacha*, and rabbits (*Lepus*).

A NORTH AMERICAN TEMPERATE GRASSLAND COMMUNITY

As painted for 'Encyclopaedia Britannica' by Walter A. Weber

The biotic formation or biome usually termed temperate grassland or steppe is pre eminently developed in North America, extending from Alberta to the Mexican plateau as a continuous north-south band, bordered by the semiarid scrub of the Rocky Mountain foothills on the west and by the forests of the eastern United States and Canada on the east. The western portion of this area, the great plains is covered by short grass sod, merging to the east into the higher mixed grassland of the United States savanna—the prairie.

That such grasslands in various parts of the world have had a long geological history is evidenced by the association with them of animals eminently adjusted to the plains environment, and specifically adapted to feeding on grass, whether on the lush growth of spring or on the winter killed but nutritious dry stems and seed filled heads.

In western North America the transition to desert is gradual to the southwest and again between the high grass prairies and the eastern forests, which in terridiglate in alternating grassy ridges and tree fringed river courses o. the Mississippi is approached from the west.

In North America the conspicuously dominant large grassland mammal was for ages the bison (in American English, the buffalo) *Bison bison*. The American bison had even more gigantic predecessors in the late Tertiary and in Pleistocene times. Bison lived in great but variously fragmented herds, which merged for an oblique north-south and south-north seasonal migration. The food of these vast assemblages of herbivores was supplied by the sod forming low grasses of the "short grass plains," such as buffalo grass (*Bouteloua dactyloides*) and the blue grama (*Bouteloua gracilis*). The predominance of these grasses seems to be directly associated with the presence of the herbivorous herds, whose continuous grazing holds back the taller grasses.

The carnivores most evidently associated with the bison were the wolves and coyotes preying on the aged and crippled individuals and taking on occasional unguarded calf.

The scene on the plate opposite is idealized to represent the appearance of the "short grass plains" before the coming of the white man. The American Indians, after their advent to the plains, became the principal bison predator, but even after the acquisition of the horse, they quite evidently lived only on the surplus of the vast herds.

The near extermination of the bison as a species toward the end of the 19th century, and its preservation by the activity of a group of active and vocal conservationists are part of the history of the conquest of North America by the white man.

Open grasslands and large gregarious herbivorous mammals, with attendant omnivores are correspondingly developed in Africa, Eurasia, South America and Australia.

cuniculus), they often live in large communities, and underground, in extensive areas. Armadillos (*Dasypus*), and armadarks (*Oryzotropus*), with hogs (*Placerhans*) and predatory mammals (e.g., the American badger) dig holes for themselves in open country. The birds are ground breeding forms, but others such as eagles which usually nest in trees occasionally breed on the ground in such regions. Others again make their nests in the holes of rodents, e.g., the burrowing owl (*Syrtyon*). In such regions, where there is little cover, the coloration of the animals is frequently adapted to that of the surroundings the less cover present the greater the degree of adaptation. This is found to the greatest degree in deserts, where the most varied kinds of animals have coloration similar to that of the ground. A few insects which have special protection in their hard cuticle (some Tenebrionidae), or which eject a poisonous fluid against attackers (the locust *Egaster gaveni*), have a striking black coloration. Black is an oft seen desert colour.

Agile animals are particularly characteristic of open country. Here are found running birds such as the sparrow, the swift, desert jays (*Pandora*) and larks. The shelds and two-legged jumping animals are inhabitants of open country. Visual and olfactory organs assist orientation, as the outlook is wide and the winds carry scents. Animals of open country, in contrast to those of forests, make little noise. Gregarious animals are particularly common. The extensive grasslands are the richest game regions of the world. The North American prairies formerly harboured enormous herds of bison, the South African plains still swarm with herds of hoofed animals.

Plains where winter is the dry season and the ground covered with snow at this season differ from the others. In the dry season the former offer food in dry grass and its seeds, which keeps life from dying out. In regions where the grass in winter is covered by snow, vegetation is less available as food and animals tend to hibernate or migrate. When the dry season is past and the first rains begin, life awakens suddenly, but where there is snow, plants and animals awaken gradually at the end of the winter. All these peculiarities are most marked in desert regions with their extreme conditions of life. The severity of animal life and the sharp contrast, the frequency of protective coloration, the polar coloration of the animals are all direct effects of climate.

Fauna of Mountain Regions.—In mountain regions there is generally sufficient moisture for the growth of forests, but, with the decrease of temperature in proportion to increase of altitude, the forests are confined to a zone, higher or lower according to latitude. In the Colombian Andes the limit of trees is 3,200 m above sea level, in the Swiss Alps, on an average 1,800 m. The forest fauna extends to this limit above, and adjoining it from the lower limit of the region of snow, a characteristic alpine fauna is found. As the height above sea level increases, atmospheric pressure and temperature decrease. The low atmospheric pressure, e.g., the small amount of oxygen in the air, causes an increase in the number of red blood corpuscles in homoiothermal animals. Plains dwelling mammals suffer from lack of oxygen. If they ascend high ("mountain sickness"). Nevertheless, mammals are able to dwell at heights of more than 6,000 m, e.g., the rodent *Ochotona vellatula* at 6,125 m on Mt. Everest. More important is the decrease in temperature, and the shortening of the warmer season in alpine regions. For these reasons the number of species decreases rapidly with increasing altitude. In Switzerland up to 700 m there are 178 species of birds, up to 1,800 m 178 species (partly other kinds) in the alpine region (up to 2,700 m) 90 species, in the region of the snows only 8 species. The species of gastropods, insects and mammals show a similar decrease. The special conditions of temperature at ground level lessen, for small animals, the unfavourable climate of mountain regions. In consequence of the strength of the sun's rays, the surface layers of the ground, and the air in the tussock

only warmed by the sun from time to time. Homoiothermal animals are more independent of temperature, but are very dependent on food to obtain it, they often migrate down towards the valleys in winter. Most truly alpine birds are nonmigratory, many species are relatively scarce. Homoiothermal animals in high mountain regions are often larger than their relatives in the plains, e.g., the tree-creeper (*Certhia famularis*) and the wood mouse (*Mus sylvaticus*) of the Swiss Alps. Many specifically mountain dwellers can not live in the plains, they are isolated in the mountain ranges by the surrounding lowland, and have been transformed into geographical races, e.g., the ibex (*Capra ibex*) of the Alps, Caucasus, Taurus mountains, Mt. Sinai, and Abyssinia.

Fauna of Polar Regions.—Variation similar to that in the fauna of the lower slopes of mountains appears in regions approaching the north pole. Organisms in the arctic and in the antarctic regions are very different, owing to the difference in the topography and climate. In arctic regions there is a short summer, with sunshine and high temperatures, which awakens plant and animal life, in the antarctic, although the winter is not quite so cold, the summer is cooler, and the sky is constantly overcast, and therefore little life develops on land. Arctic and the highest alpine regions have many species in common, which are absent in the intervening areas, such as the Alpine hare (*Lepus timidus*), the ptarmigan (*Lagopus mutus*), the gastropod *Antionomia harpa*, and some lepidopterans, which traversed the warmer intervening areas during the Glacial period. The number of arctic insects is greater than might be expected. Diptera and Coleoptera are most abundant, Orthoptera and Hemiptera are rare. Among Hymenoptera, bumblebees are relatively numerous and are strikingly large, thus having proportionately smaller surface to give off heat. The few species of gastropods are small. Amphibians and reptiles are very few, only in the southern portion and these species are the same as those ascending highest in mountain regions. Homoiothermal animals are characterized by adaptations for conservation of heat, they are sturdy, have short appendages (ears and tail) and a thick covering of fur or feathers. The white colour of so many polar birds and mammals is important in reducing heat radiation. Experiments have shown that the proportion of heat given off by light coloured and black guinea-pigs is as 100:124. Polar mammals do not hibernate, as the frozen ground provides no protection from temperatures below freezing point. The number of birds and mammals is small, apart from those which find their food in the sea. In eastern Greenland, among polar bears and seals, only seven kinds of mammals are found (the hare, lemming, musk ox, reindeer, ermine, arctic fox and wolf). In Spitzbergen, there are only two kinds, the reindeer and arctic fox. In the antarctic truly terrestrial animals are practically absent, all homoiothermal animals are confined to the sea.

Animals of Islands.—The characteristic peculiarities many island faunas have in common result chiefly from isolation. Animals of islands are originally derived from those of continents, and the sea forms a barrier preventing the influx of the parent-species. This barrier, however, is not insuperable. In many cases land connections were formerly present. Such islands are termed "continental", in contrast to "oceanic" islands, which have arisen in the sea by volcanic agency, or as coral reefs, and were originally devoid of terrestrial animals. Isolation brings about differentiation of species, each form developing its peculiarities undisturbed by intercrossing with the original stock. This process being continued, races are produced confined to certain localities. In all islands the length of the time of separation, and the degree of isolation, i.e., the distance from the mainland, is important, the longer and more complete the isolation, the greater the degree of differentiation of the species. Madagascar has long been isolated, forms of Ethiopian origin are here so greatly differentiated that, for example, all nonvolar mammals except a few later immigrants belong to endemic genera, and, usually, also to subfamilies and families not found elsewhere. On the other hand, the British Isles, which have been separated only since the end of the Glacial period, have only one peculiar vertebrate (the red grouse).

In ancient oceanic islands, the number of endemic species increases with the distance from the mainland. While the Azores, in addition to endemic species, have many in common with Europe and Africa, most of the fauna of St. Helena is endemic. The island of Hawaii, the Hawaiian Islands (more than 3,000 km from the mainland), there are numerous genera, and among gastropods and birds, families also, which are not found elsewhere. The isolation of oceanic islands by the sea implies selection in the fauna. Mammals, amphibians and freshwater fishes are unable to overcome this obstacle, and are therefore absent. Reptiles can seldom reach such islands, but birds can do so much more frequently. Flying insects may be carried to them by winds, and some even reach them unaided. Terrestrial gastropods and wood-boring insects (e.g., weevils) reach them on driftwood.

Isolated regions offer shelter from rivals and enemies. Thus, in Tasmania, the carnivorous marsupials *Thylacynus* and *Sarcophilus* can hold their own, but on the Australian continent they succumb to the imported dog. Loss of the power of flight, which often occurs in birds inhabiting islands, is connected with the absence of mammals, in the Galapagos Islands there is a flightless cormorant (*Phoebastria*), in New Zealand the kiwi (*Apteryx*). On other islands, flightless birds have become extinct in historical times, as in Mauritius. The large

size of the birds found on islands may be connected with the loss of flying powers, the limit of size imposed by flight disappeared when this was abandoned. On the other hand, we frequently find dwarf varieties of mammals on islands, on the islands of the Red sea *Gazella arabica* does not exceed a third the normal weight of the species.

Some of the peculiarities of animals of islands are explained by the climate. On small islands feeble fliers are in danger of being carried out to sea by strong winds. For this reason most insects on the Polynesian islands take shelter from wind, in the East Frisian island few flying insects are found. Animals that feed on these insects (fly catchers, swallows, small bats, etc.) are also absent. On the storm swept islands of the subantarctic, numerous insects have vestigial wings (of eight species of flies in Kerguelen one only has normal wings). An evolutionary superiority of continental animals over the endemic forms of islands is often conspicuous. Extinctions of island forms have frequently resulted from the introduction of domestic animals by man, as in the case of the dodo and its associates, which appear to have been destroyed by pigs, or from the accidental introduction of continental forms, as is notably illustrated in the decline of the native insect fauna of Hawaii and in the effects of the recent introduction of an exotic land snail in the Marianas Islands.

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DISTRIBUTION OF PLANTS. see PLANTS AND PLANT SCIENCE. *Plant Ecology*

DISTRIBUTION OF TERMS In logic a term is said to be distributed in a proposition when explicit reference is made to its whole extent or extension. Otherwise (that is, not only when reference is made explicitly to a part only of the extension of the term, but when explicit reference is simply not made to its whole extension) it is said to be undistributed. Thus, in a proposition of the form *No S is P* both the subject and the predicate are distributed. In the form *Some S is P*, neither *S* nor *P* is distributed. In *All S is P*, *S* is distributed, but *P* is not. Lastly, in *Some S is not P*, *S* is not distributed, but *P* is. Briefly, only universal propositions distribute the subject term (*S*), and only negative propositions distribute their predicate (*P*). Naturally, singular terms (including proper names used as singular terms) are always distributed, for they only refer to one object, and can not refer to less. The importance of the distribution of terms arises from the fact that it is a principle of formal inference that no term may be distributed in this conclusion unless it was distributed in the premises. That is why, e.g., *All S is P* can only be converted into *Some P is S* (not into *All P is S*), and *Some S is not P* can not be converted at all.

DISTRIBUTIVE LAW, in algebra the law which asserts that $a(b+c+d) = ab+ac+ad$, one of two factors (*a*) being distributed, as it were, among the parts (*b*, *c* and *d*) of the other factor ($b+c+d$). Stated in words, the result of first adding several numbers and then multiplying the sum by another number is the same as the result of first multiplying each of the several numbers separately by the other number and then adding the products. For example, $2(5+3) = 2 \times 8 = 16$, and $2 \times 5 + 2 \times 3 = 10 + 6 = 16$. The law is equally valid for negative, fractional, irrational, and complex numbers.

DISTRIBUTOR, in electrical engineering, a form of switch, generally rotary, arranged so that it transmits successive electrical impulses to definite points in a given order (see MAGNETO, HIGH TENSION).

DISTRICT, a word denoting in its more general sense, a tract or extent of a country, town, etc., marked off for administrative or other purposes, or having some special and distinguishing characteristics (see LOCAL GOVERNMENT, etc.). In mediaeval Latin the word *districtus* is defined by Du Cange as *Territorium feudis seu tractus, in quo domini vassallos et tenentes suos distringere potest*, and as *justitiae exercendae in eo tractus facultas*. It was also used of the territory over which the feudal lord exercised his jurisdiction generally. In British India the word is used to represent the *zillah*, an administrative subdivision of a province

or presidency.

In the United States of America the word has many administrative, judicial and other applications. In South Carolina it was used instead of "county" for the chief division of the state other than in the coast region. In the Virginias, Tennessee, Georgia, Kentucky and Maryland it answers to "township" or precinct, elsewhere the principal subdivision of a county. It is used for an electoral "division," each state being divided into congressional and state legislative districts, and also for a political subdivision either of an unorganized or an organized territory.

DISTRICT OF COLUMBIA see WASHINGTON, D. C.

DISTYLE, in architecture, a portico of two columns, usually between antae (*qu*) and called "distyle in antis," or a building with such a portico in front, e.g., so called treasuries at Delphi.

DITA BARK, the bark of a fruit tree (*Alstonia scholaris*) growing in the Philippines and elsewhere. It has had considerable local reputation as an antimalarial but later work has shown it to be of little or no value as such.

DITHMARSCHEN or **DITMARSH** (in the oldest form of the name *Thuatmaresgah*, Dietmar's Gau), a territory between the Eider, the Elbe and the North sea, forming the western part of the old duchy of Holstein. It contains about 5500 sq. m., half of which consists of good pasture land, preserved from mroads of the sea by banks and dams, the other half being mostly waste. The district was subjugated and Christianized by Charlemagne, and ranked as a separate *Gau*, probably included in the countship of Stade. Ultimately the archbishops of Bremen claimed supremacy over the land, but the inhabitants, who had developed and consolidated a systematic organism for self government, made obstinate resistance, and rather attached themselves to the bishop of Schleswig. Ditmarsch continued part of the Danish dominions till the disastrous battle of Bornhöved in 1227, when its former independence was regained. The claims of the archbishop of Bremen were now so far recognized that he exercised the royal rights of *Hoerbann* and *Blutbann*, and was represented first by a single *advocatus*, or *Vogt*, and afterwards by one for each of the five *Dorfs*, or marks, into which the land was divided after the establishment of Meldorf. The community was governed by a *Landrath* of 48 elective consuls, being 12 from each of the four marks. In 1319 and 1404 the inhabitants defeated the invasions of the Holstein nobles, and though in 1474 the land was nominally incorporated with the duchy by the emperor Frederick III., the attempt of the Danish king Hans and the duke of Gottorp to enforce the decree in 1500 resulted only in their complete rout in the marshes of the Dussend Duwels Warf. During the early part of the following century Ditmarsch was the scene of violent religious conflict, and, thus weakened, it was obliged in 1559 to submit to partition among its three conquerors—King Frederick II. of Denmark and Dukes John and Adolphus. A new division took place on Duke John's death in 1581, by which Frederick obtained South Ditmarsch, with its chief town of Meldorf, and Adolphus obtained North Ditmarsch, with its chief town of Heide, and this arrangement continued till 1773, when all the Gottorp possessions were incorporated with the Danish Crown.

See Dahlmann's edition of Niebuhr, *Chronik von Dithmarschen* (Kiel, 1827), and *Geschichte Danemarks* (1840-44), Michelsen, *Urkundenbuch zur Geschichte des Landes Dithmarschen* (1834), *Sammlung altdithmarscher Rechtsquellen* (1842), and *Dithmarschen im Verhältniss zum bremischen Erststift*, Kolster, *Geschichte Dithmarschens*, nach F. R. Dahlmanns Vorlesungen (1873).

DITHYRAMBIC POETRY, the description of poetry in which the character of the dithyramb is preserved. It remains quite uncertain what the derivation or even the primitive meaning of the Greek word *δithyrambos* is. It was, however, connected from earliest times with the choral worship of Dionysus. The earliest dithyrambic poetry was probably improvised by priests of Dionysus at solemn feasts and expressed, in disordered numbers, the excitement and frenzy felt by the worshippers. The dithyramb was traditionally first practised in Naxos, it spread to other islands, to Boeotia and finally to Athens. Anon is said to have introduced it at Corinth, and to have allied it to the worship of Pan. It was thus "merged," as Professor Gilbert Murray says, "into the Satyr choir of wild mountain-goats" out of which sprang the earliest form of tragedy. It flourished in Athens until

after the age of Aristotle. So far as we can distinguish the form of the ancient Greek dithyramb it must have been a kind of a regular wild poetry, not divided into strophes or constructed with any evolution of the theme. It was accompanied on some occasions by flutes on others by the lyre. Pindar, in whose hands the ode took such magnificent completeness, is said to have been trained in the elements of dithyrambic poetry by Iphias of Hermione. In the opinion of antiquity pure dithyrambic poetry reached its climax in the lost poem *The Cyclops*, by Philoxenus of Cythera, a poet of the 5th century B.C.

In modern literature although the adjective "dithyrambic" is often used to describe an enthusiastic movement in lyric language and particularly in the ode, pure dithyrambs have been extremely rare. The *Sezze di Isabella* of Francesco Redi (1626-88), which was translated from the Italian, with admirable skill by Leigh Hunt, is a piece of genuine dithyrambic poetry. *Alexander's Feast* (1691), by John Dryden, is the best example in English. But perhaps more remarkable are more genuinely dithyrambic than either, are the astonishing improvisations of Karl Mikul Bellini (1750-95) whose Bacchic songs form one of the most remarkable bodies of lyrical poetry in the literature of Sweden.

DITTERSBACH, a town of Germany, in the Prussian province of Silesia, 3 mi. by rail S.E. from Widenburg and 50 mi. S.W. from Breslau. It has coal mines, bleaching and nitch, chemical and benzol works. Population (1933) 15,392.

DITTERSDORF, KARL DITTER VON (1739-1799), Austrian composer and violinist, was born in Vienna on Nov. 2, 1739; his father's name being Ditters. He took the name of Dittersdorf on his ennoblement in 1773. The boy Ditters was a brilliant violinist and attracted the attention of Prince Joseph Frederick of Hildburghausen (1702-87), who gave the boy, then 11 years old, a place in his private orchestra—the first of the kind established in Vienna. Later he obtained a place in the Vienna opera, and subsequently in 1761 he accompanied Christoph Gluck to Italy where his violin playing won him great renown. He became conductor of the orchestra of the bishop of Grosswarden, a Hungarian magnate, at Pressburg. He set up a private stage in the episcopal palace, and wrote for it his first "opera buffa," *Amore in musica*. His first oratorio, *Isacco figura del Redentore*, was also written during that time, but the scandal of performances of light opera by the bishop's company, even on fast days and during Advent, outweighed this pious effort, the empress Maria Theresa sharply called the bishop to order, and he, in a huff, dismissed his orchestra (1769).

After a short interlude, Ditters was again in the service of an ecclesiastical patron, Count von Schaßgotsch, prince bishop of Breslau, at his estate of Johannsburg in Silesia. At Johannsburg Ditters also produced a comic opera, *Il Viaggiatore americano*, and in oratorio *David*. The title role of David was taken by Signora Nicolini, whom Ditters married. In 1773 his oratorio *Ester* was produced in Vienna. After the peace of Teschen (1779) he again became conductor of the reconstituted orchestra of the bishop of Breslau. From this time forward his output was enormous. In 1780 ten months sufficed for the production of his *Giobbe* ("Job") and four operas, three of which *Doktor und Apotheker* (1786), *Das Raskapchen* (1788) and *Hieronymus Kucker* (1789) had a great success. But when the bishop died in 1795, his successor dismissed the composer with a small money gift.

Poor and broken in health, he accepted the asylum offered to him by Ignaz Freiherr von Stillfried, on his estate near Neuhaus in Bohemia, where he continued to write operas, symphonies and piano-forte pieces. He died on Oct. 1, 1799, pining "God's reward" for whoever should save his family from starvation. On his deathbed he dictated to his son his *Selfish epigram*.

While in the work of Luigi Boccherini there are traces of the influence of Franz Joseph Haydn as a force tending to disintegrate the symphonic suite forms of instrumental music in Dittersdorf, so the other hand the popular conception of the modern symphony and orchestral style is seen.

See also Dittersdorf's symphonies on the *Melomorphosis* of Ovid

were republished in 1899 (ed. J. Liebeckind, Leipzig) the century of his death. The end of the representation of the conversion of the Lycian peasants into frogs is prophetically and ridiculously Wigner in its ingenious expansion of rhythm and eminently expert orchestration.

DITTO—*Selbstbiographie*, published at Leipzig 1801 (English trans. by A. D. Coleidge 1961), an attack in the *Russische Musenal* vol. 11 p. 7-7 the attack "Dittusdorf" in Grove's *Dictionary of Music and Musicians*. K. Kall *Dittusdorf* (1900), with bibliography, and L. Rudinow *Karl von Dittersdorf als Opernkomponist* (1911).

DITTO, that which has been said before the same thing (from the Lat. *dictum* something said, Ital. *ditto*, "fore-said"), frequently abbreviated into "do."

DIU, an island and town of India belonging to Portugal at the southern extremity of the peninsula of Kathiawar. The district (1911 14 sq. mi.), which includes the village of Goval in the mainland and the fortress of Simbor 5 mi. W., is subject to the governor general of Goa. Pop. of the island (1930) 19,731. The anchorage is protected from the sea, but the depth of water is only about two fathoms. The channel between island and mainland is navigable only by small craft. The town is surrounded by a wall with towers at regular intervals.

Many of the inhabitants become Banyan merchants of the east coast of Africa and Arabia. Industries which were established include nixing salt, fishing and distillation of native spirits from the palm. The trade of the town, however, decayed.

There are remains of several fine ancient buildings. The cathedral of St. Matuz, dating from 1601, was formerly a Jesuit college. The Portuguese under treaty with Bahadur Shah of Gujarat, built a fort there in 1535, but were besieged in 1538 and 1545. The second siege, the subject of an epic by Jeronymo Corte Real (1591) is one of the most famous in Indo-Portuguese history.

DIURETICS are drugs which produce an increased flow of urine. They are used for (1) the removal of excess water and salt from the body, thus relieving or preventing oedema such as may result from circulatory and nutritional disorders, (2) the hastening of the excretion of ingested poisons, (3) the removal of accumulated metabolic products, and (4) the dilution of urine in order to prevent precipitation of drugs in the kidney tubules (see SULFONAMIDES). In general, diuretics act either by increasing the filtration through the glomerulus or by decreasing the absorption from the tubules (see URINARY SYSTEM). The first group includes drugs which alter the osmotic pressure or electrolyte balance of the plasma, such as the saline diuretics, urea and intravenous sucrose, and drugs such as digitalis and strophanthin which improve the circulation by strengthening the heart. Drugs which decrease the tubular reabsorption include the mercurial diuretics such as mersalyl (salyrgan) and merbaphen (novasurol) and probably also the xanthine diuretics (theobromine, theophylline and caffeine). (F. L. A.)

DIURNAL MOTION, the apparent motion of the heavens from east to west resulting from the earth's rotation on its axis from west to east. The axis of this apparent motion passes through the celestial poles (coincident in direction with the earth's axis) so that the stars appear to describe circles around the pole star.

DIURNAL VARIATION, the small daily change in value of the magnetic quantities, dip, declination and the horizontal component of the earth's magnetic force, also the daily changes in meteorological quantities, such as temperature, pressure, cloudiness, etc. (See TERRESTRIAL MAGNETISM.)

DIUSHAMBE (now STALINABAD), a small town in Turkistan, capital of the Tadzhik S.S.R., situated south of the Hissar mountains but north of the town of Fervar, on the Dushambe river, a tributary of the Amudarya river which flows into the Aral Sea. Pop. (1930) 82,540. It is the centre of a fertile loess area producing grains (including rice), cotton, melons, grapes, apricots and other fruits. The town itself is built on a low hill and its streets and gardens and water tank are shaded by poplar trees. Formerly of little importance, for its main link with the U.S.S.R. was a caravan route to Samarkand. Stalinabad developed rapidly after its incorporation by the Tatars (1929) and the establishment of its communication with Tamer and Kurgan.

It is also a base for the All Union Academy of Science

DIVAN, Persian word probably from Armenian, meaning a "countinghouse, bureau, tribunal", thence on one side, the "account books and registers" of such an office, and on another, the "room where the office or tribunal sits", thence again, from "account book, register," a "book containing the poems of an author," arranged in a definite order (alphabetical according to the rhyme words), perhaps because of the saying, "Poetry is the register (*divan*) of the Arabs", and from "bureau, tribunal," "a long seat, formed of a mattress laid against the side of the room, upon the floor or upon a raised structure or frame, with cushions to lean against" (E. W. Lane, *Arabic English Lexicon*, p. 930 *et seq.*) All these meanings existed and exist, especially "bureau, tribunal," "book of poems" and "seat," but the order of derivation may have been slightly different. The word first appears under the caliphate of Omar (A.D. 634-644). Later, as the state became more complicated the term was extended over all the government bureaus. The divan of the Sublime Porte was for long the council of the empire presided over by the grand vizier. (See DEWAN, ARABIC LITERATURE, and A. von Kremer, *Culturegeschichte des Orients unter den Chalifen*, vol. 1, 64, 198 (Vienna, 1875))

DIVER, a name applied to many birds, but properly restricted to the family Gaviidae, containing the single genus *Gavia*. They are sea birds, strong swimmers, and feed mainly on fish. Their legs are set far back on the body, so that they cannot walk more than a few steps at a time, sometimes they progress on land by bounds. They fly well when once on the wing. The red-throated diver (*G. stellata*) has a patch of bay on the throat in summer dress, replaced by black in the striped black throated diver (*G. alatica*). The Pacific loon (*G. pacifica*) resembles the black throated diver. The yellow billed loon (*G. adamsi*) breeds in Arctic America from the Siberian coast to the Mackenzie delta. The genus and family constitute the order Gaviiformes.

The largest form is the great northern diver (*G. immer*) which has a black back, marked with white spots, a black head and neck, and two semi-collars of black and white vertical stripes. These birds inhabit the Arctic seas of both new and old worlds. They breed in the Hebrides, Scandinavia, Canada, Iceland and other suitable places in the north. The American form is usually called loon (*G. v.*). There is a remarkable mutual courtship, in which the birds may run erect over the surface of the water (see J. S. Huxley, *Journ. Linn. Soc.*, 1923).

DIVERS, EDWARD (1837-1912), English chemist, was born in London on Nov. 27, 1837. He was educated at the City of London school and the Royal College of Chemistry and then studied medicine at Queen's college, Galway where he also acted as assistant and demonstrator. Between 1853 and 1873 he held a number of posts at the medical schools of several London hospitals where he lectured on materia medica, on medical jurisprudence, and on physics and chemistry. In 1873 he accepted the post of professor of chemistry to the Imperial Government of Japan and stayed in Japan until he retired in 1899. Divers supervised the building and equipment of his own laboratories at the newly built engineering college. In 1886 the college was incorporated in the newly organized imperial university and Divers was transferred to the college of science of that university. After his retirement he lived in London, where he died on April 8, 1912.

His early work in Japan included an examination of Japanese minerals, which led to some fruitful work on tellurium and selenium. This was followed by work on the compounds of nitrogen and sulphur and on the composition of Japanese bird lime, the manufacture of calomel in Japan and Japanese meteorites and springs.

DIVERS AND DIVING APPARATUS The earliest reference to the practice of diving occurs in the *Iliad*, 16, 745-750 where Patroclus compares the fall of Hector's chariot to the action of a diver diving for oysters. Thucydides mentions the employment of divers during the siege of Syracuse to saw down the barriers which had been constructed below the surface of the water with the object of obstructing and damaging any Grecian war vessels which might attempt to enter the harbour. At the

siege of Tyre, divers were ordered by Alexander the Great to impede or destroy the submarine defences of the besieged as they were erected. Lavy records that in the reign of Perseus considerable treasure was recovered by divers from the sea. By a law of the Rhodians, their divers were allowed a proportion of the value recovered.

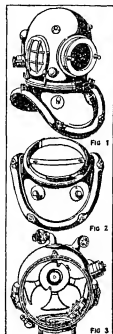
Early Diving Appliances—The earliest mention of any appliance for assisting divers is by Aristotle, who says that divers were sometimes provided with instruments for drawing air from above the water and thus they were able to remain a long time under the sea (*De Part. Anim.* 2, 16), and also that divers breathed by letting down a metallic vessel which did not get filled with water but contained the air within it (*Problem.* 32, 5).

It is also recorded that Alexander the Great made a descent into the sea in a machine called a *Columpha*, which had the power of keeping a man dry and at the same time of admitting light. Pliny also speaks of divers engaged in the strategy of ancient warfare, who drew air through a tube, one end of which they carried in their mouths, whilst the other end was made to float on the surface of the water. Roger Bacon in 1240, 100, is supposed to have invented a contrivance for enabling men to work under water, and in Vegetius's *De Re Militari* (editions of 1511 and 1532, the latter in the British Museum) is an engraving representing a diver wearing a tight fitting helmet to which is attached a long leather pipe leading to the surface where its open end is kept afloat by means of a bladder.

Repton invented "water armour" in the year 1617, but when tried it was found to be useless. G. A. Borelli in the year 1679 invented an apparatus which enabled persons to go to a certain depth. It embodied means for altering the specific gravity of the diver, but was not practical. John Lethbridge, a Devonshire man, in the year

1715 contrived "a watertight leather case for enclosing the person." This leather case held about half a hoghead of air, and was so adapted as to give free play to arms and legs, so that the wearer could walk on the sea bottom, examine a sunken vessel and save her cargo, returning to the surface when his supply of air was getting exhausted. It is said that Lethbridge made a considerable fortune by his invention. The next contrivance worthy of mention and most nearly resembling the modern diving-dress was an apparatus invented by Klengert, of Breslau, in 1798. This consisted of an egg ended metallic cylinder enveloping the head and the body to the hips. The diver was encased first of all in a leather jacket having tight fitting arms, and in leather drawers with tight-fitting legs. To these the cylinder was fastened in such a way as to render the whole equipment airtight. The air supply was drawn through a pipe which was connected with the mouth of the diver by an ivory mouthpiece, the surface end being held above water after the manner mentioned in Vegetius, viz by means of a floating bladder attached to it.

In 1819, Augustus Siebe invented his "open" diving dress worked in conjunction with an air force pump. The dress consisted of a metal helmet formed with a shoulder-plate attached to a jacket of waterproof leather. The helmet was fitted with an air inlet valve to which one end of a flexible tube was attached, the other end being connected to the air pump. The air, which kept the water down below the diver's chin, found its outlet at the edge of the jacket, exactly as it does in the case of the diving bell. Excellent work was accomplished with this dress—work which could not have been attempted before its introduction—but it was still far from perfect. It was absolutely necessary for the diver to



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FIGS 1 TO 3—HELMET

FIG 1—A diver's helmet complete with corselet

FIG 2—Corselet

FIG 3—Interior of helmet showing valves and telephone connections

maintain an upright or but very slightly stooping position whilst under water, if he stumbled and fell, the water filled his dress, and, unless brought quickly to the surface, he was in danger of being drowned. To overcome this and other defects, Siebe carried out a great many experiments, extending over several years, which culminated, in the year 1830, in the introduction of his 'close' dress in combination with a helmet fitted with air inlet and regulating outlet valves. Though, of course, many great improvements have been introduced since Siebe's death, in 1872, the fact remains that his principle is in universal use to this day. The submarine work which it has been instrumental in accomplishing is incalculable.

Modern Apparatus.—A set of ordinary modern diving apparatus consists essentially of seven parts, viz. —(a) An air pump, (b) an incompressible helmet with breastplate, or corselet, (c) a compressible, or flexible, waterproof diving dress, (d) a length of flexible non collapsible air tube, with metal couplings joining it to pump and helmet, (e) a pair of weighted boots, (f) a pair of lead weights for breast and back, (g) a life line. Most apparatus is fitted with a telephone, and submarine lamps are also largely used.

Helmet (figs 1, 2 and 3).—The helmet proper is separate from the corselet, and is secured to the latter by segmental neck rings which are provided on both parts, enabling them to be connected together by one eighth of a turn, a catch on the back of the helmet preventing any chance of unscrewing. The helmet and corselet are usually made of highly planished tinned copper. The valves and other fittings being of gun metal. The helmet is provided with a non-return air inlet valve to which the air supply pipe is attached. This valve allows air to pass from the pump to the helmet, but not in the reverse direction. A regulating air outlet valve fitted to the helmet enables the diver to control the amount of air in the dress, and hence his buoyancy. By screwing up the valve, he retains the air in the dress, and so maintains or increases his buoyancy; by unscrewing it he allows the air to escape, thus causing the dress to become deflated, with a consequent loss of buoyancy. On reaching the bottom and starting work, the diver will adjust his valve so as to maintain himself comfortably in equilibrium, altering the adjustment only when he wishes to ascend, that is, of course, assuming, as should be the case, that air is pumped to him at a uniform rate. Thick plate glass windows are fitted to the helmet. The front window is detachable from the helmet, usually by unscrewing, though some helmets are fitted with hinged windows similar to those used for ships' scuttles.

Dress (fig 4).—The diving dress is a combination suit which is made of two layers of tanned twill with pure rubber between, and which envelops the whole body from foot to neck, the sleeves being fitted with vulcanized rubber cuffs which make a watertight joint round the diver's wrists. The dress is also fitted with a vulcanized rubber collar, which is secured to the corselet, or breastplate, of the helmet in such a manner as to render all watertight.

Air Pipe.—The diver's air pipe is flexible and non-collapsible. At the ends are fitted metal couplings for securing the pipe to the pump and helmet respectively.

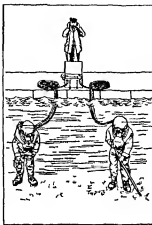
Boots.—To maintain himself in an upright position under water, the diver wears heavily weighted boots (about 32 lb the pair).

Weights.—Two lead weights, 40 lb. each, one on the back and one on the chest, ensure the diver's equilibrium under water.

Life-line.—The diver's life line is for use in case of emergency, for hauling the diver to the surface, and also for making signals, the diver and his attendant having a pre-arranged code in which varying numbers of pulls or jerks on the life line have definite

meanings. When the telephone is provided, the telephone wires are embedded in the life-line.

Diver's Telephone. (fig 5).—This most useful instrument was introduced by Siebe, Gorman & Co and is used to day through out the British and many other navies. Means are provided whereby the attendant at the surface can converse with No. 1 or with No. 2 diver, or with both together. He can also put No. 1 diver into communication with No. 2, himself hearing their conversation. The telephone wires are embedded in the life line,



BY COURTESY OF SIEBE GORMAN AND CO LTD

FIG 5.—TELEPHONE APPARATUS WHICH ENABLES DIVERS TO CONVERSE WITH ATTENDANTS AND ONE ANOTHER

Air Pumps.—Diver's air pumps are of various patterns, depending principally upon the depth of water in which work is being carried out, since the greater the depth of water the greater the quantity of air required by the diver. The pumps are of the reciprocating type and are mostly manually operated. Fig. 7 shows the Siebe Gorman two cylinder double acting pump (removed from its tank chest) adopted by the British Admiralty. Pressure gauges are provided which indicate the pressure of air which the pump is supplying, and the depth at which the diver is working. The cylinders are water jacketed to ensure a supply of cool air to the diver.

Air Compressors driven by electric motors, oil and steam engines are sometimes employed. In these cases the air is delivered

into steel reservoirs, the divers' air pipes being connected to an air control panel which receives its air from the reservoir, so that in case of a breakdown of the motive power, a reserve of air sufficient to bring the diver safely to the surface is assured. A typical machine of this description is shown in fig. 8. In the pearl and sponge fisheries the small boats from which the divers work are sometimes propelled by oil engines which also drive the air compressors.

The type of air pumping apparatus employed varies with the depth of water and the conditions under which the diving operations are conducted. Examples of manually operated and power-driven pumps are shown.

The Diver's Air Supply.—The diver's air supply must be adequate both in volume and pressure—the volume sufficient to ensure proper ventilation of the helmet, and the pressure fully equal to that which corresponds to the depth of water at which the diver may be working. In fresh air, there is only 0.3% of carbon dioxide, and, at ordinary atmospheric pressure, no ill effects are felt

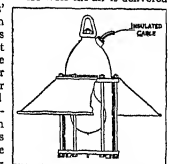
which has metal connections at each end for attaching to helmet and battery box. The diver's telephone receiver is situated generally in the crown of the helmet, and the transmitter between the front glass and one of the side glasses. The diver can ring a bell or buzzer at the surface by pressing with his chin a contact-piece situated inside the helmet.

Submarine Electric Lamps

(fig 6).—Very many forms of submarine lamps are available. Of these, the most widely used are those which incorporate incandescent electric bulbs, ranging in candle-power from 5,000 down to about 50, the former being supplied with current from the surface, the latter being self-contained with accumulator batteries in a watertight case.

Submarine Electric Lamps (fig 6).—Very many forms of submarine lamps are available. Of these, the most widely used are those which incorporate incandescent electric bulbs, ranging in candle-power from 5,000 down to about 50, the former being supplied with current from the surface, the latter being self-contained with accumulator batteries in a watertight case.

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BY COURTESY OF SIEBE GORMAN AND CO LTD

FIG 8.—3000 CANDLE POWER SUBMARINE ELECTRIC LAMP WITH REFLECTOR



BY COURTESY OF SIEBE GORMAN AND CO LTD

FIG 4.—DIVING DRESS WITH LACED LEGS



BY COURTESY OF (4) THE TIMES LONDON PHOTOGRAPHS (1 2 3 5 6 7 8) INTERNATIONAL (9) TELFA

DIVING APPARATUS FOR RESCUE WORK AND SALVAGING

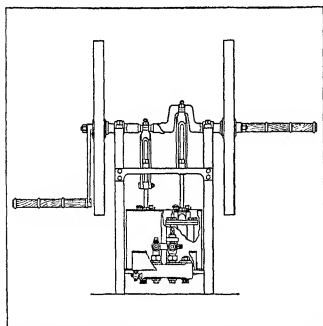
1. Compression chamber for gradual reduction of depth pressure.
2. Diver being lowered from rescue boat.
3. Diving in the Lake of Neuchâtel near Rome for remains of Roman galleys.
4. Diver in deep-sea diving armor, with air pump shown at left.
5. Diver in helmeted apparatus, showing ball-jointed neck and flanged construction.
6. Rescue bell lowered and fastened to the submarine's hatch.
7. Rescue bell lowered and fastened to the submarine's hatch.
8. Diver in helmeted apparatus, showing ball-jointed neck and flanged construction.
9. Diver in helmeted apparatus, showing ball-jointed neck and flanged construction.

until 3% of the gas is present. As a diver descends, the pressure is increased and the effect of a small percentage of carbon dioxide in his helmet becomes greater.

J S Haldane, who conducted deep diving experiments for the British Admiralty, found from a large number of analyses of air issuing from the diver's helmet, that 150 cu ft of air per minute would be needed to keep the percentage of carbon dioxide at a safe level. This volume of air is required at all depths, so that the actual quantities required at different depths down to 231 ft are as follows—

| Depth in fathoms | Depth in feet | Pressure per sq in above atmospheric pressure, in lb | Quantity of air at atmospheric pressure required per min by the diver cu ft |
|------------------|---------------|--|---|
| 0 | 0 | | 15 |
| 5½ | 33 | 14.7 | 30 |
| 11 | 66 | 29.3 | 45 |
| 16½ | 99 | 44.0 | 60 |
| 22 | 132 | 58.7 | 75 |
| 27½ | 165 | 73.4 | 90 |
| 33 | 198 | 88.1 | 105 |
| 38½ | 231 | 94.0 | 110 |
| 38½ | 231 | 102.8 | 120 |

Effects of Air Pressure on the Diver.—When a diver descends into the sea, the extra air pressure to which he is subjected is instantly transmitted to the whole inside of his body. At great depths his blood vessels and tissues become saturated with nitrogen. It should be remembered that a gas in contact with a liquid on which it has no chemical action is absorbed by the liquid in amounts proportional to the pressure of the gas at the time. In the lungs we have the blood practically in contact with the air, which consists of three important gases—oxygen, nitrogen and carbon dioxide. Of these, the nitrogen alone can remain and accumulate in the blood, the oxygen is used up by the tissues, and the breathing prevents the pressure of carbon dioxide from in-



BY COURTESY OF SIEBE GORMAN AND CO. LTD.

Fig 7.—MANUALLY OPERATED 2 CYLINDER DOUBLE ACTING DIVERS AIR PUMP. SHOWING VALVES AND AIR DISTRIBUTING ARRANGEMENT FOR ONE OR TWO DIVERS.

creasing, so that the only gas which accumulates in abnormal quantity in the blood when the diver is under pressure is the nitrogen.

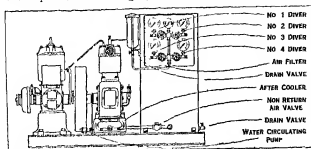
When gas is forced into a soda water bottle under pressure, the water appears to be unchanged so long as the pressure is kept up, but the moment the pressure is reduced, by the removal of the

coil, we see the gas come bubbling off the liquid. J S Haldane has applied the analogy to diving. He says: "The diver is the soda water bottle, and his blood the fluid in the bottle. As the diver descends, nitrogen under pressure is forced into contact with his blood, which takes up the nitrogen from the air. So long as he stays below under that pressure, his blood appears to be unaltered, when however, he rises, the excess of nitrogen that the blood has taken up begins slowly to bubble off, if the blood were as fluid as water, it would come off as readily as from the soda water. Fortunately for the diver, the blood is a thickish, albuminous fluid, in which bubbles do not readily form, and, as far as we can see, it can retain about twice the amount in solution that water can keep at any given pressure. Every diver knows that it is quite safe to come up from a depth of five or six fathoms to the surface as

| Up to Feet | Fathoms | Pressure per sq in | Time under water from surface to beginning of ascent | Stoppages in minutes at different depths feet | | | | | Total time for ascent in minutes |
|------------|---------|--------------------|--|---|----|----|----|----|---|
| | | | | 60 | 40 | 30 | 20 | 10 | |
| 33 | 5½ | 15 | No limit | | | | | | 0 to 1 |
| 48 | 8 | 21 | Up to 1 hr 1 to 3 hrs Over 3 " | | | | | | 1½ 7 12 |
| 66 | 11 | 29½ | Up to 15 min 15 to 30 " 30 to 48 " 48 to 60 " 1 to 1½ hrs 1½ to 2 " 2 to 2½ " Over 2½ " | | | | | | 2 7 12 15 19 22 27 32 |
| 84 | 14 | 37 | Up to 10 min 10 to 20 " 20 to 30 " 30 to 40 " 40 to 45 " 45 to 55 " 55 to 65 " 65 to 75 " | | | | | | 3 5 7 10 13 16 18 20 |
| 96 | 16 | 42½ | Up to 10 min 10 to 20 " 20 to 30 " 30 to 45 " 35 to 45 " 45 to 55 " | | | | | | 1 3 5 7 11 18 22 27 |
| 108 | 18 | 48 | Up to 5 min 5 to 10 " 10 to 15 " 15 to 20 " 20 to 25 " 25 to 30 " 30 to 35 " 35 to 40 " | | | | | | 3 6 8 11 15 20 23 28 |
| 132 | 22 | 59 | Up to 5 min 5 to 10 " 10 to 15 " 15 to 20 " 20 to 25 " 25 to 30 " 30 to 35 " 35 to 40 " | | | | | | 5 8 13 17 20 23 28 33 |
| 144 | 24 | 64½ | Up to 6 min 6 to 12 " 12 to 16 " 16 to 20 " 20 to 25 " | | | | | | 2 5 10 16 21 26 31 36 |
| 168 | 28 | 75 | Up to 5 min 5 to 10 " 10 to 15 " 15 to 20 " 20 to 25 " | | | | | | 2 5 10 16 21 26 31 36 |
| 192 | 32 | 86 | Up to 5 min 5 to 10 " 10 to 15 " | | | | | | 1 3 5 8 12 17 22 27 |
| 210 | 35 | 94 | 10 min | | | | | | 2 4 6 8 11 14 17 20 |
| 231 | 38½ | 102.8 | 10 " | | | | | | 2 3 4 6 8 11 14 17 |
| 276 | 46 | 122.7 | 10 " | | | | | | 7 10 12 15 20 25 30 36 |

DIVERS AND DIVING APPARATUS

quickly as he likes, the reason for this will now be easily understood, since at such a depth the blood has only twice as much nitrogen in it as it has on the surface and therefore, bubbles are unlikely to form. If, however, the diver has been for any considerable time at, say 180 ft., and then comes up too quickly it is almost certain that bubbles will form and cause serious symptoms, such as paralysis of the legs (diver's palsy), severe pains in the



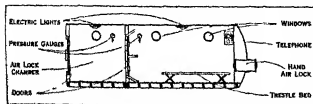
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FIG 8—OIL ENGINE DRIVEN AIR COMPRESSING SET WITH STEEL AIR RECEIVER FOR SUPPLYING AIR TO 4 DIVERS SIMULTANEOUSLY.

The compressed air after being cooled is delivered into air receiver whence it passes to four control valves to which are connected divers' air tubes joints and muscles etc. Not only is the air taken up by the blood but the tissues of the body also get saturated with it. In the case of the blood, the saturation is very quick, it is probable, indeed, that the blood leaving the lungs is always saturated to the existing pressure but the tissues take up the gas at a much slower rate—rate which depends on the blood supply. Where this is good, as in the brain and spinal cord, the saturation is quick, but in the fibrous tissues about the joints, etc., saturation is very slow. Those tissues which are saturated quickly also give up their surplus nitrogen quickly, and those which saturate slowly also desaturate slowly.

In ascending, the diver is decompressing himself, and it is this gradual decompression that is the most important factor in the prevention of accidents from the formation of bubbles of nitrogen. The dangers are to be avoided by working to the following schedule drawn up by Prof. Haldane, during which there is but little chance of the diver getting dangerously saturated with nitrogen. It is important that the diver descend as fast as his air supply will allow him, for every minute spent in descending is time lost, since his body is becoming saturated.

Compressed Air Illness—Although the rules laid down are calculated completely to prevent compressed air illness, cases do sometimes occur, owing to accidents or mistakes, where the diver comes up too quickly from deep water. In such cases, whether the diver has already shown symptoms of compressed air illness or



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FIG 9—RECOMPRESSION CHAMBER FOR TREATMENT OF CASES OF COMPRESSED AIR SICKNESS DUE TO TOO RAPID ASCENT FROM DEEP WATER.

not, he should be sent down again without delay to the depth at which he has been working, and kept there for five minutes, after which he can start to come up again at the following rates—

| While the pressure on the pump gauge is— | Pressure should be allowed to fall at a rate not faster than— |
|--|---|
| Over 30 lb | 1 lb in one minute |
| Between 30 lb and 15 lb | 2 " " two minutes |
| 15 " " 10 " | 3 " " three " |
| 10 " " 5 " | 5 " " five " |

On some deep diving operations, however, a Siebe Gorman Re-

compression chamber, as fig 9, is provided, the use of which is a much better and more comfortable method of treatment than sending the diver into deep water again. This chamber is of steel, provided with a bench on which the diver can sit or lie, electric light, telephone, etc. Windows are provided through which the diver can be watched during the process of decompression, a small hand air lock attached to the chamber allows refreshments, etc., to be passed into him. It is usually found sufficient to raise the pressure in the chamber to 30 lb, but it should never exceed 45 lb. As soon as the diver is relieved of any symptoms, the pressure is allowed to fall at the following rates—

| When the pressure in the chamber is— | Pressure may be allowed to fall at a rate not faster than— |
|--------------------------------------|--|
| Between 45 lb and 30 lb | 1 lb in three minutes |
| 30 " " 15 " | 2 " " five " |
| Below 15 " | 3 " " eight " |

Helium and Oxygen for Deep Sea Diving—Some years ago the proposal was made by Prof. Elhu Thomson, F.R.S., of Swampscott, Mass., U.S.A., to use helium in place of nitrogen in the atmosphere supplied to divers engaged in deep sea work, and the practical utility of this suggestion has been demonstrated recently by experiments conducted at the Government Bureau of Mines, U.S.A. Helium has a solubility in water nearly 40% less than nitrogen, therefore, during exposure to compressed air, nearly 40% less gas will be dissolved in the watery part of the body. The rate of diffusion of helium is 2.64 times that of nitrogen, its molecular weight being 4 against 28 for nitrogen. Helium will thus escape from the lungs much more quickly than nitrogen during decompression. Experiments on animals have so far shown that the safe decompression time for helium and nitrogen is some where about 1 to 3 or 4. To reduce the decompression periods to one third or one fourth would be a very great advantage.

Greatest Depths for Useful Work—The greatest depth at which useful work has been accomplished by divers is 275 ft. This was at the salvage of the U.S.A. submarine "F4," sunk off Honolulu, by divers of the United States Navy using the British Admiralty decompression system described in the present article. The Spanish diver, Erostrich, recovered £9,000 worth of silver bars from a depth of 182 ft. Siebe, Gorman & Co.'s chief diver, the late Alexander Lambert, salvaged £70,000 worth of Spanish gold coin from the wreck of the "Alphonse XII" sunk in 1651 off Las Palmas. W. Ridyard brought up £50,000 worth of dollars from the "Hamilla Mitchell" lying in 150 ft of water. These are a few examples of treasury recovery notable by reason of the great depths involved. But there have been many cases where far larger sums have been recovered from lesser depths, e.g., the case of the "Laurentic" in 130 ft, sunk during the World War, with gold on board to the value of five million pounds sterling, all but £40,000 worth of which was recovered by British naval divers. Then there is the case of the "Oceanic" from which specie, etc., to the value of £700,000 was salvaged by divers.

The sponge divers of the Mediterranean work at a maximum depth of about 150 ft, but they make exceedingly short stays on the bottom, and so, in most cases, avoid risk of pressure troubles. The pearl divers of Australia usually work at about 120 ft. Submarine operations on the great majority of harbours, dock and bridge works are conducted at depths of from 40 to 80 ft. The weighted tools employed by divers differ very little from those used by workmen on terra firma. Pneumatic tools, worked by compressed air conveyed from the surface through flexible tubes, are great aids, particularly in rock-blasting work.

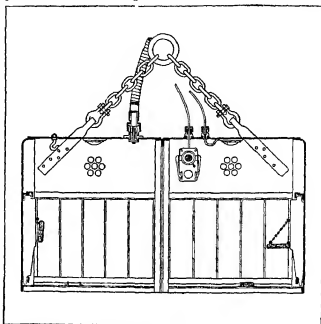
Self-contained Diving Apparatus (fig 10)—The first really practicable self-contained diving apparatus was designed by H. A. Fleuss working in conjunction with Siebe and Gorman, about 50 years ago. The original apparatus enabled a diver to do good work in the flooded Severn tunnel in 1882. The diver on that occasion had to travel nearly a quarter of a mile through the workings—encountering all sorts of obstacles, floating timber, etc., on his journey—to a heading in which he had to close an iron door and a sluice valve. Later, Fleuss and R. H. Davis improved the apparatus considerably. The apparatus supplies a

factitious, but perfectly respirable air by means of regenerating devices, thus making him independent of the surface. His dress, helmet and boots are of the ordinary patterns. Attached to a leather equipment carried on his back is (1) a cylinder of oxygen and air in certain proportions (it is dangerous to breathe pure oxygen at pressures above one atmosphere plus, hence the dilution), (2) a reducing valve connected to the cylinder, and passing the gas into the helmet through a tube connection at the requisite pressure and volume, (3) a watertight chamber, containing caustic soda, also connected by tube to the helmet. The diver's exhaled air is passed through the caustic soda, which takes up the carbonic acid, and, thus purified, comes back into the helmet where it mixes with the fresh oxygen and air which is constantly passing from the cylinder. This process of regeneration goes on automatically for from 45 minutes to two hours, according to the depth at which the diver may be working. The apparatus can be used at depths down to 150ft.

Recently, Neufeldt and Kuhnke have constructed a diving dress of steel and aluminum alloy, which, they claim, enables the wearer to do the work of a diver in the ordinary (flexible) dress. This diving suit is independent of outside air supply, and is designed to withstand the pressure due to the head of water at which the diver is working. The diver, therefore, breathes air at normal atmospheric pressure, thereby eliminating the effects due to excessive air pressure. Connection with the ship can be maintained by a cable and communication effected by a telephone. A diver equipped with the dress has recently (Aug. 1928) worked on the wreck of the Belgian steamer "Elizabethville," sunk in 1917 off Belle Isle, at a depth of 240 feet.

Diving Bells.—The first designer of the diving bell may have received inspiration from the water spider which makes its home in a bell-shaped chamber of silk, anchored, orificed downwards, by silken threads to water weeds, etc. The hairs which cover the hinder part of the spider's body are long and hooked at the ends, and have the power of entangling air, so that, when it dives beneath the surface, the insect is partially enveloped in a bubble. The bell when first made is, of course, full of water. To expel the water, the spider disengages the bubble of air inside the bell, and so displaces a little water, the operation being repeated until the

originator of the diving bell, but actual records are not to be had. Of the records preserved to us, the most trustworthy is the description in the *Philosophical Transactions of the Royal Society*, 1717, of Dr Edmund Halley's bell, constructed of wood, and supplied with air by means of two closed barrels, with a hole in the bottom, and with a leathern tube, connected at the top, the open end of the tube falling below the bottom of the barrel. The



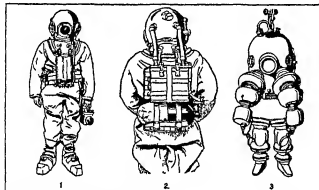
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Fig. 11—SECTIONAL VIEW OF A DIVING BELL OF THE ORDINARY TYPE. Open at the bottom, the water is kept out by compressed air pumped down from the surface. Illustration shows inlet valve, lamp, telephone apparatus, electric lamp, folding seats, behind which are slabs of cast iron serving as ballast to give the necessary sinking weight to the bell.

barrels were lowered and raised alternately. When the tubes were taken into the bell, the pressure of water, acting through the hole in the bottom of the barrel, forced the enclosed air into the bell.

Fig. 11 illustrates one of several Siebe Gorman ordinary diving bells, built of steel, as used during the construction of the National Harbour at Dover. Each measured 17ft long by 10½ft wide by 7ft high, and weighed 35 tons. It was lighted electrically, and fitted with telephonic apparatus which enabled the bell divers to converse with the engineers and crane and compressor attendants at the surface. Air was supplied to the bell by a steam-driven compressor housed on the gantry which carried the traveling cranes for lowering and raising the bell through the water to a maximum depth of 60ft, and also for lowering the concrete blocks. The air tube for the compressor was connected to a non return air inlet valve fitted in the crown of the bell. As in the case of the diving dress, an adequate supply of air at the right pressure is maintained to ensure proper ventilation of the bell, the excess escaping at the lower edge of the latter. The bell divers were employed in leveling the sea bed in readiness to receive the blocks, which weighed 40 tons apiece. Having levelled one section, the bell was moved to the next. The blocks were then lowered, and were placed in position by helmet divers. The bell divers, clad in woolen suits and watertight thigh boots, worked in two hour to three hour shifts. The cost of such a bell, with air compressor, telephone and electric lamps, is about £2,000.

The air lock diving bell comprises a steel working chamber similar to the ordinary diving bell already described, with the addition of a steel shaft attached to the roof. At the upper end of the shaft is an airtight door, and about 8ft below this is another similar door, the space between the two forming an air-lock. When the men wish to enter the bell, they pass through the first door and close it after them, and then open a valve and let into the lock compressed air from the working chamber till the pressure is equalized, they then open the second door and pass into the main shaft, closing the door after them. Access to the working



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Fig. 10—FEATURES OF THE SELF-CONTAINED DIVING DRESS AN APPARATUS WHICH NEEDS NO AIR SUPPLY FROM THE SURFACE.

- 1 Front view, showing emergency oxygen and air cylinder in weighted chamber.
- 2 Back view, showing oxygen and air cylinder, and exhaled air purifying chamber.
- 3 New German self-contained diving dress, invented by Neufeldt and Kuhnke. Made of cast steel alloy. It permits diver to explore freely at depth of 40 fathoms (240 feet).

water is replaced entirely by air, the latter being re-oxygenated by the same process. Pressure of water increases with its depth. Sink a diving bell to a depth of, say 33ft., and the air inside it will be compressed to about one-half its original volume, and the bell itself will be half filled with water. But keep up a supply of air at a pressure a little above that which is equal to the depth at which the bell is submerged, and you will not only keep the water down to the lower edge of the bell, you will also ventilate it and enable its occupants to work for hours at a stretch.

Tradition gives Roger Bacon, in 1250, the credit of being the

chamber is by ladder, secured to the side of the shaft. When returning to the surface, they reverse the operation, opening the lower door, entering the lock and closing the door again, then opening a valve to release the air pressure, when the upper door is opened and the men emerge to atmosphere. Some bells of this type are fitted with two shafts each with its air lock—one for the passage of the bell men the other for materials.

See R. H. Davis, *A Diving Manual* (1920), *Report of British Admiralty Deep Diving Committee* (1907), *U.S.A. Bureau of Mines Report* on possibilities in the use of Helium Oxygen Mixtures as a Mixture of Caisson gases (6th Annual Report, 1916).

(R. H. D.)

DIVIDENDS Ordinary dividends are the current or accumulated net earnings appropriated for and distributed among stockholders of a corporation in proportion to their respective holdings and is determined by the class of their holdings.

In the United States, there are statutory rules that limit the payment of dividends by boards of directors of corporations. The most frequent general restriction is that dividends are payable only to solvent corporations only to the extent that the value of the assets exceeds the liabilities by an amount greater than the legal capital, that is, dividends are payable out of surplus. The major exceptions to this general restriction are made in connection with mining corporations operating with wasting assets. Within the statutory limits and the contractual rights in the case of preferred stock, the authority of declaring and paying dividends is lodged with boards of directors.

Dividends are usually payable in cash on an annual basis, although on occasions distributions are made in the form of shares of stocks. The actual payment is made to stockholders of record. It should be noted that a stock dividend issued to a certain class of stockholders does not change the equity position of this class of stockholders.

Dividends on Preferred Stock—Many corporations obtain their capital by issuing both preferred stock and common stock. The preferred stockholders are entitled to a preferential dividend usually at a fixed rate, and the common stockholders get a portion of what remains after payment of the dividends on preferred stock. The dividend on preferred stock may be either cumulative or contingent on annually determined net earnings. When cumulative, if the net earnings for any year are insufficient to pay in full the fixed rate on preferred stock, the deficiency has to be made good out of net profits earned in subsequent years. The holders of noncumulative preferred stock have no right to dividends with respect to any year when the net earnings are insufficient. When the reported net earnings, however, are sufficient to provide for dividends to noncumulative preferred stockholders, the board of directors may still withhold payment of dividends in the interest of the corporation's financial position. In this instance, however, the rights of the holders of noncumulative preferred stock in the net earnings of the year involved are not diminished.

Wasting Asset Dividends and Liquidating Dividends—Wasting-asset dividends and liquidating dividends should be distinguished from ordinary dividends. The board of directors of a corporation which is engaged in exploiting a natural resource need not determine the amount of depletion in ascertaining the net earnings of any year available for dividends. The amount distributed to stockholders of a mining corporation in the form of dividends may, therefore, be partly a return of capital. This leeway given to the boards of directors of mining companies is based on the idea that corporations with wasting assets otherwise would be converted into investment companies, not the purpose for which they were originally organized.

Liquidating dividends are, also, a distribution of capital. In the absence of creditors' claims and preferred stock, the board of directors of a corporation may distribute all or a portion of its capital to stockholders. In general, however, such a distribution among stockholders must be sanctioned by the holders of a large majority of the shares. Otherwise, the declaration and payment of liquidating dividends would eliminate the original purpose of the investment.

In the case of liquidating trusts, bankrupt companies and the like, liquidating dividends are paid to claimants and various classes of stockholders, in so far as the value of the liquidated assets permit.

Ex Dividend—When the price of a share of stock is quoted on the stock market as "ex dividend" it means that the price does not include the dividend which is just about to be paid on it. Stock market experience has shown that the question of dividend payment is no likely to become germane until the time approaches when the payment is drawing near. Under certain circumstances, there may be sufficient trading to influence the price of a share of stock in contemplation of a dividend declaration.

Assuming that no change occurs in supply and demand conditions, the price of a share of stock between the payment of one dividend and that of the next should increase as the dividend payment date draws near. Then, when the quoted price is officially declared ex dividend, the market quotation will tend to fall by the net amount of the dividend. This does not necessarily happen although the tendency is for stock prices to rise as dividend dates approach. It has been suggested that potential buyers of shares of stock have a parity for those shares of common stocks upon which a payment of dividend can be expected in the near future. It has also been observed that potential sellers may object to parting from the opportunity of receiving a dividend and prefer to await market quotations which are ex dividend before effecting sales.

Stock exchange rules govern all cases of ex dividend marking and make provisions for various contingencies. The New York Stock exchange rules with respect to dates on which shares of stock shall sell ex dividend are as follows:

- (1) When transactions are not made for cash, shares of stock shall be quoted ex dividend on the full business day preceding the record date fixed by the board of directors of the corporation.
- (2) When transactions are made for cash, shares of stock shall be quoted ex dividend on the full business day following the record date.
- (3) The board of governors, in any specific case may, however, direct otherwise. (See STOCK EXCHANGE.)

Dividend Payments in the United States—Dividend payments are a substantial portion of the national income of the United States. Between 1936 and 1941, according to the estimates of the United States department of commerce, these distributions to stockholders did not fall in any one year below \$3,000,000,000. During the period 1928 to 1930, dividend payments were at an annual rate above \$5,000,000,000. When compared with a national income (in current dollars) ranging between \$55,000,000,000 to \$76,000,000,000 for the period 1936 to 1941, it is evident that the distributive share of the national income in the form of dividend payments is a significant amount. The table shows national income and dividend payments (both in current dollars) in the United States for the period 1927 to 1941, as estimated by the United States department of commerce.

National Income and Dividend Payments in the U.S., 1927-1941

| Year | National Income | Dividends |
|------|-----------------|-----------------|
| 1927 | \$7,200,000,000 | \$5,000,000,000 |
| 1928 | 80,100,000,000 | 5,300,000,000 |
| 1929 | 83,300,000,000 | 5,100,000,000 |
| 1930 | 68,900,000,000 | 5,600,000,000 |
| 1931 | 54,200,000,000 | 4,300,000,000 |
| 1932 | 40,000,000,000 | 2,700,000,000 |
| 1933 | 42,300,000,000 | 2,300,000,000 |
| 1934 | 49,200,000,000 | 2,700,000,000 |
| 1935 | 55,700,000,000 | 2,600,000,000 |
| 1936 | 62,000,000,000 | 2,700,000,000 |
| 1937 | 71,300,000,000 | 4,700,000,000 |
| 1938 | 84,000,000,000 | 5,000,000,000 |
| 1939 | 70,600,000,000 | 5,000,000,000 |
| 1940 | 77,000,000,000 | 4,000,000,000 |
| 1941 | 93,000,000,000 | 4,400,000,000 |

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DIVIDIVI, the native and commercial name for the astragal genus *Cercasalmia coriaria*, a leguminous shrub of the subfamily Caesalpinioideae, growing in open, semi arid regions, especially above tidal flats of the coast from Mexico to northern South America and the West Indies. The plant is between 20 and 30 ft. in height and bears white flowers. The pods are flattened and curl up in drying, they are about $\frac{1}{2}$ in broad, from 2 to 3 in long and of a rich brown colour. Dividivi was first brought to Europe from Caracas in 1763. The pods yield a high percentage of tannin of exceptional qualities.

DIVINATION, the process of obtaining knowledge of secret or future things by means of oracles, omens or astrology, from contact with superhuman or divine sources. Divination is practised in all grades of culture. The information is commonly held

to come directly or indirectly from superior, non human sources in the Bornean cult of the hawk the divine bird is regarded as knowing the future, or as a mere messenger. Divination is largely employed to discover the cause of death, where it is assumed to be due to magic. In some cases the spirit of the dead man is held to give the information, in others the living magician is the source of the knowledge.

Divinatory methods may be classified as (a) internal, conditioned by change in the consciousness of the soothsayer, (b) external. (a) Internal methods depend on (i) sensory or (ii) motor automatisms, or (iii) mental impressions, for their results (i) *Crystal gazing* is analogous to dreams, except that the vision is voluntarily initiated, though little, if at all, under the control of the seer. *Shell hearing* and similar methods are less common. In these the information is gained by hearing a voice (ii) The diving rod (qv) is the best known example of this class. In mediaeval and modern times water divining or *dowsing* (qv) has been largely and successfully used. Similarly a sieve held suspended gives indications by turning, and divination by a suspended ring is found from Europe in the west to China and Japan in the east. The ordeal by the Bible and key is equally popular, the book is suspended by a key tied in with its wards between the leaves and supported on two persons' fingers, and the whole turns round when the name of the guilty person is mentioned. Divination by automatic writing is practised in China. *Trance speaking* may be found in any stage of culture and in many cases the procedure of the magician or shaman induces a state of auto hypnosis, at a higher stage these utterances are termed oracles (qv) and are believed to be the result of inspiration. (iii) Observation shows that by the aid of mental impressions, akin to clairvoyance (qv), fortunes are told successfully by means of palmistry or by laying the cards, for the same "lie" of the cards may be diversely interpreted to meet different cases. In other cases the impression is involuntary or less consciously sought, as in dreams (qv), which, however, are sometimes induced for purposes of divination by the process known as incubation or temple sleep. Dreams are sometimes regarded as visits to or from gods or the souls of the dead, sometimes as signs to be interpreted symbolically. (b) In external divination the process is by inference from external facts. The methods are very various. (i) The casting of lots, *sortilege*, was common in classical antiquity. Similarly dice are thrown for purposes of sortilege, the *astragal* or knucklebones, used in children's games at the present day, were implements of divination. In Polynesia the coco nut is spun like a tectotum to discover a thief. In ancient times the poets were often consulted, more especially Virgil, whence the name *sortes virgilianae*, just as the Bible is used for drawing texts in our own day, especially in Germany. (ii) In *haruspicy*, or the inspection of entrails, in *scapulomancy* or divination by the scapula-bone or shoulder-blade, in divination by footprints in ashes, the diviner must take active steps to secure the conditions necessary to divination. (See also HEPATOSCOPY.) (iii) In the case of *augury* and *omens* (qv), the behaviour and cries of birds, and meeting with ominous animals, etc., may be voluntarily observed. (iv) *Astrology* (qv) still finds believers among people of good education. (v) In other cases the tie that binds the subject of divination with the omen giving object is sympathy. The name of the life-index is given to a tree, animal or other object believed to be united by sympathetic ties to a human being so that the fate of the latter is reflected in the condition of the former. (See the articles AUGURS, ORACLE, ASTROLOGY, OMEN, etc.)

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DIVING see DIVERS AND DIVING APPARATUS

DIVING-ROD The art of using a diving-rod for discovering something hidden is of immemorial antiquity, and the Roman *virgula divina*, used in taking auguries by means of casting bits of stick, is described by Cicero and Tacitus. The particular form of *virgula furcata*, or forked twig of hazel or willow, described by G. Agricola (*De re metallica*, 1546), and in Schöner's Munster's *Cosmography* in the early part of the 16th century, used especially for discovering metallic lodes or water beneath the earth, must be distinguished from the general superstition. The "dowsing" or diving rod dates from its use by prospectors for minerals in the German (Harz mountains) mining districts in the 15th century. The *Schlagruthe* (striking rod) or forked twig of the German miners was brought to England by the merchant ventures of Queen Elizabeth's days for those engaged in the Cornish mines. As mining declined in Cornwall its use was transferred to water finding.

In modern times the professional dowsing (qv) is a "water finder," and there has been a good deal of investigation of his claims to be able to locate underground water, where it is not known to exist, by the use of a forked hazel twig which, twisting in his hands, leads him by its directing power to the place where a boring should be made. A widespread faith exists, based on frequent success, in the dowsing power. Prof. Sir W. F. Barrett was satisfied that the rod twists without any intention or voluntary deception on the part of the dowsing, and ascribed the phenomenon to "motor automatism" on the part of the dowsing, a reflex action excited by some stimulus upon his mind, which may be either a subconscious suggestion or an actual impression (obscure in its nature) from an external object or an external mind, both sorts of stimulus are possible, so that the dowsing himself may infer that the stimulus is an external object (like water). Like the "homing instinct" of certain birds and animals, the dowsing's power lies beneath the level of conscious perception, and the forked twig acts as an index of some material or other mental disturbance within him, which otherwise he could not interpret. Not all dowsers use a rod. Some use a willow rod, or withy, others a hazel twig (the traditional material), others a beech or holly twig, or one from any other tree, others even a piece of wire or watch spring. The best dowsers have generally been more or less illiterate men, engaged in some humble vocation.

DIVISION, a general term for the action of breaking up a whole into parts (from Lat. *dividere*, to break up into parts, separate). Thus, in political economy, the phrase "division of labour" implies the assignment to particular workmen of the various portions of a whole piece of work, in the musical terminology of the 17th and 18th centuries, the term was used for rapid passages consisting of a few slow notes amplified into a florid passage, i.e., into a larger number of quick ones. The word is used also in concrete senses for the parts into which a thing is divided, e.g., a division of an army, an administrative or electoral division, similarly, a "division" is taken in a legislative body when votes are recorded for and against a proposed measure.

Mathematics—In mathematics, division is the process of finding one of two factors when their product and the other factor are given. The given product and factor are called the dividend and divisor respectively. The factor required to be determined is called the quotient. In the system of numbers consisting of the integers and fractions there is a uniquely determined quotient for every choice of dividend and divisor except when the latter is zero. In dealing with integers, however, the division is possible only when the dividend is a multiple of the divisor. If the dividend D is between dq and $d(q+1)$ —two consecutive multiples of the divisor d —then the integer q is called the quotient and the integer $D-dq$ the remainder, the process of finding the quotient and remainder is referred to as division with remainder. Unique division with remainder is also definable in the division of polynomials in a single variable x by requiring the remainder to be of lower degree in x than the divisor. The details of the division process are given in elementary arithmetic and in high school algebra textbooks (see ARITHMETIC and ALGEBRA).

A contraction of the usual division process when the dividend

is a polynomial in the variable x and the divisor is $x-r$ is known as synthetic division. Thus, if the dividend is ax^2+bx^2+cx+d the synthetic division by $x-r$ is arranged as follows

$$\begin{array}{r|rrrr} & a & b & c & d \\ & & ar & cr & fr \\ \hline & a & b+ar & c+cr & d+fr \end{array}$$

The numbers r, f, g are the sums of the two numbers directly above each. The remaining numbers are self-explanatory. The quotient and remainder are read from the bottom line, the quotient is ax^2+bx+g and the remainder is g . For instance, the quotient and remainder when $x^3-3x^2+x^2-7$ is divided by $x+1$ are seen to be x^2-4x+5 and -2 , respectively, from the following calculations

$$\begin{array}{r|rrrr} & 1 & -3 & 1 & 0 & -7 \\ & & -1 & 4 & -5 & 5 \\ \hline & 1 & -4 & 5 & -5 & -2 \end{array}$$

(X)

Logic—In traditional logic, division is a technical term for the process by which a genus or wider class is differentiated into its subclasses or species. For example, the genus "Man" (mankind) has been divided by some anthropologists into three broad groups, Caucasian, Mongoloid and Negroid. These in turn have been divided into subclasses—the Caucasian into Nordic, Alpine, etc., the Mongoloid into Asiatic Mongoloid, American Indian, etc., the Negroid into Negro, Negrito and so on. Thus, logical division moves from the more general to the less general, breaking up wider concepts into narrower. It is closely related to the process of classification (qv) which moves, however, in the opposite direction, beginning with particulars and moving through an ascending series of classes to the widest possible genus. Division is also closely related, in Aristotelian logic, to definition (qv), the process of stating the nature of a species of thing by naming the genus into which it falls and then giving the differentia of this species that is, the characteristics by which it is distinguished from other species within the same genus. In any scientific or other intellectual work, these processes by which materials are organized are likely to go hand in hand. Especially are division and classification so intimately involved with one another that they are usually carried on at the same time in actual practice.

The rules of division, which apply also to classification, are

1. The division must be exhaustive. That is, every member of the genus must be included in one or another of the species into which the genus is divided. In the above example, if there were men who did not fit into any one of the three broad racial groups, the division would not satisfy the ideal conditions set forth in this rule.

2. The division must be exclusive, that is, each of the species must exclude the members of all other species, there must be no overlapping among these subclasses. This rule can be violated in several ways. One is to bring down to a certain level a class which belongs above it, or to bring up to a certain level a class which belongs below it. To group together as co-ordinate classes books, newspapers, magazines and printed matter would be illogical, for the last term includes the others. Nor would it be logical to place in a co-ordinate group newspapers, magazines and dailies, for the latter is a subdivision of one of the classes. An other violation of the second rule results from failure to observe the third rule, as will be explained.

3. The division must employ a single principle by which the species are differentiated from one another, and as far as possible must continue to employ this principle at all stages of the process. The traditional term for the basic principle is *fundamentum divisionis*. For example, the basic principle by which to divide the genus Man into various races might be skin colour. But other principles have been used, such as facial features, shape of head, cranial capacity, blood chemistry, type of hair, geographic distribution or some carefully selected group of traits. It would be a violation of the third rule to resort to one principle at first and then allow one or more different principles to intrude at the same level, as would be the case if races were divided into black-skinned, white-skinned, wavy haired and round headed peoples.

The use of more than one principle results in what is called cross division. From the example it is clear that the second rule, as well as the third, has been violated. To the three main rules a fourth is sometimes added.

4. Division must proceed gradually, that is, the genus must be resolved into the next (proximate) species. To leap over the intermediate levels, dropping down at once from the widest genus to the narrowest species, would have little value in organizing the materials under consideration.

From the examples given above, it can be seen that certain general problems are suggested by the process of division. Division may appear to be wholly arbitrary. If one *fundamentum divisionis* is selected, the subject matter is organized in one way, but a different principle gives a different grouping. On the basis of skin colour, mankind falls into certain races, on the basis of head shape, the racial groups are different. What are the "real" races? The difficulty of this problem, which has sometimes led anthropologists to debate the question whether there are distinguishable races at all, well illustrates the relation of logical division to more profound problems of scientific method and philosophy. It would seem to be clear that in some areas where division is applied, the choice of one principle rather than another is merely a matter of convenience. In the latter part of the 19th century and first half of the 20th a strong tendency developed among some groups of logicians and scientists to hold that this is all that is, or ever can be, the case. But the older philosophical and scientific ideal, that it is possible for man to find the real "joints" or dividing lines in nature itself, retained vigorous adherents through this same period. Some distinguished biologists affirmed that, however arbitrary other classifying terms in their science might be, the concept of species remained securely rooted in the objective realities of the animal kingdom. It is in general true, however, that the classical rules of division, which are from traditional Aristotelian logic, are too formal to be followed strictly by those who work in the sciences. It is frequently necessary, for example, to use one basic principle for one or more levels of the process of division, and then resort to a different principle in order to carry the division on down to lower levels. Thus, the second half of the third rule is often necessarily and justifiably rejected. The example of racial division given earlier in this article illustrates the difficulty of using a single principle.

A more radical result of the development of logical theory in the 19th and 20th centuries was the origin of theories in symbolic or mathematical logic which tended to displace the traditional Aristotelian logic altogether in most matters, including that of division. Notable in this connection is the theory of types, formulated by Alfred North Whitehead and B. A. W. Russell (*Principia Mathematica*, 2nd ed. [1925]). This approach placed the whole problem of classes in a new setting, and directed attention to the problems of "significant symbolism." But in spite of these later technical developments, and in spite of the many limitations of the formal rules of division, the classical conception of the process of division remains of great value in many areas where it is necessary for the human intellect to bring order into a field of scattered or chaotic materials.

(E. L. Mx)

Military Science—In military science, division is the term given to a higher formation of an army. The infantry division, a permanent formation of all arms, is provided with every necessary means of subsisting, marching and fighting independently of any other formation. Divisions as we know them today were first formed by the French in 1770, but it was not till 100 years later that they became a permanent part of the army in peacetime. At the opening of World War I the French division, which may be taken as typical of European practice, comprised two infantry brigades each of two 3 battalion regiments, a cavalry squadron, two artillery groups each of three 6 gun batteries, engineer, medical and administrative units, in all, 12,000 men and 36 guns. The Prussian army introduced the divisional system at the opening of the Wars of Liberation in 1813, and it was adopted for the whole German army after the war of 1866, and continued in essentials unchanged down to 1914. Other European armies were slower to follow suit, but by the end of the 19th century practically all had

done so

In the British army the division had been the highest tactical and administrative unit throughout all the wars from the Peninsular to the Boer War, but it did not really become a part of the peacetime organization till the period of Lord Haldane's reforms in 1906. At the opening of World War I the British division differed in some important particulars from its continental counterparts, consisting as it did of three infantry brigades, each of four battalions, four artillery brigades, each of three 6 gun batteries, one 60 pounder battery, three field companies of engineers, three field ambulances, a signal company and administrative units such as the divisional ammunition column, a supply train and a veterinary section. Numerically, it was considerably stronger than the average continental division.

During World War I in all the armies the division became the tactical and administrative unit. Various modifications took place in its internal composition. By 1918 the strength of the infantry had been greatly reduced, though the number of machine guns and automatic weapons had increased, divisional cavalry had disappeared, and the proportion of artillery and administrative units was larger. The majority of the remodelled armies of the postwar period showed similar tendencies in the composition of their higher formations. The division tended more and more to become the kernel of peacetime armies. The numerical reduction of the infantry went hand in hand with a rearmament which greatly increased its firepower and its potentialities for attack and defense, including defense against tanks. Divisional cavalry on the other hand was generally reintroduced while the lavish artillery allotment necessary for position warfare was reduced to an amount considered more suitable for mobile operations. Finally, the mechanization of transport considerably increased the radius of action of the whole formation.

In the British army, however, these tendencies were perhaps less marked than elsewhere. The 4 battalion infantry brigades were retained, the artillery, signal, engineer and medical units remained much as before the war and no divisional cavalry was allotted. The great increase in infantry firepower was, however, fully maintained, and the mechanization of transport proceeded further than in any other army, so that, though the framework of the British division changed but little in broad outline, it became a far more powerful engine of war than its prototype which took the field in Aug. 1914.

Cavalry divisions were first formed in war in the time of the first Napoleon, but though they became part of the French peacetime organization in 1875, the Germans, in common with the majority of European armies, had few or none in peace and formed them as required on the outbreak of war. They usually comprised six regiments, organized in two or three brigades, with horse artillery and ancillary units. Since World War I, in which, after the early stages, at any rate in the European theatres, cavalry was rarely able to carry out its normal functions, the general tendency has been to remodel them as light divisions, of which cavalry forms only a proportion of the combatant strength, mechanized units, such as armoured cars, motor machine guns, cyclists, artillery and mechanical transport, have been added to increase mobility and firepower. (See ARMY.)

United States Army.—The division is the highest tactical and administrative command in the United States army in time of peace. Prior to World War I the regiment was the highest. Provisional manoeuvre divisions were assembled in 1908 and 1911 and again in 1913, largely under the influence of conditions on the Mexican border. Theirs, however, was only a transitory existence. The 1928 divisional organization of the army of the United States was a World War I development.

The 1928, or square, divisional organization was lacking in firepower and flexibility. To remedy these defects, a new, triangular organization was evolved. This modern structure had its initial testing in the United States in extensive manoeuvres prior to World War II. In actual combat from 1941 to 1945, the new triangular division proved far superior to the former square type, providing increased firepower and being capable of rapid adaptation to the demands of a constantly shifting type of warfare which

frequently involved combinations of land, sea and air power.

Initial strength of the triangular division was set at 624 officers, 6 warrant officers and 14,615 enlisted men. Organizations provided are: division headquarters, headquarters and military police company, signal company, reconnaissance troop, engineer battalion, medical battalion (with attached medical troops), quartermaster battalion, chaplains, 3 infantry rifle regiments, division artillery.

Each infantry rifle regiment has a strength of 110 officers, 1 warrant officer and 3,229 enlisted men. The interior organization of the regiment includes a headquarters and band, 1 service company, a headquarters company, an antitank company, and 12 light infantry companies, A to M, inclusive, grouped into 3 battalions each of which has a strength of 28 officers and 604 men.

Division artillery (truck drawn) includes a total of 121 officers, 1 warrant officer and 2,563 enlisted men. Interior organization includes headquarters and band, headquarters battery, three 105 mm. howitzer battalions (26 officers and 558 enlisted men to each battalion) and one 155 mm. howitzer battalion.

Armament of the division includes

| | |
|---|-------|
| Pistols, automatic, cal 45 | 7,107 |
| Rifles, U.S., cal 30 M1 | 6,947 |
| Rifles, automatic, cal 30, Browning M1918 A 2 | 375 |
| Guns, submachine, cal 45 | 11 |
| Guns, machine, light, cal 10, M1919 A 4 | 57 |
| Guns, machine, Browning, cal 30, M1917 (H) | 12 |
| Guns, machine, Browning, cal 50, M2, flat | 36 |
| Guns, machine, Browning, cal 50, M2 (HB) | 27 |
| Guns, 37 mm AT | 60 |
| Mortars, 81 mm | 81 |
| Mortars, 81-mm | 96 |
| Guns, 75 mm | 8 |
| Howitzers 105-mm | 16 |
| Howitzers, 155-mm | 12 |

Division vehicles

| | |
|----------------------------------|-------|
| Ambulances, 1 ton, cross country | 40 |
| Cars, light 5 passenger sedan | 70 |
| Cars, scout | 16 |
| Motorcycles, solo | 25 |
| Motorcycles, with sidecars | 14 |
| Tricycle, motor | 7 |
| Trucks | 1,326 |
| Special vehicles | 7 |
| Trailers | 267 |

DIVORCE. Marriage, as distinguished from concubinage or promiscuous sexual intercourse, is a relationship which envisages in its inception a lifelong union of the parties. Many legal codes, however, provide for the dissolution of this union, for various reasons, during the lifetime of the parties. Such dissolution is known as divorce.

Lower Culture Groups.—Among a few uncivilized peoples marriage is said to be indissoluble or divorce unknown, and among many others divorce is said to be rare or marriage as a rule to last for life, but there are also many tribes in which divorce is reported to be of frequent occurrence or marriage of very short duration. Because of the defective character of the information it is impossible to say anything definite about the comparative prevalence of lifelong unions and of divorce among the lower races in general, or about the duration of marriage at the different grades of economic culture compared with one another. It is interesting, however, to note the universal or almost universal prevalence of lifelong unions among some of the lower hunters and incipient agriculturists, such as the Veddas of Ceylon, the Andamanese, the Orang Maman and Orang Akit of Sumatra, and the "pure" tribes of the Malay peninsula. Somewhat more definite than the information we possess of the actual prevalence of divorce among the simpler peoples are the statements as to the circumstances in which their customs allow it to be practised. Among a large number of tribes the husband is said to be able to dissolve the marriage at will or on the slightest grounds or pretexts, and in the majority of these cases a similar right is granted to the wife. But we are also frequently told that a man must not divorce his wife and a wife not separate from her husband without just or good cause. The most generally recognized ground for divorce is probably adultery on the part of the wife, and among some peoples the wife is said to have a right to divorce an

unfaithful husband. A very frequent cause of divorce is barrenness in the wife while the birth of a child may make marriage indissoluble, and sometimes we are told that the wife can effect divorce if the husband proves impotent. Other recognized grounds for divorce are, as follows: a man may divorce his wife if she is lazy or neglectful, if she suffers from a foul or incurable disease, if she becomes too old, if ill her children die or, of course, if she deserts him. The wife again may dissolve the marriage if the husband neglects or ill treats her, if he deserts her or if she has a strong repugnance to him. Among some natives of eastern central Africa the wife may divorce a husband who fails to sew her clothes. Among the Shins of Burm, should the husband like to drinking or otherwise misbehave, the wife has the right to turn him adrift and to retain all the goods and money of the partnership.

Semitic Peoples.—Among Semitic peoples the husband has had or still has the legal right of repudiating his wife at will. In Babylon, according to the laws of Hammurabi, however, the wife and even a concubine had certain pecuniary guarantees against arbitrary divorce, and she might also herself in certain circumstances claim a divorce, or at least separation. The right of the husband to repudiate his wife if his pleasure is the central thought in the system of Jewish divorce law, and the rabbis neither did nor could set it aside, although they gradually tempered its severity by numerous restrictive measures. It ceased to exist in practice and was at last, in the earlier part of the 19th century, formally abolished, whereas the husband retained the right to divorce his wife if a good cause could be shown. On the other hand, the wife has no right to divorce her husband. But the Mishnah allowed her to sue for divorce, and if the court decided that she was entitled to be divorced the husband was forced to give her a bill of divorce although he was supposed to give it of his own free will and accord. In the modern state of Israel there is no distinction between nullity and divorce, the grounds for divorce being bigamy, breach of the law of affinity, the wife's idleness or refusal of marital rights, the husband's leprosy, vice, neglect, refusal to maintain the wife, impotency, or other bodily defects, and behaviour disturbing to common life. Divorce may also be obtained by mutual consent.

As the ancient Hebrews, so the pagan Arabs let the husband repudiate his wife whenever he pleased, and subsequently this unlimited customary right was crystallized in Mohammed's law, and it Mohammedan, as in Jewish law, the wife can never divorce her husband, although she may take steps leading to the dissolution of her marriage. When she desires a divorce she may obtain from him a release from the marriage contract by giving up either her settled dower or some other property, and when the husband is guilty of conduct that makes the matrimonial life intolerable to the wife or when he fails to fulfil his engagements she has the right of preferring a complaint before the judge and demanding a divorce by authority of justice. But the facility with which Mohammedan women can effect a dissolution of their marriage is influenced by local custom. So also the frequency of divorce differs considerably in different parts of the Mohammedan world. In some parts it is practised to an extent that is almost without a parallel, whereas among the Mohammedans of India the husband seldom exercises his right to divorce his wife without any special reason. This may be due to Hindu influence.

Hindu Practice.—With orthodox Hindus marriage is a religious sacrament which cannot be revoked. A woman convicted of adultery may be deprived of her status and turned out of her caste but even in this case divorce in the ordinary sense is an impossibility. The law, however, was not always equally stringent. At present the orthodox Hindu law of divorce is more or less disregarded by certain low castes in the north of India and by many castes, both high and low, in the south, among whom usage has superseded texts, agreeably to such usage the granting of a divorce, or the recognition of a divorce as one properly made, is the duty of the caste.

Early Greeks and Romans.—Among the Greeks and Romans in the early days, as among the Hindus, marriage evidently was a union of great stability, although in later times contrary to what is the case among the Aryans of India, divorce became easy and

frequent. Among the Greeks of the Homeric age divorce seems to have been almost unknown, but afterward it became an every day event in Greece. According to Attic law the husband could repudiate his wife whenever he liked and without stating any motives, while the wife could demand a divorce by appealing to the archon and stating the motives for her demand. A Roman marriage was perhaps at no time indissoluble, but the specifically patrician kind of marriage, by *confarreatio*, was at any rate very rarely so. The other forms of marriage, not being of the same mystical and sacramental character, could be dissolved without difficulty. The husband's legal authority in regard to the dissolution of a marriage with *manus* (i.e., the legal or customary provision whereby the wife passed into the almost unrestricted power of her husband) was absolute, whereas in the old law a wife *in manus* was as little a free party to the act of divorce as a slave was a free party to that of emancipation. Yet in practice the husband's right was no doubt more or less checked by public opinion and, as it seems even by the censors, it was said that for 500 years no one took advantage of the liberty of divorce. In regard to a "free" marriage, which implied that the wife did not fall under the *manus* of her husband, the rule of divorce was very different. The dissolution of such a marriage could be brought about either by mutual agreement between both parties or by the will of one party only. The rules of divorce that were recognized in the case of a free marriage were afterward practically extended to marriages with *manus*, and in the end marriages with *manus* fell into disuse altogether. Toward the close of the republican era and during the empire divorce was very frequent among the upper classes, almost all the well-known ladies of the Ciceronian age were divorced at least once.

Teutonic Peoples.—According to the old customary law of the Teutonic peoples a marriage could be dissolved by agreement between the husband and the woman's kin, and the husband was entitled to repudiate his wife if she was sterile or guilty of conjugal infidelity and perhaps for some other offenses. On the other hand the wife had originally no right to dissolve the marriage. (T. W. K.)

Divorce Law.—Divorce is the dissolution, in whole or in part, of the tie of marriage. In the main the practice in the legal systems of the civilized world is derived from the Roman law and the canons of the Christian churches. In countries in which the Roman Catholic creed is supreme, subject to certain exceptions indicated later, complete divorce is *vinculo matrimonii* (the bond of marriage) is not legally possible, though the same result may be achieved in rare cases by the ecclesiastical courts declaring that the marriage was a nullity. The papal decree of divorce *a mensa et thoro* (from bed and board), which is the practice in the Republic of Ireland and other Roman Catholic countries and is represented in English laws by judicial separation, leaves the parties still married, neither being able to remarry during the lifetime of the other. In the end it was due to the spread of Christianity and the authority of the Church of Rome that marriage came to be regarded not only as a civil contract but also as a sacred bond.

How far the Founder of the Christian religion laid down any moral law in regard to divorce has always been a matter of controversy because of the form of His declaration that has come down to us and the different conceptions then existing of the conjugal relations monogamy, so far as a husband was concerned, had not in His time been established. The rule of the Mosaic law was expressed as follows: "When a man hath taken a wife and married her, and it come to pass that she find no favour in his eyes, because he hath found some uncleanness in her, then let him write her a bill of divorcement, and give it in her hand, and send her out of his house. And when she is departed out of his house, she may go and be another man's wife" (Deut. xxiv, 1, 2).

The Pharisees asked Jesus "Is it lawful for a man to put away his wife for every cause?" Jesus replied "What God hath joined together let no man put asunder" and also said "Moses, because of the hardness of your hearts, suffered you to put away your wives, but from the beginning it was not so." Then came the declaration which is the main basis of the canon law "Whosoever shall put away his wife, except it be for fornication, and shall marry

another, committeth adultery, and whoso marrieth her which is put away doth commit adultery" (Matt xix, 3-9). Practically the same formula was used in the Sermon on the Mount (Matt v, 32) and in Luke xvi, 18 and Mark x, 11-12 with the important omission of the exception for fornication, and many modern textual critics have regarded this exception as the interpolation of a scribe.

The Roman Church has always interpreted the exception of fornication as applying only to incontinence by the wife before marriage discovered by the husband after marriage, and has treated it, not as just cause for dissolution of marriage, but as invalidating the marriage itself. It will be observed also that right down to the 20th century incontinence has been regarded as a matrimonial offense only if committed by the wife. In most countries where the civil law allows complete divorce husband and wife are now on an equal footing as to the grounds of divorce.

The Roman Law of Divorce.—The history of divorce took its earliest colour from that conception of the *patria potestas*, or the power of the head of the family over its members, which enters so deeply into the jurisprudence of ancient Rome. The wife was transferred at marriage to the authority of her husband, *in manus*, and consequently became so far subject to him that he could, at his will, announce his rule over her and terminate his companionship, subject at least to an adjustment of the pecuniary rights which were disturbed by such action. As early, however, as the time of Romulus, it is said that the state asserted its interest in the permanence of marriage by forbidding the repudiation of wives unless they were guilty of adultery or of drinking wine, on pain of forfeiture of the whole of an offender's property, one-half of which went to the wife, the other to Ceres. But the law of the Twelve Tables allowed freedom of divorce. At last the *lex Julia de adulteris*, while recognizing a power of divorce both in the husband and in the wife, imposed on it, in the public interest, serious restrictions and consequences. It required a written bill of divorce (*libellus repudi*) to be given in the presence of seven witnesses, who must be Roman citizens of age, and the divorce had to be publicly registered. In this way a wife could divorce a lunatic husband, or the *paterfamilias* of a lunatic wife could divorce her from her husband. The *lex Julia* was followed by a series of acts of legislation extending and modifying its provisions.

In A.D. 449 divorce was made easier by Theodosius and Valentinian.

The modification in the civil law of Rome effected by Justinian under the joint influence of the previous law of Rome and that of Christianity was remarkable. Divorce by mutual consent, hitherto, as we have seen, absolutely free, was prohibited except in three cases: (1) when the husband was impotent, (2) when either husband or wife desired to enter a monastery, and (3) when either of them was in captivity for a certain length of time. At a later period Justinian, under the influence of the Christian idea of marriage, placed a further restriction or even prohibition on divorce by consent by enacting that spouses dissolving a marriage by mutual consent should forfeit all their property and be confined for life in a monastery (which was to receive one-third of the forfeited property, the remaining two-thirds going to the children of the marriage). The prohibitions of Justinian on divorce by consent were repealed by Justin II, his successor.

Justinian further re-enacted, with some modifications, the power of divorce by a husband or wife against the will of the other. Divorce by a wife was allowed in five cases: (1) the husband's being party or privy to conspiracy against the state, (2) attempting his wife's life, or failing to disclose to her plots against it, (3) attempting to induce his wife to commit adultery, (4) accusing his wife falsely of adultery, (5) taking a woman to live in the house with his wife, or, after warning, frequenting a house in the same town with any woman other than his wife. A husband was allowed to divorce his wife for any one of seven reasons: (1) failure to disclose to her husband plots against the state, (2) adultery, (3) attempting or failing to disclose plots against her husband's life, (4) frequenting dinners or balls with other men against her husband's wishes, (5) remaining from home against

the wishes of her husband except with her parents, (6) going to the circus, theatre or amphitheatre without the knowledge or despite the prohibition of her husband, (7) procuring abortion.

The Canon Law.—The canon law of Rome was based on two main principles: (1) that there could be no divorce *a vinculo matrimonii*, but only a *mensa et thoro*, i.e., separation, (2) that no divorce could be had at the will of the parties, but only by the sentence of an ecclesiastical court. It is thus apparent that there was no divorce in the sense in which it was defined at the beginning of the article. But the canon law held the marriage to be null and void if (*inter alia*) the parties were within certain prohibited degrees of consanguinity or affinity, and by the middle ages the degrees of consanguinity and affinity which invalidated a marriage were so much extended as to make annulment of marriage possible on the flimsiest of grounds. For example, in the reign of Edward III a marriage was annulled because the husband, before his marriage, had stood godfather to a female cousin of his future wife (Year Book 29 Edward III, f. 31).

GREAT BRITAIN

In England the law of divorce, being based on the canon law of Rome, was practically unchanged until the Matrimonial Causes Act, 1857. Divorce *a mensa et thoro* could only be granted by the ecclesiastical courts, which were invested with this jurisdiction, apart from a break during the Commonwealth, until 1857. These were the courts of the various dioceses, including that of the archbishop of Canterbury, the court of arches, and that of the rich bishop of York, the consistory court of York. An appeal lay to special delegates appointed by the crown *ad hoc*, until in 1823 the judicial committee of the privy council was given this appellate jurisdiction. Adultery and cruelty were the main grounds for this sort of divorce allowed by the ecclesiastical courts, and the principles acted upon by those courts are still those imposed by statute upon the present courts in regard to judicial separation, except that desertion was added by the 1857 act as a ground for a decree. As regards adultery a mere confession by a spouse of her guilt was not regarded by the canon law as a safe ground for a decree, if uncorroborated, and in the present practice in cases for dissolution of marriage a confession has to be supported by some sort of circumstantial evidence in the English court. In general the principle was accepted, and is still the rule, that if an illicit affection is proved and there are opportunities by association to gratify a guilty passion, then a *prima facie* case is made out, justifying a decree if there is no defense.

As regards cruelty the definition accepted by the ecclesiastical courts as that of the canon law is the same now. It was accepted by the house of lords in *Russell v. Russell* (1897 A.C. 395), in which "legal cruelty" was defined as conduct of such a character as to have caused danger to life, limb or health (bodily or mental), or as to give rise to a reasonable apprehension of such danger. Those who wish to read the classic exposition on the subject of legal cruelty should read the judgment of Lord Stowell in the case of *Evans v. Evans* (1790, 1 Hagg. Con., 35). Thereafter there were innumerable decisions all showing that the court is not bound by any cast iron rule in its interpretation of what constitutes cruelty within the range of this definition.

Apart from a bare denial the canon law allowed three grounds of answer: (1) *compensatio criminis* was the committal by the spouse bringing the charge of the same matrimonial offence in which case the petitioner could be refused relief, (2) *condonatio* was complete forgiveness of the offending spouse by the other with full knowledge of the facts. Resumption by a husband of marital relations with his wife when he has full knowledge of her adultery is conclusive proof of condonation under the English divorce law, but resumption by a wife of marital relations with a guilty husband, with full knowledge, is not necessarily conclusive proof of condonation on her part. A matrimonial offence even of a different kind revives the former one, even if condoned. Condonation was a bar to relief, and still is, (3) *convivencia*—this is also a bar to relief, and always was, as it was held that a man could not avail himself of a charge if he did not appear with clean hands. The presumption of law is against convivencia, and



the intimation must be clearly shown for the court to refuse the petitioner relief. The petitioner need not be the active agent in the adultery of the other spouse. He may be guilty of connivance merely by neglect or indifference, though in that case the modern plea under the English statute law would probably come under the head of *conduct conducive*, which is in some cases hardly distinguishable from connivance and may equally be held a bar to relief.

Collusion between the parties for the purpose of presenting a false case to the court was also held by the ecclesiastical courts to be a bar to relief whether it was an agreement to give the appearance of having committed adultery when none had occurred or merely to withhold material facts from the knowledge of the court. The principle, in the words of Lord Stowell, is that there is no real injury "where there is a common agreement between the parties to effect their object by trial in a court of justice." It applies to any agreement not to defend, even where the agreement is disclosed to the court. In the law of divorce in England collusion may be held to exist not only when a false case is presented but also where there is a good case. Thus in a suit where the husband made provision for the future of his wife pending divorce proceedings Lord Merivale, president, though granting a decree, uttered a warning against any transaction pending divorce proceedings which raised a suspicion of collusion. In another case a divorce petition was dismissed in the first place because of an agreement by which the petitioner received a certain sum in advance in respect of damages from the respondent, and his second petition on a later charge was dismissed because by taking such sum he had connived at the further adultery of his wife. A party may show, however, that the negotiations with a view to a collusive bargain were abortive, or that the collusive agreement had been wholly spent in operation.

The ecclesiastical courts provided for the pecuniary rights of the wife by granting to her alimony during the progress of a suit, and a proper allowance after its termination in cases in which she was successful. Such payments were dependent on the pecuniary means or *fortunes*, as they were termed, of the husband and were subject to subsequent increase or diminution in proper cases. But the ecclesiastical courts did not deal with the custody of the children of the marriage, it being probably considered that that matter could be determined by the common law rights of the father or by the intervention of the court of chancery.

As regards suits for divorce any substantial delay might lead to the imputation of acquiescence or even condonation. To that extent, at least the maxim *vigilantibus non dormientibus jura subveniunt* applied. Desertion by either party to a marriage, except as giving rise to a suit for restitution, was not treated as an offense by canon law in England. It formed no ground for a suit for divorce and constituted no answer to such a suit by way of recrimination. It might indeed deprive a husband of his remedy if it amounted to connivance, or perhaps even if it amounted only to culpable neglect.

Conjugal rights are those rights which a husband and wife have to each other's society, though the exact scope of this consortium has not been defined. When either party continues to refuse to render these rights to the other, they may be enforced by a suit for the restitution of conjugal rights. Until the grounds of complete divorce were equalized in 1923, the procedure of restitution was mainly used by wives to shorten the statutory period of desertion, noncompliance by the husband with a decree being followed by the wife's petition for divorce on the dual grounds of adultery and desertion.

Intimation of marriage is a persistent claim by a person of a marriage falsely alleged to have taken place between himself or herself and the complainant, who petitions for a decree enjoining perpetual silence on the person alleging such marriage in regard to it. In these days such a remedy is rarely required, though it was not an uncommon proceeding when "Fleets" and other irregular marriages were frequent and rights to property were involved. The procedure might still be useful for obtaining a declaration as to the validity of a disputed marriage in cases where the procedure under the Legitimacy Declaration act, 1858, re enacted in

the Matrimonial Causes act, 1950, section 17, is not convenient or applicable. The most historic case in which jactitation arose was the dukes of Kingston's case in 1776, reported in the *Slate Trials*. The only case to be reported for a quarter of a century was in 1930, when the petition was granted.

Criminal Conversation—Up to the Matrimonial Causes act, 1857, a husband could bring an action for damages against his wife's paramour (action for criminal conversation). It was a common law suit, and the damages were estimated according to the loss he was supposed to have suffered by the seduction and loss of his wife. This procedure was abolished by the 1857 act and grafted upon the new procedure in divorce by way of a separate prayer for damages against the respondent in a petition for dissolution. In theory the damages are assessed on the same principle, though in practice a jury often fixes the amount at a figure calculated to inflict a severe punishment on the respondent. If a petitioner for divorce or the respondent husband dies before the petition comes to trial, the petition is "abated," i.e., abandoned, the matrimonial tie having been dissolved by death. But if it is the respondent wife who dies the husband's prayer for damages against the respondent may be pursued to trial.

It was for some time supposed after the Reformation that the sentences of divorce pronounced by the ecclesiastical courts acquired the effect of allowing remarriage, and such divorces were in some cases granted. In the marquis of Northampton's case in the reign of Edward VI the delegates, as one of the steps in a series of political manoeuvres, pronounced in favour of a second marriage after a divorce *a mensa et thoro*. They did not purport to dissolve the first marriage, and when Northampton was later convicted of treason his first marriage was restored by act of parliament. It was, however, finally decided in Foljame's case, in the 44th year of Elizabeth, that a marriage validly contracted could not be dissolved for any cause. In 1670 a private act of parliament was granted in the case of Lord de Roos and this was followed by another in the case of the duke of Norfolk, submitted in the sessions 1692, 1699 and 1700, meanwhile (1697-98) the earl of Maclesfield had obtained a parliamentary divorce. Such acts were, however, rare until the accession of the house of Hanover, only five acts passing before that period. The jurisdiction thus assumed by parliament to grant absolute divorces was exercised with great care. They were very expensive and, in all, only 229 were successfully promoted.

The Acts of 1857, 1860 and 1866—The Matrimonial Causes act (which came into operation on Jan. 1, 1858) embodied two main principles: (1) the constitution of a lay court for the administration of all matters connected with divorce, (2) the transfer to that court, with as little change as possible, of the powers exercised in matrimonial matters by (a) the house of lords, (b) the ecclesiastical courts, (c) the courts of common law.

The functions of the new court, termed "the court for divorce and matrimonial causes" (after 1873, the divorce court, part of the probate, divorce and admiralty division of the high court) were practically entrusted to the judge of the court of probate (which was also established in 1857), termed the "judge ordinary," who then in matters of probate and divorce became the representative of the former ecclesiastical jurisdiction. The parties to a suit obtained the right of trial by jury of all disputed questions of fact, and the rules of evidence of the common law courts were made to apply. An appeal to the full court was given in all matters, which the judge ordinary was enabled to hear sitting alone.

So this court were transferred all the powers of the ecclesiastical courts with regard to suits for divorce *a mensa et thoro*, to which the name was given of suits for "judicial separation," nullity, restitution of conjugal rights and jactitation of marriage. In all such proceedings it was expressly enacted (section 22 [comprised in sections 32 and 103 of the Judicature (Consolidation) act, 1925]) that the court should act on principles and rules as nearly as possible conformable to the principles and rules of the ecclesiastical courts. Judicial separation could be obtained by either husband or wife on adultery or cruelty or desertion continued for two or more years.

There were also transferred to the court powers equivalent to those exercised by the legislature in granting absolute divorce. The husband could obtain a divorce for adultery, the wife could obtain a divorce for adultery coupled with cruelty or desertion for two or more years, and also for incestuous or bigamous adultery or rape or unnatural offenses. As has been explained above, connivance, condonation or collusion continued to be absolute bars to divorce, and the court was given discretion to refuse relief where the petitioner had been guilty of adultery or conduct conducing to the respondent's adultery or had delayed unreasonably in prosecuting his suit.

This act assigned a new force to desertion. The ecclesiastical law regarded it only as suggestive of connivance or culpable neglect. But the act of 1857 made it (1) a ground of judicial separation if continued for two years, (2) a ground in part of dissolution of marriage if continued for the same period, (3) a bar, in the discretion of the court, to a petition for dissolution, though it was not made a bar to a suit for judicial separation.

Section 32 provided, in case of dissolution, for maintenance of the wife by the husband on principles similar to those recognized by the ecclesiastical courts, and section 45 for the settlement of the property of a guilty wife on her husband or children. By later acts of 1859 and 1878 provision was made for altering settlements made in contemplation or in consequence of a marriage. The act (section 35) provides also, in all divorce proceedings and in those of nullity, for provision for the custody, maintenance and education of children by the court. It was made obligatory to join an alleged adulterer in the suit, and damages (section 33) might be claimed against him, and he might be ordered to pay the cost of the proceedings (section 34).

The act of 1857 also provided (section 21) that a wife deserted by her husband might apply to a magistrate in petty sessions and obtain an order which had the effect of protecting her earnings and property, and during the currency of such order of protection a wife was to be in the same position as if she had obtained an order for judicial separation. The effect of this section appears to have been small, but the Summary Jurisdiction (Married Women) act, 1895, now reinforced by the Maintenance Orders act, 1950, afforded a cheap and speedy remedy to all classes. The act of 1857 made no provision as to the name to be borne by the wife after a divorce, and this omission led to litigation in the case of a peer's wife, in *Cowley v. Cowley* (1901, A.C. 450), in which Lady Cowley was allowed to retain her title.

By the act of 1860 a very important change was made, hiving for its object a practical mode of preventing divorces in cases of connivance and collusion or of misconduct of the petitioner. It was provided that a claim of dissolution (a provision afterward extended to decrees of nullity) should in the first instance be a decree nisi which should not be made absolute until the expiration of a period then fixed at not less than three months, but by subsequent legislation enlarged to not less than six. Under a general court order, as authorized by statute, the period was later cut down to six weeks. During the interval which elapsed between the decree nisi and such decree being made absolute, power was given to any person to intervene in the suit and show cause why the decree should not be made absolute, by reason of its having been obtained by collusion, or by reason of material facts not having been brought before the court. At any time before the decree was made absolute, the queen's proctor, if led to suspect that the parties were acting in collusion for the purpose of obtaining a divorce contrary to the justice of the case, might under the direction of the attorney general intervene and allege such case of collusion. It was established in *Sloggett v. Sloggett* (1928, P. 148, 44 The Times L.R., 394) that it was open to the king's proctor by direction of the court to intervene during the progress of a divorce suit before decree nisi and to call new evidence, not only when collusion is in question but in regard to other matters.

By an act of 1866 the court was given power to order a guilty husband to make provision for the maintenance of his former wife on the marriage being dissolved, and by an act of 1907 the court was enabled in suitable cases to order the husband to make similar provision when he was the petitioner and she the guilty

spouse. Additional powers to make orders for maintenance were given to the high court by the Matrimonial Causes act, 1950. From time to time the law of evidence in the divorce court was varied by statute until in 1860 it was enacted that no witness in any proceeding should be asked or be bound to answer any question tending to show that he or she had been guilty of adultery, unless in the same proceeding that witness had given evidence in disproof of the alleged adultery. This was still the law at mid 20th century.

The 1912 Commission Report.—The royal commission on divorce and matrimonial causes, after sitting for three years, completed its monumental labours in Nov. 1912 and by a majority report recommended important changes in the substantive law of divorce. The more important recommendations of the majority report were as follows: (1) hearing of divorce locally by commissioners of the high court, (2) powers of magistrates to make orders having the permanent effect of a decree of judicial separation to be abolished and replaced by a simple process in the high court, and husbands to be entitled to separate orders on the grounds of cruelty, habitual drunkenness and wilful desertion, equally with wives, (3) amendment of law so as to place the two sexes on an equal footing as regards the grounds of divorce, (4) five new grounds for divorce to be desertion for three years, cruelty, incurable insanity after five years' confinement, habitual drunkenness found incurable after three years from first order of separation and imprisonment under commuted death sentence, (5) habitual drunkenness as a ground for judicial separation, (6) provision for overcoming difficulties of jurisdiction as to domicile and residence, (7) unsoundness of mind, actual or incipient, at the time of the marriage, if unknown to the petitioner, and the fact that a spouse was suffering from a venereal disease unknown to the other, or the wife pregnant by another man, both at the time of the marriage, to be grounds for nullity, (8) provision for proceedings *in forma pauperis*, (9) no reports of divorce suits until a case is finished, and divorce judges to forbid or limit reports at their discretion.

In their minority report the archbishop of York (Cosmo Gordon Lang), Sir William Anson and Sir Lewis Diddin confined their recommendations to placing the sexes on the same basis as to grounds of divorce and to accepting the above recommendations as to the ground for nullity, plus that of wilful refusal to consummate the marriage.

By the Matrimonial Causes act, 1923 (sometimes called the Ent-whistle act from the name of its chief sponsor), it was provided that since July 18, 1923, any act of adultery by a husband would entitle his wife to a divorce. This act was repealed but re-embodied in the Judicature (Consolidation) act, 1925. Thus the royal commission's proposal in (3) above was carried into effect, and an unneccessary change made in the law of divorce, in keeping with the spirit of the Sex Disqualification (Removal) act, 1919, but in contradistinction to the principle which actuated the divorce statutes of the 19th century. Thus a woman might now divorce her husband for a single act of infidelity. As a consequence of the alteration in the law the number of wives' petitions increased in a marked degree. Moreover the procedure of restitution of conjugal rights, mostly utilized up to 1923 for the purpose of shortening the statutory period of two years for desertion, became extremely rare.

By the Administration of Justice act, 1920, provision was made for the local hearing of undefended divorce suits on assize. Under the Legal Aid and Advice act, 1949, replacing and vastly extending the previous rules relating to poor persons, special provisions were made for persons desirous of petitioning for divorce. Solicitors and counsel acting for assisted persons are paid out of a special legal aid fund to which persons aided may be asked according to their income and assets, to contribute. This brought divorce within the range of people whose small means formerly discouraged this resort to the court.

By the majority of three law lords to two the house of lords in *Russell v. Russell* (1924, A.C. 687) effected a retrograde movement in the law of evidence by denying to spouses the right of stating on oath anything as to the possibility of marital access, if such evidence would tend to bastardize a child. The judge of first

sought to extend the relief afforded by the courts in matrimonial causes by a procedure fairly to be considered within the reach of all classes. In 1895 an act was passed which re-enacted in an improved form the provisions of an act of 1878 of similar effect. By the act of 1895 power was given to a married woman whose husband (1) has been guilty of an aggravated assault upon her within the offences against the Person act, 1861, or (2) has been convicted on indictment of an assault on her and sentenced to pay a fine of more than £5 or to imprisonment for more than two months, or (3) has deserted her, or (4) has been guilty of persistent cruelty to her or of wilful neglect to maintain her or her infant children and by such cruelty or neglect shall have caused her to leave and live apart from him, to apply to a court of summary jurisdiction and to obtain an order containing all or any of the following provisions: (1) that the applicant be not forced to cohabit with her husband, (2) that the applicant have the custody of any children under 16 years of age, (3) that the husband pay to her an allowance not exceeding £2 (later £5) a week. (The words in italics above were repealed by the Separation and Maintenance act, 1925, with the result that a wife might apply to the magistrates notwithstanding that she had not left her home because of her husband's neglect and cruelty.) The act provided that no married woman in guilty of adultery should be granted relief, but with the very important condition, altering the rule of the common law, that the husband should not have connived at the adultery or conducted to it by wilful neglect or by misconduct or otherwise. Reforms were made in this branch of the law in 1949 and 1950.

Scotland and Ireland—So far as matrimonial laws are concerned Scotland and Ireland are just as independent of the English law as are foreign countries.

In Scotland marriages may be judicially dissolved for two causes, adultery and wilful desertion, these being the grounds at common law. Wilful desertion for three years was made a statutory ground of divorce in 1938, and four new grounds were added: incurable insanity after care and treatment as an insane person for five years, cruelty, sodomy, and bestiality. Actions for judicial separation (which also are available. Contumacious, connivance and conduct constituting (the latter pleaded as *lenocinium*) are bars to relief. A petitioner's adultery is no bar to a divorce but may be set up by the accused spouse by way of counterclaim (delay in prosecuting the suit has to be considered by the court but is rarely a bar to relief). The lord advocate has much the same powers as the king's proctor in England in matters of collusion.

In Ireland by article 41 of the constitution of Eire (i.e. of the Republic of Ireland) the family is recognized as "the natural primary and fundamental unit group of Society, and as a moral institution possessing inalienable and imprescriptible rights, antecedent and superior to all positive law." In consequence, the state is pledged to guard with special care the institution of marriage, on which the family is founded, and to protect it against attack. The same article provides that no law shall be enacted providing for the grant of a dissolution of marriage. Further, no person whose marriage has been dissolved under the civil law of any other state, but which is a subsisting valid marriage under the law of the Republic of Ireland, shall be capable of contracting a marriage in Ireland during the lifetime of the other spouse. Thus no divorce may be granted in Ireland, and foreign dissolution decrees will only be recognized where given in the court of the common domicile of the parties. Proceedings for nullity and judicial separation may still be brought in Ireland.

Divorce in Northern Ireland is controlled by a Matrimonial Causes act of 1939. Either party may petition on the grounds of adultery, desertion for three years, cruelty and insanity after five years' care and treatment, and a wife may petition on grounds of rape, sodomy or bestiality.

COMMONWEALTH OF NATIONS

In Canada, though divorce is a matter exclusively within the control of the dominion parliament, that body did not see fit to pass any general overriding act with the result that the divorce laws of the ten provinces which remain in force until altered or

repealed by dominion legislation vary considerably. The provinces of British Columbia, Alberta, Saskatchewan and Manitoba adopted English law after 1857 (1858 for the first named 1870 for the other three), so that their courts have jurisdiction, as was available in England after the Matrimonial Causes act of that year, to grant decrees of divorce. As to Ontario, by a dominion act of 1940, the English law of divorce as in July 1870 was made to apply therein the day behind the date chosen in this enactment was to make the law of Ontario uniform with that of Manitoba, Saskatchewan and Alberta. In the case of Nova Scotia, New Brunswick and Prince Edward Island, English law was introduced well before 1857, but, by legislation of the provinces themselves (effected before the dominion was established in 1867), the power to grant divorce was given to the respective provincial courts. The courts of Quebec were not given divorce jurisdiction. "Marriage can only be dissolved by the natural death of one of the parties, while both live, it is indissoluble" the law is the same for Newfoundland incorporated as a province of the dominion in 1949. In 1925 the dominion parliament, following the provision of the English act of 1913, enacted that in those provinces possessing divorce jurisdiction a petitioning wife need not prove more than the adultery of her husband.

In Australia the grounds of complete divorce vary according to the state but are generally wider than in England including conduct which would only justify a judicial separation in England.

In New Zealand the grounds of absolute divorce are: (1) adultery, (2) wilful desertion for three years, (3) habitual drunkenness for four years coupled with cruelty or desertion by the husband and neglect of household duties by the wife, (4) conviction and sentence of imprisonment for seven years or more for attempting to commit the murder of the petitioner, or wounding of the petitioner or a child of the parties, (5) conviction for the murder of a child of the parties, (6) incurable lunacy for at least ten years, including confinement for seven of these years, (7) failure to comply with a decree for restitution of conjugal rights, (8) three years of separation agreed either orally or in writing, (9) in three years' lapse of time after the making of a New Zealand decree of judicial separation, (10) rape, sodomy, bestiality. A married woman in New Zealand who, if a *feme sole*, would be domiciled there, may present a divorce petition in New Zealand, regardless of her husband's domicile elsewhere, providing that they have been living apart for at least three years.

In the Union of South Africa the Roman Dutch law is in operation for the most part, the grounds of divorce being: (1) adultery or unnatural offenses, (2) malicious desertion, (3) lifelong imprisonment, (4) five years' imprisonment after declaration that the respondent is a habitual criminal, (5) incurable insanity after seven years.

EUROPE

As regards European countries, there is no complete divorce where the Roman Catholic Church still preserves its ancient powers and influence.

Italy, Spain and Portugal—In Italy a husband may secure a divorce *a mensa et thoro* on the ground of his wife's adultery. The wife is entitled to the same decree if her husband keeps a concubine in such a way as to constitute a grave indignity to his wife, or if he voluntarily deserts her or fails to make a home for her, or is guilty of violence, threats or cruelty endangering her safety or health, or if he is sentenced for a grave crime. The Italian courts do not recognize foreign divorces relating to Italian subjects, but if a national of a foreign country celebrates his marriage in Italy and then gets a decree of divorce in another country, this decree, under certain conditions, may be enforceable in Italy through special proceedings (*deliberazione*) in a court of appeal. In Spain and Portugal the law is practically the same as in Italy.

France—In France the law of divorce has had a chequered history. Before the Revolution the Roman canon law prevailed, marriage was considered indissoluble and only divorce *a mensa et thoro*, known as *la séparation d'habitation*, was permitted, though it would appear that in the earliest age of the monarchy divorce *a vinculo matrimonii* was allowed. But the French Revolution

swept away marriage among the institutions which it overwhelmed, and by the law of Sept. 20, 1792, so great facility was given for divorce a *vinculo matrimonii* is practically to terminate the obligations of marriage. A reaction came with the Code Napoléon, yet even under that system of law divorce was fairly easy. On the restoration of the monarchy in 1816 divorce a *vinculo* was abolished.

Divorce was re-enacted by a law of July 27, 1884, the provisions of which were simplified by laws of 1886 and 1907. But a wide departure was made by these laws from the terms of the Code Napoléon. Divorce by consent was not permitted, and the following became the causes for which divorce was allowed: (1) adultery by either party to the marriage at the suit of the other, without in the case of adultery by the husband the aggravation of introduction of the concubine into the home required by the Code; (2) violence (*écœu*) or cruelty (*sauveur*); (3) *injures graves*, acts reflecting on honour or reputation and such things as justify a refusal of marital rights or habitual drunkenness; and (4) *peine afflictive et infamante*, a legal punishment involving corporal confinement and moral degradation.

In addition to its recognition of full divorce, the French law recognizes *séparation de corps*. The grounds are the same as those for divorce, and if a *séparation de corps* has existed for three years, it may be turned into a divorce upon the application of either party to the court.

On a divorce both parties are at liberty to remarry. The husband could remarry at once, but the wife (article 296 of the Code) was only allowed to remarry after an interval of ten months. By the act of 1907 this article was abolished and the wife allowed to remarry as soon as the judgment or decree granting the divorce had been entered, providing 300 days had elapsed. Under the law of March 26, 1924, article 295 was amended in favour of greater, but not complete, freedom of remarriage of the parties divorced, not still in a state of wedlock. The publication of divorce proceedings in the press is forbidden under heavy penalties. After a divorce the wife may not continue to use the name of her divorced husband. An appeal may be brought against a decree of divorce within two months, and a decree made on appeal is subject to revision by the court of cassation within two months. A decree must be transcribed in the register of civil status before it becomes absolute. (*Cf. Woodland v. Woodland*, 44 The Times L.R. 495.)

Germany.—In Germany, the absence of a peace treaty after World War II delayed re-establishment of a uniform code. In the British zone of control in western Germany, law no. 16, part 2, *Recht der Ehescheidung*, followed closely the old pattern of German law. Divorce might be decreed for adultery, violation of marriage duties, disreputable or immoral conduct (*Eheverfehlung*), mental derangement, mental diseases which make "spiritual companionship" impossible or infection with contagious and repulsive diseases. Petitions on these grounds had to be "morally justified," especially in relation to the duration of the marriage, the age of the parties and, where relevant, the circumstances in which the disease was contracted. If the parties had not kept a common household for three years and if there was a "deep rooted, incurable disruption of the marriage bond," again divorce might be granted. In certain circumstances, a woman retained her husband's name after divorce but, unless she gave birth to a child within the ten months after dissolution, she might not marry again within that period (section 8).

Other European Countries.—In Austria the grounds for complete divorce are adultery, conviction for a crime for which the penalty could be five years' imprisonment, malicious desertion, cruelty or conduct endangering life or health, and invincible aversion. A judicial separation is allowed on the same grounds, and also by mutual consent. In Hungary the law is very similar.

Dissolution of marriage by mutual consent is allowed in several European countries. Thus in Belgium this course is permitted, subject to the approval of the court. The other grounds of complete divorce in Belgium are the adultery of the wife, the adultery of the husband only if he has brought a concubine to the home, cruelty and conviction for an infamous offense. The law on separa-

tion was modified by a law of March 20, 1927. There has to be an interval of ten months before remarriage in the case of the wife. Divorce by mutual consent is also permitted subject to proceedings which take a year to complete. In these cases, three years must elapse before either party may remarry. In Switzerland divorce by mutual consent was abolished in 1912, grounds for divorce are adultery, cruelty or dishonourable treatment, wilful desertion for three years and incurable insanity or mental disease of three years' duration, and in cases of gross antagonism a couple may be granted a trial separation for two years, followed by a divorce if there is no reconciliation. The ground most relied on, however, is that of "conjugal disturbances" under article 142 of the code.

In Sweden a divorce is granted after the expiry of a year from the date of a judicial separation allowed on the ground of aversion, if there has been no reconciliation, other grounds of divorce are adultery, six years' absence by one spouse without news, insanity for three years, conduct endangering life and imprisonment for life. These are judicial grounds, but a divorce may also be pronounced by means of the judicial prerogative against a person who has been the subject of a sentence for a grave crime, or on proof of violence, inebriety or profligacy. In Norway and Denmark the grounds are very similar and in the former country a royal decree of divorce may be obtained by mutual request after three years of separation. In the Netherlands judicial separation is allowed on the usual grounds of the canon law, and complete divorce can be secured for each of the following grounds: adultery, wilful desertion for six years, unnatural offenses, life imprisonment and absence for ten years. The court sits in camera.

The U.S.S.R.—In Soviet Russia, in place of the previous procedure, under which a divorce was granted by either spouse alone without assuming custody, a decree of 1945 provided for a judicial procedure for divorce. In 1947 a decree prohibited marriages between Soviet citizens and foreigners. Under the imperial law the grounds for divorce used to be adultery, bigamy, impotence at the time of marriage, absence of one spouse without any news for five years, exile to Siberia and loss of civil rights. (See H. C. Mo, J. E. S. S.)

UNITED STATES

In colonial times the only available method of dissolving a marriage was by act of a legislative assembly, and such power was exercised by some state legislatures but later was denied by constitutional provisions in all but a few states. Divorce is to be distinguished: (1) from a decree of annulment of marriage, which is a judicial determination that no legal marriage ever existed between the parties, and (2) from a decree of separation, which permits or commands the parties to live apart, but does not completely and for all purposes sever the marriage tie.

Divorce Rate.—Statistics concerning divorce have been gathered by the U.S. department of labour, the bureau of the census and the national office of vital statistics. The latter agency collected data showing that the rate of divorces to population rose steadily after 1867 with the exception of temporary dips in the general upward curve after wars and business depressions. The 1867 rate was 0.3 divorces per 1,000 population. By 1887 it was 0.5 and by 1907 it had reached 0.9 per 1,000 population, increasing at an accelerated pace to a high in 1946 of 4.1 per 1,000 population, including the armed forces overseas. The total number of divorces granted in 1946 was estimated at 610,000. The rate declined to 3.4 in 1947 and 2.8 in 1948. The divorce boom and decline, following World War II, repeated the post World War I pattern. This phenomenon was attributed to hasty and ill conceived wartime marriages and to unstable conditions during wartime.

The effects of economic conditions are also reflected in the United States divorce rate. When times are good and income seems likely to be assured, the divorce rate rises. In periods of industrial depression it falls, fluctuating thus in the same way as the marriage rate. For instance, the divorce rate dropped during the depression years commencing with 1929, levelled off during 1932-33 and mounted steadily thereafter during the industrial recovery.

Government figures also show interesting variations in the divorce rate between different states and different regions of the United States. The rate in Nevada, for instance, for many years ran from 24 to 35 times that for the nation as a whole and the Florida rate averaged between 2 and 3 times the national rate. These states, and a few others, attracted "divorce business" through the enactment of laws making quick divorce easily available to persons from other states having less liberal divorce laws. With the exception of Florida the divorce rate was generally lowest in the states along the Atlantic seaboard, none was higher in the northern Mississippi valley area and climbing still higher in the regions to the south and west. But generalizations as to regional trends were subject to such notable exceptions as Wisconsin, the Dakotas, Iowa, Nebraska and Louisiana, where the divorce rates remained generally lower than the national average.

Two statements often made regarding divorce in the United States are not warranted by the statistics, namely: (1) that the real motive

of one or both parties to most divorces is the desire for marriage to a third person and (2) that a large proportion of divorces are granted to persons who move from one jurisdiction to another in order to avail themselves of lax divorce laws. On the first point U. S. statistics are practically silent since, in issuing a marriage license to parties one of both of whom have been previously divorced, no record is ordinarily made of the fact. In Connecticut, however, for a number of years this information was required and, if the statements were trustworthy, the number of persons remarrying each year was about one third of the total number of persons divorcing—probably a rate not widely different from that of widows and widowers of the same age. What statistical evidence there was on the subject therefore, tended to discredit this popular opinion.

The evidence against the second belief was even more conclusive. About four fifths of all the divorces granted in the United States were issued to parties who were married in the state in which the decree of divorce was later made, and when we deduct from this number one fifth those divorces in which the parties migrated for other reasons than a desire to obtain an easy divorce, the remainder constituted a small, almost a negligible, fraction of the total number.

Legal Aspects.—Divorce became available in every state the District of Columbia, the territories the insular possessions and the Canal Zone. The grounds for divorce and the procedures through which it may be obtained are determined by the statutes of each political division. Such statutes are derived principally from ecclesiastical law which expresses certain moral concepts. Thus divorce is granted only upon proof that one spouse, and only one, is guilty of conduct showing moral culpability within one of the categories specified by statute. If both parties are guilty there can be no divorce, and by the same token, if neither party is guilty of misconduct, no divorce can be granted, even though both may desire it. Moreover, husbands and wives must not collude in the commission of a matrimonial offense or the fabrication of evidence of such an offense for the purpose of obtaining a divorce. Nor will a divorce be granted if the wronged party has condoned or forgiven the matrimonial offense.

In actual practice 85% to 90% of divorce suits in the United States are not contested. The grounds alleged are more often a cloak than a due to the basic cause of marital discord. Thus desertion, which carries little opprobrium, is the ground charged in about one-third of all divorce suits. Physical cruelty is alleged in another third or more of the cases, and in many cases consists of proof of a resort to physical aggression even though trivial, as meeting legal requirements. Less than 10% of divorces are granted for adultery, although infidelity is one of the real causes of separation in a majority of instances. Another common ground for divorce is the commission of various states is habitual drunkenness, nonsupport, conviction of felony, impotency, incurable insanity, communication of venereal disease, habitual indulgence in violent and ungovernable temper and in duties to the person of an innocent spouse rendering his or her condition intolerable.

The great variation in the legal requirements for divorce in the different states stimulated so-called "matrimonial divorces." Residents of states where divorce was hard to obtain sought divorce in other states, such as Nevada, where legal grounds and procedures facilitated the securing of marital ties. At mid-th century only six weeks' residence was required of an applicant for divorce in Nevada and Idaho. Florida required 90 days' residence and Wyoming only 60 days, except that in the latter state a year's residence was necessary if insanity was the ground for divorce. Residence requirements in other states ran much higher, the majority ranging from six months to a year or more.

Conflicts between state laws created great uncertainty as to the validity and scope of out-of-state divorces. Parties to such divorces were sometimes involved in serious legal difficulties. The United States supreme court ruled that the courts of any state have the right to inquire into the jurisdictional facts in connection with divorces decreed granted by other states before recognizing such decrees as valid. The "full faith and credit clause" of the constitution required the recognition only of those out-of-state divorces where jurisdiction is based upon the actual residence of the plaintiff established in good faith and not merely for the purpose of divorce. It therefore became possible for persons who married after obtaining a divorce in one state to be prosecuted and convicted of bigamy in another state. Other complications arose in connection with the effect of out of state divorces on property rights. The U. S. supreme court decreed a concept, called by one of the justices "disposable divorce," by which a marriage might be dissolved in one state without leaving courts of another state from recognizing property rights arising out of the marriage.

Social Considerations.—The frequency of divorce in the United States has been the subject of endless discussion in books and periodicals with general agreement that marital maladjustments and the breaking up of families have grave social consequences, especially through the weakening of parental controls and the inevitable insecurity felt by the children of divorced couples. Certainly the high rate of delinquency among such children may be fairly ascribed to the disorganization of the family life.

If he often been pointed out, however, that divorce is a symptom

rather than an evil in itself. The courts merely sever the bonds of matrimony. By the time married couples reach the divorce courts their marriage is already on the rocks and can only be saved by a complete emotional reorientation.

The generally accepted view at mid-century youth was that the cure for divorce lies in better preparation for marriage through training young people in an understanding of the responsibilities as well as the rewards of family living. Efforts were begun in many schools and colleges to furnish such advice through courses in family relations. Similarly, premarital clinics and advisory services were established in many cities in the hope of equipping prospective husbands and wives with a sound attitude toward the marital relationship. It was also recognized that efforts to reduce the frequency of divorce should not stop with premarital advice. The same agencies which offer such service are usually also ready to counsel married couples over their difficulties and problems. Conciliation services have likewise been set up in connection with divorce courts. There has no doubt that such efforts had a substantial effect in adjusting marital discord in many families.

Although the most effective action toward reducing the frequency of divorce must be through preparation for marriage and adjustment after marriage, there was general agreement also that divorce laws throughout the United States needed overhauling. There was less agreement, however, as to the type of legal reform that should be enacted. One view was that divorce should be made slower and more difficult through greater strictness as to residence requirements and the grounds for divorce and by providing "cooling off" periods and delays before final decrees could be obtained. Opposing this attitude were the proponents of more liberal divorce laws, contending that the only requirement for divorce should be the actual separation of the parties for a period long enough to indicate their intention to live apart permanently. All the old concepts concerning guilt, recrimination, collusion and condonation would be abolished in favour of laws based on an acceptance of divorce as the means by which married couples might lawfully free themselves from a bond that no longer has any emotional validity.

Reformers also advocated the establishment of specialized courts with jurisdiction over all family problems such as adjustment of marriage, divorce, alimony, adoptions, bastardy, nonsupport and juvenile delinquency. There was growing sentiment in favour of the passage of uniform divorce laws throughout the United States to put an end to the present bidding between states for divorce litigation and to make it more difficult for runaway husbands to avoid contributing to the support of dependent wives and children. Some progress had been made at mid century toward the latter objective through the enactment by a group of states of reciprocal nonsupport laws providing the means for collecting support money in such cases.

BIBLIOGRAPHY.—Publications containing divorce statistics include *A Report on Marriage and Divorce in the United States, 1897 to 1898* published by the U. S. Commissioner of Labor, *Reports on Marriage and Divorce, 1887 to 1906*, *Marriage and Divorce 1916*, *Marriage and Divorce, Annual Reports 1922 to 1932*, *A Review of Marriage and Divorce Statistics, 1887 to 1937*, and the annual *Statistical Abstract of the United States*, all published by the U. S. Bureau of the Census, and the *Statistical Bulletin* published by the Metropolitan Life Insurance Company. Legal aspects of divorce are covered by such text books as W. T. Nelson, *Divorce and Annulment*, 2nd ed. (1945).

(M Dc)

DIWANIYEH, a town of Iraq in 31° 58' N and 45° E about 40 mi below Hilla on the Euphrates, here crossed by a floating bridge, and on the Baghdad Basra railway. The town is a frontier post on the edge of the desert, and is a strategic military point.

DIX, DOROTHEA LYNDIE (1802-1887), U. S. philanthropist was born at Hampden (Me), April 4, 1802. About 1820 she attended a school in Boston. From 1824 to 1839 she wrote books of devotion and stories for children. Her *Conversations on Common Things* (1834) had reached its 60th edition by 1869. In 1841 she became interested in the condition of jails and almshouses, investigating especially the treatment of the pauper insane. Her memorial to the state legislature resulted in improved treatment of the insane, and she thereafter extended her work into many other states and foreign countries. She was superintendent of women nurses during the Civil War, and her labours on behalf of defectives were continued after the war. She died at Trenton, N. J., July 17, 1887.

See Frances Tiffany *Life of Dorothea Lyndie Dix* (1892).

DIX, JOHN ADAMS (1798-1879), U. S. soldier and political leader, was born at Boscawen, N.H., on July 24, 1798. He studied at Phillips Exeter academy and at the College of Montreal, and as a boy took part in the War of 1812. In July 1828, having attained the rank of captain, he resigned from the army, and for two years practised law at Cooperstown, N.Y. He soon became prominent as one of the leaders of the Democratic party.

in the state and for many years was a member of the so called "Albany ranciness" (q.v.), a group of Democrats who between about 1820 and 1850 exercised a virtual control over their party in New York. In 1833-39 he was secretary of state and superintendent of schools in New York. From 1845 to 1849 he was a United States senator from New York. In May 1860 he became postmaster of New York city, and from January until March 1861 he was secretary of the treasury of the United States, in which capacity he issued (Jan. 29, 1861) to a revenue officer at New Orleans a famous order containing the words, "If any one at attempts to haul down the American flag, shoot him on the spot." He was appointed major general of volunteers in June 1861, and during the Civil War commanded various departments until July 1865. He was minister to France in 1866-69, and in 1872 was elected by the Republicans governor of New York.

His son, **MORGAN DIX** (1847-1908), was rector of Trinity church, New York city, from 1862 until his death. He published *A History of the Parish of Trinity Church, New York City* (1898-1905) and a biography of his father, *Memoirs of John Adams Dix* (1883).

DIXIE, a popular name given to the southern states of the United States which lie south of the Mason and Dixon line. There are various reasons given for the name, one of the most plausible being that it had its origin in money issued by a bank in New Orleans before the Civil War. On the back of the ten dollar bills was printed the French word *Dix* with other lettering in French, hence the south particularly Louisiana became known as the land of Dixies and thereupon Dixie land. It was about this time that Daniel Emmett, "Negro minstrel" and song writer while looking out on the cold dreary streets of New York city and wishing he were in Dixie, picked up his violin and composed that rollicking song, which has been called the national anthem of the south, "Away down South in Dixie."

DIXON, GEORGE (c. 1755-1800), English navigator. He served under Capt. James Cook in his third expedition, and after his return became a captain in the royal navy. In the autumn of 1785 he sailed in the "Queen Charlotte," in the service of the King George's Sound Company of London to explore the shores of the present British Columbia, with the special object of developing the fur trade. His chief discoveries were those of Queen Charlotte's Islands and sound (the latter only partial), Port Mulgrave, Norfolk bay and Dixon's Entrance and archipelago. He disposed of his cargo in China and returned in 1788, and published *I Voyage round the World, but more particularly to the North-West Coast of America* (1799), the bulk of which consists of descriptive letters by William Berezford, his supercargo. His own contribution to the work included valuable charts and appendices. He is usually identified with the author of *The Navigator's Assistant* (1791), who was teacher of navigation at Gosport. It is believed that he died c. 1800.

DIXON, HENRY HALL (1822-1870), English sporting writer under the nom de plume "The Druid," was born at Warwick Bridge, Cumberland, and educated at Rugby and at Trinity college, Cambridge, where he graduated in 1846. Three of his novels, *Port and Paddock* (1856), *Sisk and Scarlet* (1859), and *Scott and Selkirk* (1862) appeared in the *Sporting Magazine*.

See also Francis Lawley, *Life and Times of "The Druid"* (1895). **DIXON, RICHARD WATSON** (1833-1900), English poet and divine, son of James Dixon, a Wesleyan minister, was born on May 4, 1833. At Pembroke college, Oxford, he became one of the "Birmingham group" there who shared with William Morris and Sir Edward Burne-Jones in the pre-Raphaelite movement. He died at Warwick, of which parish he was vicar, on Jan. 23, 1900. His principal work is *History of the Church of England from the Abolition of the Roman Jurisdiction* (1878-1902). At the time of his death he had completed six volumes, covering the period 1530 to 1570.

Dixon's *Selected Poems* were published in 1909 with a memoir of the author by Robert Bridges.

DIXON, a city of northern Illinois, U.S., on the Rock river and the Lincoln highway, 98 mi W of Chicago, the county seat of Lee county. It is served by the Chicago and North Western and

the Illinois Central railroads and by bus line.

The population was 11,532 in 1950 and was 10,671 in 1940 by the federal census. Dixon is the centre of a rich farming region, and has a number of manufacturing industries, for which the river supplies power.

It was laid out in 1835 by John Dixon (1784-1876), the first white settler in the county, and was chartered as a city in 1859. In 1832, at the close of the Black Hawk War, Jefferson Davis, Zachary Taylor and Abraham Lincoln were comrades in the old blockhouse that stood near the northern end of the present bridge across the river.

DIZFUL, a town and district in the province of Khuzestan, Iran, in 32° 25' N and 48° 35' E, anciently known as Abi-damish. It is 6,50 ft above sea level on the left bank of the Abi-Diz, tributary of the river Karun, here crossed by an imposing bridge 430 yds in length in large part dating from Sassanian times and recently repaired under British auspices, the central span now being of the suspension type.

The population is estimated at 40,000 and includes Persians, Lurs and Arabs.

Dizful is an important station on the Trans Iranian railway between Burayrd and Ahwaz.

The town is on conglomerate cliffs about 70 ft above river level, in which cool and dry underground chambers are extensively cut for use in the hot weather. The ruins of Susa (q.v.) are about 15 mi to the southwest. The industries peculiar to Dizful are the preparation of indigo, the dyeing of cloths and the making of felts. It is the principal southern market town of the nomad population of Luristan. Indigo was first introduced here in the early 19th century, but has since been almost entirely displaced by imported dyes.

Dizful reed pens are celebrated in the east and extensively exported. In the river bed above the bridge are several flour mills worked by water power. Several canals take off below the bridge and irrigate about 20,000 ac. on either bank, but a far greater area was once served by similar canals and could be again fertilized if the dam, on which the original bridge stood, were reconstructed.

DJAKOVO (DARJOVO), a city of Croatia Slavonia, Yugoslavia, occupied by Italy in April, 1941, after the axis invasion of the Balkans. Pop. 7,987. Djakovo is a Roman Catholic episcopal see. Bishop Joseph Strossmayer (1815-1905) did much to foster the sense of racial kinship among the Yugoslavs, and the town became a centre of religious and political activity. The cathedral, a basilica with a central dome and two lofty spires, was founded in 1866. Its style is Romanesque, chosen by Strossmayer as symbolical of the position of his country, midway between east and west.

Djakovo has a thriving trade in agricultural produce. Many Roman remains have been discovered.

For a full description of the cathedral, in Serbo-Croatian and French, see the illustrated folio *Stolna Crkva Djakovo*, published by the South Slavonic Academy, 1900.

DJERBA see JERBA.

D LINES, in spectroscopy (q.v.), the pair of lines, characteristic of sodium, in the yellow region of the spectrum. Their separation is too small to be detected with a spectroscope of low resolving power, hence to Joseph von Fraunhofer (q.v.) they appeared as a single line. This line was the fourth prominent absorption line in the sun's spectrum, starting from the red end, and he accordingly designated it by the letter D. It was subsequently resolved into two components D₁ and D₂, corresponding to wave lengths 5895.93 and 5895.97 Å (10⁻⁸ cm) respectively. An emission line appearing in the chromosphere, D₃, λ 5875.62, has since been discovered. This line is caused by helium.

DLUGOSZ, JAN (JOHANNES LONGINUS) (1415-1480), Polish historian, was the son of the burgrave of Bozennica. He became the secretary of Bishop (afterward Cardinal) Zbigniew Oleśnicki (1389-1455), and was employed by him on many important missions. In spite of his connection with Oleśnicki he nevertheless supported King Casimir IV in his Prussian policy in opposition to his patron. After the cardinal's death in 1455

he began his *Historia polonica* (13 vol., 1st impression, 1614, 1st complete impression, 1711). This great book, the first and still one of the best historical works on Poland, was based on an exhaustive study of the archives of Poland and Hungary. It was completed in 1479.

Długosz became archbishop of Lemberg in 1478. He died on May 19, 1480, at Pratek.

See Semkowicz, *Critical Considerations of the Polish Works of Długosz* (Cracow, 1874); Michael Bobrzyński and Stanisław Smolka, *Life of Długosz and his Position in Literature* (Cracow, 1893), both of these are in Polish.

DMITRIEV, IVAN IVANOVICH (1760–1837), Russian statesman and poet, was born at his father's estate in the government of Simbirsk on Sept. 20, 1760. In consequence of the revolt of Pugachev the family was compelled to flee to St. Petersburg, and there Ivan entered the army. During the four years from 1810 to 1814 he served as minister of justice under the emperor Alexander. The rest of his life was devoted to literature. He took sides with Karamzin in the battle for a natural Russian language against the Old Slavonic party. His poems include songs, odes, satires, tales, epistles, etc., as well as the fables—partly original and partly translated from Jean de la Fontaine, Jean de Florian and Antoine Arnault—on which his fame chiefly rests.

His writings occupy three volumes in the first five editions. In the 4th (St. Petersburg, 1831) there are only two. His memoirs, to which he devoted the last years of his life, were published at Moscow in 1866.

DMITRIEVSK, a town in the Stalin district of the Ukrainian SSR long 38° 48' E lat 47° 56' N. In 1897 it was a village with a population of 512, but in 1917 its coal mines were developed and metal and chemical industries established. Its population is 51,436.

DNEPROPETROVSK, formerly Ekaterinoslav, a town in a county of the same name, in the Ukrainian SSR. It is situated on the right bank of the Dnieper river above the rapids in 48° 21' N and 35° 4' E, alt. 210 ft. In 1927 under U.S. direction, the construction of a ferroconcrete dam, with sluices and docks allowing ships to pass and turbines for generating electricity was commenced. The proximity of manganese, nitre, coal and iron deposits to the station, and of the Zaporozhny aluminum industry is a great commercial asset. Pressure on the railway system will be relieved by the opening of river transport for wheat, timber, coal, iron and other heavy products. The town has iron smelting, and metal industries employing more than 50,000 men and there are also breweries, flour mills and other smaller industries. In 1895 it became the centre of numerous Franco-Belgian industrial enterprises, and its population has increased from 18,881 in 1861 to 500,662 in 1939. It is a trading centre for the agricultural products of the district. On the site of the present city there formerly stood the Polish castle of Kudak, built in 1635, but it was destroyed by the Cossacks. Grigory Potemkin founded the city in 1786, and Catherine II in 1787 laid the foundation stone of its cathedral, which however, was not built until 1830–35. Paul I changed the name of the city to Novo Rossiysk but its original name was restored in 1802. The oldest part of the city lies very low and is subject to floods. The civic buildings include a mining academy, an archaeological museum and a library.

DNIESTER, one of the most important rivers of Europe (the Borysthene of the Greeks, Danapris of the Romans, Uzi or Uzu of the Turks, Elksi of the Tartars, Elce of Visconti's map [1381], Lerene of Contarini [1437], Luosen of Baptista of Genoa [1514], and Lussem in the same century). It belongs entirely to Russia, and rises in the Smolensk province, in a swampy district (alt. 930 ft.) at the foot of the Valdai hills, not far from the sources of the Volga and the Dvina, in 55° 52' N and 33° 41' E. Its length is 1,400 mi and it drains an area of 202,140 sq mi. In the first part of its course, which may be said to end at Dorogobuzh, it flows through an undulating country of Carboniferous formation, in the second it passes west to Orsha and south through the White Russian SSR to the Ukrainian SSR, where it passes south through the fertile plain of Chernigov and Kiev, and then south east across the rocky steppe to Dnepropetrovsk (Ekaterinoslav).

About 45 mi S of this town it has to force its way across the same granite offshoot of the Carpathian mountains which interrupts the course of the Dniester and the Bug and for a distance of about 25 mi rapid succeeds rapid. The fall of the river in that distance is 155 ft. The Dnieper, having got clear of the rocks, continues southwest through the grassy plains of Kherson and Taurida, and enters the Black sea by a considerable estuary in 46° 30' N and 32° 20' E with the town of Kherson on its right bank. On this ramifying *liman*, into which the Bug also pours its waters, stands Nikolaev. Navigation extends as far up as Dorogobuzh, where the depth is about 12 ft., and rafts are floated down from the higher reaches. The banks are generally high, more particularly the left bank. About the town of Smolensk the breadth is 455 ft., at the confluence of the Pripiet 1,400, and in some parts of the Dnepropetrovsk district more than 14 mi. In the course above the rapids the channel varies very greatly in nature and depth, and it is not infrequently interrupted by shallows. The rapids form a serious obstacle to navigation, it is only for a few weeks when the river is in flood that they are passable, and even then the venture is not without risk and can be undertaken only with the assistance of special pilots. As early as 1732 an attempt was made to improve the channel. A canal, which ultimately proved too small for use, was constructed at Nensitsets in 1780 at private expense, blastings were carried out in 1798 and 1799 at various parts, in 1805 a canal was formed at Kaunditski and the channel straightened at Sursk, by 1807 a new canal was completed at Nensitsets, in 1833 a passage was cleared through the Staro Kaunditski rapid, and in the period 1843 to 1853 numerous ameliorations were effected. The result has been not only to diminish greatly the dangers of the natural channel, but also to furnish a series of artificial canals by which vessels can make their way when the river is low. A ferroconcrete dam was constructed in 1927 across the falls, under U.S. direction, with sluices and docks for letting ships pass, and a station and turbines for the production of electric power. Of the tributaries of the Dnieper the following are navigable—the Bereznia and the Pripiet from the right, and the Sozh and the Desna from the left. By means of the Dnieper Bug (King's) canal, and the Bereznia and Oginski canals, this river has water connection with the Baltic sea.

In the estuary the fisheries give employment to large numbers of people. At Kiev the river is free from ice on an average for 234 days in the year, at Dnepropetrovsk 270 and at Kherson 277.

DNIESTER, a river of southeastern Europe belonging to the basin of the Black sea. It rises on the northern slope of the Carpathian mountains in Poland, and for 150 mi from Zaleszczyki to Karmassy, where it forms a broad estuary as it flows into the Black sea. The Dniester drains an area of 29,670 sq mi. It is excessively meandering, and the current in most parts even during low water is decidedly rapid as compared with Russian rivers generally, the mean rate being calculated at 1 1/2 mi per hour. The average width of the channel is from 500 to 750 ft., but in some places it attains as much as 1,400 ft., the depth is various and changeable. The navigable portion of the river is interrupted by a granitic spur from the Carpathians which gives rise to the Yampol rapids. For ordinary river craft the passage of these rapids is rendered possible, but not free from danger, by a natural channel on the left side, and by a larger and deeper artificial channel on the right, for steamboats they form an insuperable barrier. The river falls into the sea by several arms, passing through a shallow lagoon a few miles southwest of Odessa. There are two periodical floods—the earlier and larger caused by the breaking up of the ice, and occurring in the latter part of February or in March, and the latter caused by the melting of the snows in the Carpathians, and taking place about June. The spring flood raises the level of the water 20 ft., and toward the mouth of the river submerges the gardens and vineyards of the adjacent country. In some years the general state of the water is so low that navigation is possible only for three or four weeks, while in other years it is so high that navigation continues without interruption, but considerable improvements were effected before World War I at government expense. In consequence the traffic increased,

the Dniester used to tip regions of great productivity, especially in cereals and timber. Steamboat traffic was introduced in the lower reaches in 1840. The fisheries of the lower course and of the estuary are of considerable importance, and these together with those of the lakes which are formed by the inundations, furnish a valuable addition to the diet of the people in the shape of carp, pike, tench, salmon, sturgeon and eels.

The tributaries of the Dniester are numerous, but not of individual importance.

DO, in music the first of the sol-fa syllables, or sound names for the notes of the scale; this syllable having been substituted, as being more sonorous, for *Ut*, which was originally the first of these syllables—*ut, re, mi, etc.*—as chosen in the 11th century by Guido d'Arezzo when he devised his system of solmization. Hence in the Tonic Sol-fa system, based on what is called the "movable *do*," *do* is the tonic of whatever key may be employed, whereas in the systems employing the "fixed *do*" it is invariably C.

DOAB, a name applied in India according to its derivation (*do*, two and *ab*, river), to the stretch of country lying between any two rivers as the Bari Doab between the Sutlej and the Ravi the Rechna Doab between the Ravi and the Chenab, the Jech Doab between the Chenab and Jhelum and the Sind Sagar Doab between the Jhelum and the Indus, but frequently employed, without any distinctive adjunct, as the proper name for the region between the Ganges and its great tributary the Jumna.

DOBBS FERRY, a village of Westchester county, New York on the east bank of the Hudson river, opposite the northern end of the Palisades, 20 mi N of New York city. It is served by the New York Central railroad. Population (1950) 6,246, (1940) 5,883 by the federal census. The Masters school is operated as a private girls' school there together with the Children's Village. Electrical appliances are manufactured and there are several publishing concerns. It is a typical commuters' neighbourhood with fine country homes. In 1775 Jeremiah Dobbs a Swede (probably from Delaware) began operating a skiff ferry there, which was kept up by his family for a century. During the Revolution fortifications were erected, and the village was a rendezvous for the British army after the battle of White Plains and for an American division in Jan. 1777. Washington's army encamped near by on July 4, 1781 and started thence for Yorktown the following month. In the Van Brugh Livingston house, on May 6, 1783, George Washington and Gov. De Witt Clinton met Gen. Sir Guy Carleton to negotiate for the evacuation of the posts still held by the British.

The village was incorporated in 1873, as Greenburgh, but the original name was soon resumed.

DOBELL, BERTRAM (1842-1914) English bookseller and man of letters, the discoverer of the poet Thomas Traherne, was born at Bittle, Sussex. In 1866 he set up business as a book-seller on a capital of £10, and in 1887 moved to Charing Cross road, where his shop became famous and his catalogues interesting for their literary gossip. Dobell met James Thomson in 1876, and helped him from that time to his death, in 1895 he edited the *Poetical Works* of his friend, with a memoir. His literary work also included the publication of much useful work on Percy Bysshe Shelley and Charles Lamb.

After his death some volumes of his verse containing some admirable sonnets were issued by his son. But his reputation rests chiefly on the identification of Thomas Traherne (q.v.), whose *Poetical Works* he edited in 1903. He died at Hampstead Dec. 14, 1914.

See S. Bradbury, *Bertram Dobell* (1909).

DOBELL, SYDNEY THOMPSON (1824-1874), English poet and critic was born at Cranbrook, Kent. His father was a wine merchant, his mother a daughter of Samuel Thompson (1766-1817), a London political reformer. The family moved to Cheltenham when Dobell was 12 years old. He was educated privately and never attended either school or university. An acquaintance with James Stansfeld (subsequently imprisoned) and with the Birmingham preacher politician, George Dawson (1793-61), which afterwards led to the foundation of the Society of the Friends of Italy, fed the young enthusiast's ardour for the liberal

ism of the day. Meanwhile, Dobell wrote a number of minor poems, instinct with a passionate desire for political reform. *The Roman* appeared in 1850, under the nom de plume of "Sydney Yendys." His second long poem, *Balder*, appeared in 1854. The three following years were spent in Scotland. Perhaps his closest friend at this time was Alexander Smith, in company with whom he published, in 1855, a number of sonnets on the Crimean War, which were followed by a volume on *England in Time of War*. He died on Aug. 22, 1874.

As a poet Dobell belongs to the "spasmodic school," as it was named by William Ayton, who parodied its style in *Furnham*. The epithet, however, was first applied by Thomas Carlyle to Lord Byron. The school includes George Gilfillan, Philip James Bailey, John Styan Bayly (1846-65), Dobell, Alexander Smith, and according to some critics, Gerold Massey. It was characterized by an undercurrent of discontent with the mystery of existence, by vain effort, unrewarded struggle and sceptical unrest.

The standard edition of his *Poems* (1875) includes a memoir by John Nichol, who also edited a collection of his prose writings under the title *Thoughts on Art, Philosophy and Religion* (1876).

DOBELN, a town of Germany, in the Land of Saxony, on the (Freiberg) Mulde two arms of which embrace the town as an island, 35 mi S.E. of Leipzig by rail, and at the junction of lines to Dresden, Chemnitz, Riesa and Oschatz. Pop. (1959) 25,048. The Nikolai kirche dating in its present form from 1485, a medieval town hall, a former Benedictine nunnery and a monument to Martin Luther are notable. The industries include wool spinning, iron founding, carriage, agricultural implement, and metal printing and stamping work.

DOBERAN, a town and watering place in the Land of Mecklenburg, Germany, lying about 2 mi from the shores of the Baltic and 7 mi W of Rostock by rail. Population 5,570. Besides the ruins of a Cistercian abbey founded by Pribislavus prince of Mecklenburg in 1173 and secularized in 1552, it possesses an Evangelical Gothic church of the 14th century, one of the finest in north Germany; a palace, a theatre, an exchange and a concert hall. Because of its delightful situation amid beech forests and its chalybeate waters, Dobern has become a favourite summer resort. In 1793 Duke Frederick Francis caused the first seaside watering place in Germany to be established on the neighbouring coast, 4 mi distant, at the spot where the Heiligen Damm, a great bank of rocks about 1,000 ft broad and 15 ft high, stretches out into the sea and forms an excellent bathing ground.

DOBLIN, ALFRED (1878-), was born at Stettin on Aug. 10, 1878. After studying in Berlin and Freiburg, he settled in Berlin as a practising doctor. His principal works are *Der schwarze Vorhang* (written 1902-03, pub. 1919), *Die drei Sprünge des Wang-lin* (a romance of China, 1915), *Wallenstein* (historical novel, 1920), *Berge, Meere und Giganten* (a tale of primitive life, 1924) and *Berlin Alexanderplatz* (1929). In these works he combines an epic force of expression with an extremely vivid narrative style. Less important are *Wladislaw Kampf mit der Dampfturbinen* (1918), *Der deutsche Maskenball* (essays, 1921), *Reise in Polen* (an appreciative travel book, 1926), *Amnos* (poem, 1927), *Das Ich über der Natur* (1927), *Babylonische Wanderung* (1934), *Pardon wird nicht gegeben* (1935, Eng. tr. 1937), *Die deutsche Literatur* (essay, 1938), and *Nochturno* (1944).

DOBRENTSI, GABOR (GABRIEL) (1878-1951), Hungarian philologist and antiquary, was born at Nagyszollos. He completed his studies at the universities of Wittenberg and Leipzig, and became a tutor in Transylvania. In 1820 Dobrentsi settled at Budapest, where he held various official posts, and there he spent the rest of his life. His great work is the *Ancient Monuments of the Magyar Language* (*Régi Magyar Nyelvmélték*, 1838 seq.).

Dobrentsi, one of the organizers of the Hungarian Academy, died near Budapest, on March 28, 1951.

DOBRICI (or BAZARGIC) capital of the department of Calicut, southern Dobruja, Rumania. Population 29,938. Dobrici is the centre of a postal district, and has a large annual fair for cattle, horses and sheep.

The small ports of Balcik and Cavarna are situated about 15 mi away, on the Black sea. The population of the district is very mixed, including Turks, Bulgars, Circassians and Tatars, Gagauz and many gypsies

DOBROVSKY, JOSEPH (1753-1829), Hungarian philologist, was born of Bohemian parentage at Gjermet, near Raab, Hungary, and studied at Prague. In 1772 he joined the Jesuits at Brunn, but on the dissolution of the order in 1773 returned to Prague to study theology, and became tutor in the family of Count Nostitz. In 1792 he was commissioned by the Bohemian Academy of Sciences to visit Stockholm, Abo, Petersburg and Moscow in search of the manuscripts which had been scattered by the Thirty Years' War, and on his return he accompanied Count Nostitz to Switzerland and Italy. Dobrovsky was the real founder of modern Slavonic studies, and the originator of the revival of Czech as a literary language. His grammar and dictionary provided the basis for modern Czech philology, and modern Czech speech. (See CZECH LANGUAGE AND LITERATURE)

The following is a list of his more important works, *Fragmentum Pragense evangelii S. Marci, vulgo autographi* (1780), *Scriptores rerum Bohemicarum* (2 vols, 1783), *Geschichte der böhm. Sprache und altern Literatur* (1793), *Die Bildsamkeit der slaw Sprache* (1799), *Institutiones linguae slavicae dialecti veteris* (1822), *Entwurf zu einem allgemeinen Etymologischen der slaw Sprachen* (1813), and a critical edition of Jordanes, *De rebus Getis*, for Pertz's *Monumenta Germaniae historica*. See Palacky, *J. Dobrovskys Leben und gelehrtes Wirken* (1833)

DOBRUJA (DOBROGEA), a region of southeast Rumania and northeast Bulgaria, bounded north and west by the Danube, east by the Black sea, and south by Bulgaria. Its area is 23,262 sq km, the population (1937) approximately 900,000. It comprises the four districts of Tulcea, Constanta, Durostor and Bazargic. It consists of low mountains, fens and sandy steppes, wind swept and drought ridden, but remarkably fertile when the lack of irrigation is considered. Its main port, Constanta, is Rumania's principal seaport, connected by a pipe line with the Rumanian oil-fields.

HISTORY

The district was known to the Greeks in the 6th century B.C. and included the Greek colonies of Istros, Tomi and Dionysopolis. In the 5th and 4th centuries B.C. invading Scythians subjugated and later submerged the Thracian population, whence the later names of Scythia Minor and Scythia Pontica. The Romans first invaded it 75-72 B.C., definitely subjecting it in A.D. 46. They and their successors the Byzantine emperors Romanized the population and erected walls for its defence, but it was repeatedly overrun by Goths, Alans and Huns.

In A.D. 678 Asparuch, Khan of the Bulgarians, settled with his horde, by permission of the Byzantine empire, near the present Nicolai, but soon repudiated his allegiance and founded the first Bulgarian empire, which included the Dobruja, with its mixed population of Slavs, Bulgars and the remnants of the old Roman colonies. It was recovered for Byzantium in 1018, but in 1186 reverted to the second Bulgarian empire, established by the alliance of Bulgars, Vlachs and Cumans. Magyars, Petchenegs and Cumans had repeatedly ravaged it, the two last named settling there in such numbers that it was known as Petchengia. In the 13th century the Tatars frequently raided it. With the decline of the Bulgarian empire, one Dobrotitch, a condottiere of Wallachian origin, founded here an independent, or at least semi-autonomous deponate, the name Dobruja derives either from Dobrotitch or from the Topruch Tatars. In 1390 it passed under the suzerainty of Mircea-Voda, Voivode of Wallachia, but after several capitulations to the Turks (1397, 1393, finally in 1411) it came under Turkish domination for nearly 500 years. These years brought a further ethnical change, numbers of Turks, Tatars and Circassians being settled in the steppes.

The Treaty of Berlin (July 13, 1878) assigned the Dobruja to Rumania, in compensation for Bessarabia, annexed by Russia. The Treaty of Bucharest (Aug. 10, 1913) advanced the frontier 30m southward, the two districts of Bazargic and Durostor being ceded to Rumania by Bulgaria. The Central Powers annexed the

entire province under the Treaty of Bucharest (May 7, 1918), the southern half was ceded immediately to Bulgaria, the northern administered provisionally by the Central Powers in condominium, while Rumania was allowed to retain the port of Constanta (Kustenej) as an outlet to the Black sea. The Treaty of Neuilly (Nov. 27, 1919), restored the 1913 frontier, leaving the entire province to Rumania. The Treaty of Craiova in Sept. 1940, restored southern Dobruja to Bulgaria. The territory ceded was about 7,600 sq km or a third of the whole area (population, 350,000), made up largely of the districts of Durostor and Bazargic. This fertile quadrilateral contains the important port of Silistra on the Danube and of Balchik on the Black sea. The territory ceded was occupied by Bulgarian troops on Sept. 30. The Rumanians living in the region were to be exchanged for Bulgarians living in the northern Dobruja. Thus the frontier of 1912 was restored. (N. L. F. H. Ko)

DOBŠINA, a small town of central Slovakia in the Triassic limestone "karst" zone of the Carpathians near the Gollnitz valley. Founded by German miners in the 14th century as a result of the wealth of the surrounding mountains in iron, cobalt, copper and mercury, it is now mainly famous for the existence about 3 km N.W. of the town of a cavern containing an icefield, nearly 2 ac in area, with remarkable formations. Pop. (1930) 4,683.

DOBSON, FRANK (1837-), British sculptor, was born in London on Nov. 18, 1837. His early training was under W. Reynolds Stephens, later he obtained a scholarship at Hospitalfield, Arbroath, New Brunswick. After study in the City and Guilds schools, London, he worked with the Cornish granite cutters. His works include "The Concertina Man," 1919 (stone), "Two Heads," 1921 (red Mansfield stone), "The Man Child," (Portland stone), "Figure of a Woman," 1924 (white marble), "Susanna" and "Morning," 1925, "Cornucopia," 1927 (Ham Hill stone), "Truth," 1930 (bronze), "Pax," 1935 (Portland stone) and "Source," 1944 (terra cotta). His portraits include "The Earl of Oxford and Asquith," 1921 (bronze), "Osbert Sitwell," 1923 (polished brass), "Lydia Lopokova," 1924 (bronze), "Head of a Young Girl," 1925 (plaster), "L. H. Myers," 1925, "Robert McAlmond," "Robin Sinclair" and "Tallulah Bankhead," 1927. In 1931 he designed and executed a series of panels in gilded faience on the river front of Hays wharf, London, illustrating "The Chain of Distribution." He designed the "Calix Majestatis" or Cup of Memory in silver gilt, which was presented to the crown for the palace of Holyroodhouse, Edinburgh, to commemorate the coronation of George VI and Queen Elizabeth in 1937. Examples of his work are in the Tate gallery, London, and the public art galleries in Manchester, Glasgow and Leeds. He helped found the X group, and was president of the London group (1923-7). He was elected A.R.B.S. 1938, and A.R.A. in 1942. (H. Hd)

See Roger Fry in *The Burlington Magazine*, vol. 45, p. 171 (1925), Clive Bell in *The Architectural Review*, vol. 59, p. 126 (1926).

DOBSON, HENRY AUSTIN (1840-1921), English poet and man of letters, was born at Plymouth and educated at Beaumans, Coventry, and the Strasbourg gymnasium. In Dec. 1856 he entered the board of trade, and from 1884 to 1901, when he retired, was a principal clerk in the marine department of that office. In 1873 he collected the poems which had appeared in various periodicals in a volume entitled *Vignettes in Rhyme*. In 1875 appeared *A Sign of the Lyre*, which contained "The Ladies of St. James's," "The Old Sedan Chair," "My Books," and the delightful "Fables of Literature and Art." The book has the flavour of the 18th century which Dobson loved so well, and of which he has left exquisite pictures in prose as well as in verse. Dobson led the movement in the late '70s for the introduction of French forms, the ballade, the triolet, and the rondeau, forms which he used in his *Proverbs in Porcelain* (1877), *Vignettes in Rhyme* and *Proverbs in Porcelain*, combined in one volume, were printed in the United States as *Vignettes in Rhyme* (1880), and with some additions as *Old World Idylls* (1883) in England. After 1885 Dobson was engaged principally upon critical and biographical prose. His biographies of *Fielding* (1883), *Bewick* (1884), *Steele* (1886), *Goldsmith* (1888), *Walpole* (1890), *Hogarth* (1893-98), *Samuel Richardson* (1902), and *Fanny Burney* (1903) are studies marked

alike by assiduous research, sympathetic presentation and sound criticism. Dobson always added something, and often a great deal, to our positive knowledge of the subject in question, his work as a critic never being solely rethoric. *Four Frenchwomen* (1890) the three series of *Eighteenth Century Ignatius* (189–96) and *The Paladin of Philanthropy* (1899) contain unquestionably his most delicate prose work. In 1907 he collected his hitherto unpublished poems in a volume entitled *Carmine Latina*.

See Alban Dobson, *Alban Dobson: Some Notes* (1918), A. Dobson, *Bibliography of the First Editions* (London, 1925).

DOBSON, WILLIAM (1810–1866), English portrait painter, was born in London and by tradition became Van Dyck's protégé. He succeeded him as sergeant painter to Charles I, whom he attended at Oxford. Of all English painters he came nearest to Van Dyck in handling and in courtly, Cavalier spirit. He also shows Venetian influence doubtless acquired from the Royal collection. Portraits by him are in the National Portrait gallery and the National gallery, London, and at Windsor, his best are in country houses.

See C. H. Collins Baker *Life and the Stuart Portrait Painters* (Boston, 1912), C. H. C. Baker and W. G. Constable, *English Paintings of the Seventeenth and Eighteenth Centuries* (New York, London, 1910), O. Millar *William Dobson* (London, 1951). (C. H. C. B.)

DOBSON FLY, insects, of the family *Cordilidae* allied to the alder flies (*q.v.*) and inhabiting North and South America, Asia, Australia and Africa. The males are remarkable for their large jaws. Dobson flies are placed in the suborder Megaloptera, order Neuroptera (*q.v.*). The larvae are aquatic.

DOCEŦAE, a name applied to those thinkers in the early Christian Church who held that Christ, during his life, had not a real or natural but only an apparent (*dokein* to appear) or phantom body. The name is first used by Theodoret (*Ep.* 82) as a general description and by Hippolytus (*Philosophumena*, viii, 5–11). Clement of Alexandria and others use the name of a distinct sect. It must, however, be regarded as a type of Christology. The origin of the heresy is to be sought in Greek Alexandrine and oriental speculations about the imperfection or rather the essential impurity of matter. Traces of a Jewish Docetism are to be found in Philo, and in the Christian form it is generally supposed to be combated in the Johannine Epistles (I ii 22 iv, v 6 10, II 7) and more formally in the epistles of Ignatius (*Ad Trall.* 9 f., *Id Smyrn.* 2, 4, *Ad Ephes.* 7, *q.v.* Polycarp *Ad Phil.* 7). It differed much in its complexion according to the points of view adopted by the different authors. Among the Gnostics and Manichaeans it existed in its most developed type, and in a milder form it is to be found even in the writings of the orthodox teachers.

The more thoroughgoing Docetae assumed the position that Christ was born without any participation of matter, and that all the acts and sufferings of his human life including the crucifixion were only apparent. They denied accordingly, the resurrection and the ascent into heaven. To this class belonged Docetism Saturninus, Cerdo Marcion and their followers, the Ophites Manichaeans and others. Marcion, for example, regarded the body of Christ merely as an "umbra" or "phantasma." His denial (because of his abhorrence of the world) that Jesus was born or subjected to human development is in striking contrast with the value which he sets on Christ's death on the cross. The other or milder school of Docetae attributed to Christ an ethereal and heavenly instead of a truly human body. Among these were Valentinus, Bardesanes, Basilides Tatian and their followers. They varied in their estimation of the share which this body had in the real actions and sufferings of Christ. Docetism springs from the same roots as Gnosticism (*q.v.*).

DOCHMIAC (Gr *δοχμια*, "a hand's breadth"), a form of verse, consisting of *dochmus* or pentasyllabic feet (usually *-u-u-u-u*) in English "rēbēl, slāves rēbēl."

DOCK, in botany, the name applied to the plants constituting a section of the genus *Rumex*, family Polygonaceae. They are annual or perennial herbs with a stout root stock and glabrous linear lanceolate or oblong lanceolate leaves with a rounded, obtuse or hollowed base and a more or less wavy or crisped margin. The flowers are arranged in more or less crowded whorls, the

whole forming a panicle, they are generally perfect, with six sepals, six stamens and a three sided ovary bearing three styles with much divided stigmas. The fruit is a triangular nut enveloped in the three enlarged leathery inner sepals, one or all of which bear a tubercle. In the common or broad-leaved dock *Rumex obtusifolius*, the flower stem is erect, branching and 18 in. to 3 ft. high, with large radical leaves, heart shaped at the base and more or less blunt, the other leaves are more pointed and have shorter stalks. The whorls are many flowered, close to the stem and mostly leafless. The flowers appear from June to August. In autumn the whole plant may become a bright red colour. It is a troublesome weed, common by roadsides and in waste places fields and pastures, where it is often accidentally introduced with clover and grass seeds. The great water dock *R. hydrolapathum*, is a tall growing species. Other British species are *R. crispus*, *R. conglomeratus*, the root of which has been employed in dyeing, *R. sanguineus* (bloody dock, or bloodwort), *R. pulcher* (fiddle dock), with fiddle shaped leaves, *R. maritimus*. The naturalized species, *R. alpinus*, or monk's rhubarb, was early cultivated in Great Britain and was accounted an excellent remedy for ague.

Thirty or more species occur in North America, widely distributed in the United States and Canada about one third of which are naturalized from the old world. The roots of the canigre (*R. hymenosepalus*) native to the southwestern United States and Mexico have been used for tanning.

The flesh, solid part of an animal's tail is also known as "dock" (*cf.* Icel *docke*, stumpy tail, Ger *Docke*, bundle, skein). The verb "to dock," especially in reference to horses and dogs, is used of the shortening of an animal's tail by severing one or more of the vertebrae. The English Kennel club (rules, 1927) disqualifies from prize winning dogs whose tails have been docked, with the exception of varieties of terriers spaniels, etc., and such other breeds as may be determined by the committee.

The prisoners dock a nailed in enclosure in which prisoners are placed during trial is apparently derived from Flm *dok*, pun or hutch. It occurs in 1610 as "brul dock, a room at the Old Bailey left open at the top."

DOCKS. The term "docks" is applied to the berthing spaces for ships and includes two classes dry docks and wet docks. Dry docks are used for the building and repair of ships out of water. They may be fixed or floating dry docks. Fixed dry docks are commonly known as graving docks. Floating dry docks although of various types, are so classified generally but because of their characteristics require further classification and detail of their structure and functions. Floating dry docks are described later in this article.

Wet docks may be natural or dredged inlets or dredged spaces along shore lines or river banks, usually flanked by wharves or platforms to facilitate loading or discharging cargoes of vessels. Such wharves, if parallel to the shore, are marginal wharves and are generally known as quays. If built into the stream or fairway at right angles or oblique to the shore they are generally known as piers. Wharves, quays and piers are integral and component parts of wet docks. The aggregate of dock structures including all appurtenances such as service, storage and administration buildings, cargo handling machinery and transportation facilities constitute a port and is so designated, as for example the port of Southampton, the port of New York and the port of San Francisco.

Where a large range of tide exists, more than 15 ft., large basins for harbour facilities are usually totally enclosed and provided with gates to maintain a uniform depth of water. The gates are closed when the tide begins to fall, as at Liverpool and Le Havre. Such basins surrounded by dikes breakwaters, quay walls or bulkheads are referred to as closed docks and are vulnerable in time of war. At river and seacoast ports with less range of tides such as Glasgow, Rouen, New York City and San Francisco dock gates are not used. There the ocean basins and river basins serve as wet docks and also provide for temporary anchorage of ships awaiting dockage. The tendency is to provide tidal berths wherever the tidal range does not exceed 7.5 feet. Floating

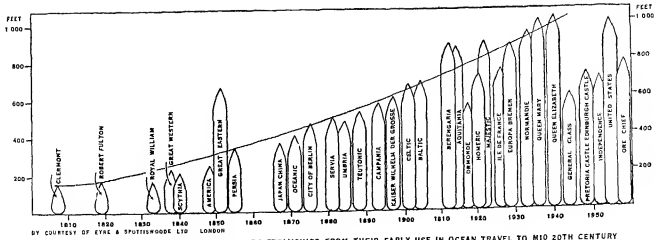


Fig 1—PROGRESSIVE INCREASE IN LENGTH OF STEAMSHIPS FROM THEIR EARLY USE IN OCEAN TRAVEL TO MID 20TH CENTURY

wharves which rise and fall with the tide have been used successfully passengers and cargo being discharged over movable transfer bridges hinged at a fixed shore quay. The intervening water affords space for barge transport. In tideless seas such as the Mediterranean, the discharging rivers (e.g., the Rhone and the Tiber) become barred by deltas at their outlets. Ports have often been established on coasts of such seas by open basins protected by breakwaters, as at Marseilles, Genoa and Naples. Frequent dredging is usually needed to keep the channels open. Where excessive silting and accumulation of littoral drift from tributaries occurs reservoirs are built to conserve the river water for sluicing the obstructions at the harbour mouth, as at the port of Dover, Eng.

The present article is concerned with the comprehensive subject of docks and integrates brief descriptions of wet and dry docks, slipways, basins and their approaches, locks and entrances, quay walls, piers and wharves, caissons, equipment and machinery and cargo handling methods.

Scope of Dock Facilities.—The frequent use of a geographical location as a point of embarkation gives rise to improved conveniences for moorings and handling of passengers and cargoes. The interchange of commerce and persons as traffic increases between such locations requires substantial docks, and the operation of modern docks is possible only through the provision of pertinent facilities such as roads, railways, canals, channels and other means of transportation. The growth of fast air transport for passengers and valuable or perishable goods become so extensive that provisions for seaplane bases and inland airports had to be provided for the landing, take off and transfer of cargoes. The economic direction of these accessory facilities led to the establishment of port administrations to correlate these interrelated functions. As a result, most large ports came to be administered by public boards known as port authorities, charged with the promotion, development and maintenance of not only the interrelated services but, in addition, the approach facilities such as highways, bridges and terminals in the contiguous areas.

History.—The story of docks begins with the earliest knowledge of water transportation of men and materials. Such transportation is implied in the earliest phases of historical research, which, for example, uncovered evidence of bronze made in Egypt about 3500 B.C., the nearest source of its essential element, tin, being in England. The navigators of the island of Crete were credited as being the first to establish sea trade routes to Spain and England from the island ports of Knossos and Mesara about 1600 B.C.

The Phoenicians, who doubtless had gained much of their maritime knowledge from the Cretans, formed the thriving trade centres of Tyre and Sidon about 2700 B.C. and became contemporary traders. The earliest known Egyptian port, a predecessor of the modern port of Alexandria, was a Phoenician trading port. Its ruins have been traced as far back as 3000 B.C. The merchant princes of Tyre and Sidon, through their promotion of the forest products of Lebanon, grew rich by exploiting the wealth of Egypt,

Persia and Syria and became at once the envy and target of the less prosperous Mediterranean traders. By 1500 B.C. their commercial trade had extended to Cadiz. Sp. Their harbour works were built of massive stone blocks bonded together and pinned with iron dowels set in lead. Tyre whose prosperity was unattained by sound economic and defense planning was besieged by Nebuchadnezzar, king of Babylon, in the 6th century B.C. The second city of Tyre and the original city of Sidon were destroyed by Alexander the Great in 332 B.C. The Phoenicians, however, continued to establish harbours in Sicily, Sardinia, Spain and Africa. Of these the harbour of Carthage was most famous for advance in planning with its massive structure and unique radial alignment of quays. Carthage prospered as a commercial port until destroyed by the Romans in 146 B.C., it was revived under Roman and Byzantine rule and finally destroyed by the Arabs in A.D. 698, when it virtually disappeared from history.

After the destruction of Tyre and Sidon in 332 B.C. Alexander the Great founded a city and a port on the ruins of the Cretan port at Pharos between Lake Marouti and the Mediterranean. It constituted the beginning of the modern port of Alexandria, although little remains of its original structures. He utilized the island of Pharos which was later extended to form a peninsula of the mainland, creating a great harbour northeast and a southern harbour. At the easterly head of the island stood an ancient light house called Pharos of Alexandria which was accepted as one of the seven wonders of the ancient world. It was built by Ptolemy Philadelphus about 200 B.C., inscribed 'King Ptolemy to the gods the saviours, for the benefit of sailors,' and mounted a continuous fire at its top. It was partially destroyed about A.D. 400 and levelled by earthquake in 1375.

The ancient Grecian port of Peiræus (330 B.C.) was a natural harbour and centre of trade for North Africa and the Aegean ports. A communicating wall 25 mi. long and 60 ft. high joined Athens and Peiræus, and the area was fortified against attack. The Colossus of Rhodes, a bronze statue of Apollo, variously reported 100 to 125 ft. high, stood on the island of Rhodes from 280 to 224 B.C. It was recognized as another of the seven wonders of the ancient world, serving as a lighthouse and landmark for travellers by sea and land until destroyed by an earthquake.

The legends of antiquity are replete with evidences of maritime activity. During the reign of King Solomon of Israel, Parian marble cut for the building of the temple in Jerusalem was conveyed to Joppa. Biblical lore and the commentaries of the early Christian era refer to periodic journeys of Joseph of Arimathea, a merchant and artificer in metals, to England in quest of tin. These commercial activities marked the early use of primitive port facilities in the British Isles.

The Rom port of Ostia and the several ports in the Bay of Naples were characterized by massive construction embellished with towers and colonnades of architectural grandeur seldom repeated. The port of Ostia was protected by breakwaters of arched alignment, each section terminating opposite a central

island, leaving entrance and exit ship channels as access to the enclosed harbour. Until about A.D. 500 the art of constructing harbour works and foundations below tidewater consisted of dropping huge stones into the sea to form mounds which when

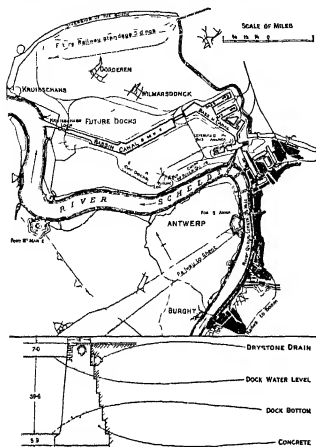


FIG 2—GENERAL PLAN OF THE PORT OF ANTWERP, BELG. AND INSET OF A TYPICAL CROSS SECTION OF THE QUAY WALLS IN THE BASIN CANAL.

roughly levelled formed a base for the more regular quarried stone. The early moles, breakwaters and quays were founded in that manner. It was not until 250 B.C. when Archimedes expounded his principles of specific gravity and the lever that the more modern developments in harbour structures were attempted. It was reserved for the Romans in the reconstruction and development of harbours to employ solid masonry founded on piles as at Ostia on the Tiber. Prior to that time such stone harbour works as were constructed were of massive quarried blocks bonded or fastened with dowels and the interstices filled with small stones or gravel. The first evidence of hydraulic cement has been noted in the Roman walls or breakwaters. Harbour development remained static for nearly 1,000 years until military needs and the advance of shipbuilding and maritime commerce dictated its progress.

Later Progress in Dock Construction.—Modern progress in dock building had its early beginning in the ports of Europe and the British Isles with the Anglo-Saxon migrations from the continent to Dover, the Norse explorations, the Norman conquest of England and explorations of the western hemisphere by Christopher Columbus, the Cabots, Ferdinand Magellan and others from 1492 well into the 18th century.

Early records mention an artificial channel, called the "Trench," cut from the river Frome into the Avon at Bristol, Eng., in the year 1247. It contained quays and wharves along its banks which became the origin of the modern port of Bristol. From its quay, John Cabot set forth in 1497 on his voyage which resulted in the discovery of Cape Breton Island and Labrador.

An elementary form of dry dock was fashioned at Southampton,

Eng., in 1434. It utilized a narrow bay in which a ship was placed at high tide. As the tide fell, the area was closed by a temporary wall of clay timber and brushwood. Later in 1496 a permanent dry dock with primitive gates caulked with clay was built at Portsmouth. While large enough to take the biggest warship of the time, it was enlarged in 1523 and again in 1656. By the middle of the 17th century, numerous dry docks were in service both in English and continental ports and at important shipping centres throughout the world.

Communication between Dover, the nearest English port to France, and the continent of Europe has been traced back to 300 years before the Roman invasion of Britain. The *Commentaries* of Julius Caesar referred to Dover as the "haven between the hills." Henry VIII, following his departure from Dover to meet the French king in 1520, ordered the building of a long pier to serve as a breakwater to protect the harbour. It was never completed and was not high enough above low water to avoid formation of long sand bars along the harbour front.

Not until the beginning of the 19th century did systematic dock construction and building begin to follow closely the demands of steady shipbuilding and marine transport developments. Heavy stone sea walls and extensive open wharf timber construction founded on wood piles were general in this period and remained so until the development of steel piles and reinforced concrete on a commercial basis about 1900. Along the eastern and western seaboard of the United States, timbermen from Norway, Sweden, Canada, Newfoundland and the forests of Maine and Oregon became dominant in the dock builders' fraternity. After 1910, however, with the use of steel bearing piles, steel sheet piles and reinforced concrete, dock construction experienced an evolution because of the increased depths required for berthing ships. The cellular cofferdam type of quay wall formed of steel sheet cells filled with earth and clay was first utilized at Black Hawk harbour at Buffalo, N.Y., in 1909. Thereafter the principle was variously adopted for pier and wharf construction, notably at New York city municipal pier in the Hudson river in 1917, to provide for construction in the dry.

An extensive cellular quay wall construction was adapted to cargo-handling facilities at Sparrows Point, Md., and at the United States navy general cargo wharf at Guam in 1948. At the ore dock on the Cuyahoga river in the Great Lakes port of Cleveland, O., steel sheet cells 100 ft. in depth were employed in natural sandy and clay soils and provided for the loads of ore handling equipment in 1950. At that time, steel sheet pile cells were being adapted increasingly to varied conditions of soils and varied depths of penetration to 120 ft. below water. While cellular construction had been found to be most economical for heavy

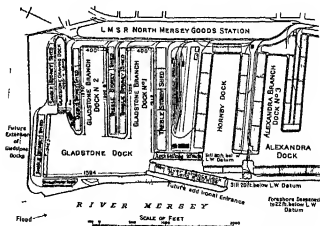


FIG 3—PLAN OF NORTHERN END OF DOCKS SYSTEM AT LIVERPOOL, ENG.

loading where great depths of soft clay were encountered, skill and experience were required in the operation to avoid poor alignment and excessive driving. Numerous variations of steel and concrete bearing piles found application where variety in soils and bearing conditions were encountered. The increasing

frequency of ship sailings demanded improved embarking facilities at points of origin. As longer voyages required larger and sturdier ships of deeper draught, the provisions for mooring and outfitting had to be improved correspondingly.

Dimensions of Shipping.—In designing new port works, it is essential to look forward to the possible future requirements of shipping. The necessity for such forethought was shown by the progressive increase in size not only of the largest ocean liners but also of cargo carrying ships. The 'City of Rome' launched in 1881, was 560 ft long, 52½ ft beam and had a maximum draught of 27½ ft. The 'Campania' and 'Lucania' of 1893 measured 600 by 65 ft. At the close of the 19th century a cargo vessel of more than 500 ft in length did not exist. The limiting draught of the Suez canal was 27 ft, and the largest merchant ship afloat, excepting those in the Atlantic trade, was 530 by 61 ft and had a 28 ft draught.

The period 1900-14 was marked by unusual advances in world wide shipping. In 1910 the largest merchant ship afloat was the 'Mauretania' of 31 938 gross tons, 762 ft long and 88 ft beam, but excluding transatlantic liners the largest cargo carrying ship did not exceed 13 000 tons. In 1914 merchant ships far exceeding the dimensions of the 'Mauretania' were either afloat or building. Harbour authorities were engaged in increasing facilities to serve shipping of far larger dimensions than any which hitherto had used their navigable waters.

Until 1930 no ship of greater dimensions than the largest of those building in 1914 was laid down. The dimensions of the 'Majestic' (formerly 'Bismarck'), laid down before World War I but not completed until 1921, were 56 551 gross tons, 915½ ft length, 100 ft beam and maximum draught 38.9 ft. The 'Leviathan' (formerly 'Vaterland') had been loaded to 41 ft draught. The 'Queen Mary', laid down in 1930 and launched in 1934, exceeded 1 000 ft in overall length, as did the 'Normandie', launched in 1933, and the 'Queen Elizabeth'. The latter two slightly exceeded the 'Queen Mary' in tonnage and dimensions, the 'Queen Elizabeth' being of about 84 000 gross tons.

In 1899 the largest general cargo vessel afloat had a gross tonnage of less than 8 000 and was 470 ft in length. By 1928 cargo ships more than 600 ft long and of 18 000 to 20 000 tons gross were in service, by 1939 there were 82 vessels entered in Lloyd's Register whose gross tonnage exceeded 20 000, 496 ships within the range of 10 000-20 000 tons were in regular service. In the period 1948-49 there were in service or building 96 steam turbine or motor driven tankers of dead-weight tonnages ranging from 21 000 to 33 000. Of these 66 tankers were of tonnages greater than 25 000 dead weight tons. The tanker 'Atlantic Seaman', launched at Camden, N.J. in 1950, was 659 ft long, almost as long as the U.S. carrier 'Saipan' (683½ ft), and had a beam of 85 ft and a draught of 34 ft. But by 1954 there were tankers approaching 800 ft in length and some with 102-ft beam. Displacement was up to 58 000 tons. An ore carrier 794 ft long, 116 ft beam and displacement of 75 000 to 80 000 tons was under construction and even larger bulk cargo carriers, to 135-ft beam, were being planned.

The progressive development of steam and motor driven ships which governed the evolution of harbour facilities is shown in Fig. 1. The increase in size of ships was the result of commercial rivalry between ocean passenger steamship lines for supremacy in speed and luxurious travel. The development of ocean air travel after World War II, however, had a tendency to discourage further building of superliners such as the 'Queen Elizabeth' and 'Queen Mary'. The growth in ship dimensions combined with the requirements of handling larger and heavier cargoes and

reducing the unproductive time that a ship remains in port, led to the extensive improvement of all port facilities.

Depth of Water.—The deepening and widening of the Suez canal enabled ships of the largest class to trade with eastern ports. By 1928 it was practicable for ships drawing 33 ft to pass through it, and in 1933 the depth over the entire canal was increased to 42 ft. Further improvements provided a surface width of 500 ft by 1953 and there was no reasonable limitation to the capacity of the canal. Important ports of the far east were developed concurrently. The opening in 1914 of the Panama canal having a navigable depth of 40 ft, also had an important bearing on the development of harbours in the far east and on the Pacific coast of America. Work was begun in 1940 on the construction of a third and larger set of locks in the Panama canal but more urgent demands of World War II for labour and materials forced its suspension in 1942.

In general, whereas in 1900 a navigable depth of 30 ft was considered ample, at least 35 ft was regarded later as essential in harbours of the first class and in special cases including the ports used by transatlantic liners, depths exceeding 40 ft and even up to 45 ft were required. The principal ports of the United States provide channel and berthing depths of 35 to 40 ft at mean low water. The berths in which floating dry docks operate are dredged to 50 ft of depth adjacent to their quay walls.

The cost of constructing port works is in general considered approximately proportional to the ratios of the cubes of the draughts of the ships for which they are designed. It is thus obvious that the problem of providing port accommodation for shipping of the largest class is one of considerable importance from the point of view of finance, and may become one of balance between the relative economy of ships of large draught and cargo capacity and the capital cost of port construction.

Sites for Docks.—Low lying land adjoining a tidal river or estuary frequently provides suitable sites for docks. The position being more or less inland is sheltered, the low level reduces the excavation required for forming the docks and enables the excavated materials to be utilized in raising the ground at the sides for quays. The river furnishes a sheltered approach channel. Notable instances are the docks at the ports of London, Belfast, Rotterdam, Boston, Philadelphia and Norfolk. Examples of docks partially formed on foreshores reclaimed from estuaries are Hull, Liverpool, Le Havre and New York. In the enlargement of the port of Antwerp a series of enclosed docks extending from Krusschans on the Scheldt 7 mi. below the city was constructed to the old dock system, cutting off a bend of the river (Fig. 2).

Occasionally when a tidal river has a shallow entrance docks formed on its foreshore adjoining the seacoast are provided with a sheltered entrance directly from the sea as in the Le Havre docks at the outlet of the Seine. Many old ports were first established on sandy coasts where a creek, maintained by the influx and efflux of the tide from low lying spaces near the shore, afforded

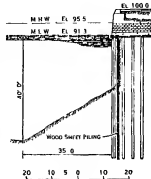


FIG. 4—QUAY WALL, NEW YORK CITY 1895

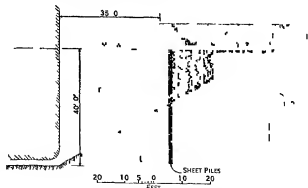


FIG. 5—U.S. NAVY ORDNANCE PIER 1895

some shelter and an outlet to the sea across the beach. Some of these such as Calus, Dunkirk and Ostend, had their access improved by parallel jetties and dredging. Docks have been readily formed in low-lying land separated only by sand dunes from the sea. (See HARBOURS.)

In the Mediterranean open basins have been formed in the sea by establishing quays along the foreshore from which wide, solid jetties, lined with quay walls, are carried into the sea at intervals at right angles to the shore. Such basins are sheltered by outlying breakwaters parallel to the coast and are reached at each end through the openings left between the projecting jetties and the breakwater, as at Marseilles and Trieste and the extensions at Genoa. In some of these ports additional accommodation has been obtained by constructing wide quays along the inner face of the breakwater (q 9). Where however the basins are formed within the partial protection of a bay, as in the old ports of Genoa and Naples, the requisite additional shelter has been provided by converging breakwaters across the opening of the bay, and an entrance to the port is left between the breakwaters.

The two deep arms of the sea at New York, known as the Hudson and East rivers, are so protected by Staten Island and Long Island that it has been necessary, only to form open basins by projecting jetties or piers into them at intervals from the west and east shores of Manhattan Island and from the New Jersey and Brooklyn shores, to provide adequate accommodation for Atlantic liners and the seagoing trade of New York. Somewhat similar conditions obtain in many of the great natural harbours in other parts of the world as for instance Sydney and San Francisco. In general, the docks of the Atlantic and Pacific sea ports of the United States are situated in natural harbours. The necessity for the construction of breakwaters, such as those of the Delaware river and Long Beach, Calif. is exceptional.

Dock Extensions—In designing dock works, it is expedient to make provision as far as possible for future extensions as the trade of the port increases. Generally this can be effected along side tidal rivers and estuaries by utilizing sites lower down the river or occupying foreshores of an estuary, as was done in the extensions of the ports of Liverpool, Boston, Philadelphia, Savannah and New Orleans. At ports on the seacoasts of tideless seas, it is necessary only to extend the outlying breakwater parallel to the shore line and form additional basins under its shelter, as at Marseilles and Genoa. Quays along rivers also furnish valuable opportunities for extending the accommodations of ports. Inland ports such as those of Manchester, Eng., Houston Tex. and Portland, Ore., convert an inland city into a seaport with an exceptionally sheltered harbour. Future extensions in most of these inland ports however, can be undertaken only at the expense of costly reclamation works.

Venice, being situated upon an island of limited area in a lagoon, secured the extension of its dock facilities by the construction of an entirely new port on the adjoining mainland. New

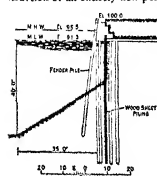


FIG 6 - QUAY WALL NEW YORK CITY 1896

York, in view of the congestion or traffic at the piers in the upper areas of the harbour, developed large districts such as Staten Island and Jamaica bay nearer the sea entrance.

Approach Channels—The accessibility of a port depends upon several factors, such as reefs, submerged ledges, harbour bars, navigation aids and the depth of its approach channel. The great increase in power and capacity of modern dredges and experience of suction dredges with cutting heads, together with the increasing draught of vessels, has resulted in considerable increase of channel depths leading to docks. It is necessary to make due allowance for the possibility of future improvement in the approach channel when determining the depth given to a new dock. On the other hand, there is an economic limit to the deepening of an approach channel depending upon its length, silting conditions and the demand upon the port for deep draught vessels. Any increase in depth is accompanied by a corresponding increase in maintenance cost. On the southern Atlantic seaboard of the U.S. the channels leading to

the river ports, in general, traverse ocean bars near the river mouths which require regular maintenance. The distances from the ocean floor at the channel depth are 8 mi. at Savannah, Ga., 7 mi. at Brunswick, Ga. and 8 mi. at Jacksonville, Fla., while Mobile, Ala., and New Orleans La., are 30 and 110 mi., respect

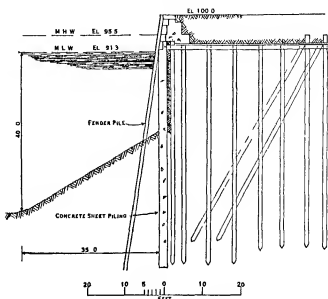


FIG 7 - QUAY WALL NEW YORK CITY 1910

tively, from the Gulf of Mexico. In the United States the approach channels are maintained by the federal government.

Tidal Ports—At tidal ports, the maximum available depth for vessels is determined by two standards. In English and European tidal ports the measurement is from high water of the lower neap tide, in U.S. ports, the measurement is referred to mean low tide, which is the average of all low tides on record (usually determined by the U.S. coast and geodetic survey). The period during which docks can be entered at each tide depends upon the nature of the approach channel, the extent of the tidal range and the manner in which the entrance to the docks is effected. Thus where the tidal range is very large as in the Bay of Fundy between Nova Scotia and New Brunswick and at Calais, Me. the approach channels to some of the ports are nearly dry at low water. The tide in Minas basin in the Bay of Fundy is 53 ft., while that at Calais is 20 to 23 ft. It would be impracticable to make these ports accessible near low tide except for small craft, whereas at high water vessels of large draught can enter the docks. Where possible, channels of sufficient depth should be and usually are provided to permit the access of large ships to the docks at all conditions of tide.

In European and British ports, however, where a large range of tides prevails and enclosed tidal basins and docks have been adopted, funnel shaped channels controlled by locks are provided between the entrance jetties or breakwaters and the dock entrances. Examples of this general practice with local modifications are found in Great Britain at King George V dock in the river Thames, the Gladstone dock at Liverpool and at Newport, Cardiff and Avonmouth. At entrance locks adjacent to a swift flowing river the locks and entrance channel are aligned at a small angle with the direction of the stream in order to counteract the tendency of large ships to get crosswise of the current.

Emergency Entrances—It is desirable though not always practical for economic reasons that a wet dock controlled by locks be provided with some alternate means of access. If there is no such provision a serious accident to the one lock or entrance might close it to traffic for a time and prevent ships already in the dock from leaving. In most of the Liverpool and London docks this risk is met by the construction of communication passages between adjoining docks so that in the event any lock or basin entrance is out of operation, some alternative entrance in another dock can

be utilized. Moreover, in busy and important docks, the building of an alternative entrance is often necessary for traffic reasons if delay to ships entering and leaving is to be avoided. It may be noted that the plans for the Gladstone wet dock provided for the future building of an entrance alongside the deep lock and of the same width (fig. 3).

At Le Havre and many other ports, a pair of gates in a tidal entrance alongside the main lock allows ships to enter and leave at high water if the lock is not working. At Barry (Wales) dock, the basin entrance is available if the lock cannot be used, and at Rosyth (Scott.) dockyard an emergency entrance closed by a sliding caisson is built alongside the entrance lock.

Dimensions of Dock Entrances and Locks.—The size of vessels which a port can admit depends upon the depth and width of the entrance to the docks, for, though the access of vessels is also governed by the depth of the approach channel, this channel is often capable of being further deepened by dredging. The solid structures of the dock entrance, on the other hand, cannot be adapted to the increasing dimensions of vessels except by troublesome and costly works sometimes amounting to reconstruction, as carried out at some of the London docks.

The width and depth of access to wet docks are in one way or more important than the length of locks. For gate entrances and also locks if both pairs of gates are opened at high water, impose no limitation as regards length on ships entering or leaving. This factor is of importance in the working of some old docks whose locks are of limited length but of ample width. It is, however, usual in modern dock construction to make a lock amply long for any ship whose beam or draught is not too large for the limiting dimensions of its entrance.

Open basins are generally given an ample width of entrance, and river quays are also always accessible to the longest and broadest ships which can navigate the channel leading to them. In a tidal port or river, however, the available depth in the berths has to be determined from the lowest low water of spring tides, instead of from the lowest high water of neap tides, if the vessels in the open basins and alongside river quays are to be always afloat.

Table I shows the controlling dimensions of typical docks and locks.

TABLE I.—Dimensions of Typical Docks and Locks

| Port | Name | Depth in dock at minimum water level | Locks | | | |
|-----------------|--------------------|--------------------------------------|---------------------|---------------------|-----------|-------|
| | | | Depth on outer sill | | Available | |
| | | | High water range | Low water spring | Length | Width |
| | | ft | ft | ft | ft | ft |
| Cardiff | Queen Alexandra | 40 | 12 | 5 | 850 | 90 |
| Avonmouth | Royal Edward | 30 | 35 | 4 | 875 | 100 |
| Swansea | King's dock | 20 | 37½ | 11½ | 875 | 90 |
| Le Havre | Florida lock | 40 | 35 | 17 | 855 | 68½ |
| Hull | King George | 35 | 37 | 31½ | 750 | 85 |
| Newport | Alexandra | 33 | 35 | 7 | 1,000 | 100 |
| Monmouth | South | 33 | 35 | 7 | 750 | 100 |
| Bombay | Alexandra | 38½ | 38½ | 39½ | 850 | 108½ |
| Rosyth | Dockyard lock | 38 | 30 | 37½ | 850 | 108½ |
| | Emergency entrance | | 38½ | 36 | | 121* |
| London | King George V | 38 | 41½ | 35 | 800 | 100 |
| Liverpool | Gladstone | 43 | 41 | 31 | 1,070 | 130 |
| Antwerp | Kruischans | 30½ | 47 | 34 | 885 | 114 |
| Tilbury | New lock | 38½ | 41 | 24½ | 1,000 | 110 |
| Calcutta | King George | 36 | 33 | 83 | 700 | 90 |
| North sea | | | | | | |
| Amsterdam canal | Ymuiden lock | | 51 | 46 | 1,312 | 164 |
| Bremerhaven | Northern | 16 | 47½ | 36 | 1,230 | 147½ |
| Dunkirk | New lock | 44 | 44 | 38 | 918 | 133 |

*At level of high water of neap tides.

†Can be increased to 910 ft if necessary by use of caisson at miter end.

Tideless Seas.—Ports on tideless seas have to be placed where deep water approaches the shore and, if possible, where there is an absence of littoral drift. The basins of such ports are always accessible for vessels of the draught they provide for, but they require efficient protection and, unlike tidal ports, they are not able on exceptional occasions to admit a vessel of larger draught than the basins have been formed to accommodate.

Inland Ports.—Numerous US ports situated on tidal rivers such as Brunswick, Houston and Savannah derive access to the sea by river channels which, although subject to habitual silting, are kept free for navigation by periodic dredging. In such cases,

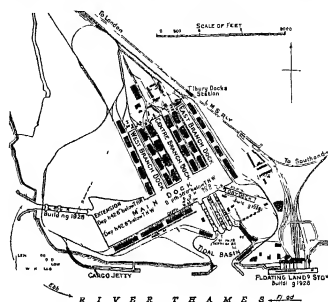


FIG. 8.—TILBURY DOCKS, PORT OF LONDON, 1929

sheltered open basins are maintained at intervals for manoeuvring of ships. An outstanding example of a river port is the Great Lakes port of Cleveland, where ore boats up to 600 ft in length negotiate tortuous bends in the river and continuous passage is accomplished despite numerous movable bridges. Because of the narrow confines of the river banks, numerous turning basins are provided by suitable quay wall construction and dredging.

DESIGN AND CONSTRUCTION OF DOCKS

Docks should be designed to provide maximum facility in the movement of ships, their cargoes and passengers. Many factors are involved, including such economic considerations as the immediate demand, probable growth of commerce and industry in the vicinity and the financial feasibility of the undertaking. The location should be co-ordinated with existing related facilities such as adjacent docks, highways, rail and air transport accommodations for freight and passengers. It also should conform to established comprehensive port and regional planning. Transit sheds and warehouses should have ready access to transportation facilities.

The physical characteristics of the site, the geological formations of the harbour bottom and its contours—whether of silt, sand, clay or rock—dictate the extent to which the site may be utilized. Borings and samplings of underlying soils afford a basis of evaluating foundation conditions and determining the form of construction to be adopted. Numerous failures of dock structures are of the nature of soil failures which could have been avoided by a better understanding of the behaviour of underlying soils such as is afforded by authoritative investigations of site conditions.

Aside from determining the dimensions of approaches, locks and entrances, the design of docks is concerned particularly with the enclosing shore structures. They embrace, in general, piers, wharves, quay walls and an imposing variety of cargo handling facilities, warehouses and utilities. Except where the related structures rest on independent foundations, their stability depends upon the strength and reliability of their quay walls. Numerous failures of dock walls have been accompanied by earth slides which could have been the cause or the effect of the failure, according to the character of the subsoil and the conditions of loading. The cause in the case of a deep-seated slide and the effect if limited to approximately the depth of the wall.

Even though dock walls may be of proper dimensions to with-

stand the combined pressures of free and normal surcharge the underlying soil may be so compressible that it will consolidate under the superimposed load causing the wall to settle or overturn. The overturning effect is a result of greater movement at the toe where the bearing pressure is greatest. Early warning of such movement indicated by misalignment at the top of the wall,

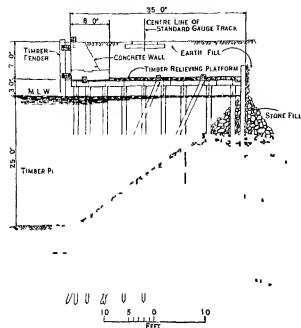


FIG 9—QUAY WALL SAVANNAH GA 1942

suggests remedial measures before the condition becomes irreparable. A notable example of such visible movement occurred at Chelsea creek in Boston harbour in 1910. The quay wall continued in limited use without alarming symptoms until loaded with a high embankment of coal which caused its complete destruction in 1920.

The variant and often indeterminate factors which enter into the design of docks are so numerous that rarely are there two situations alike. The design should be based upon a thorough examination of the site and subsoil exploration with tests on soil samples for permeability and compressibility.

The structural design of docks is governed not only by the physical limitations of the site and its exposure to the elements but also by numerous operating factors among which are (1) size of ship to be accommodated, (2) extent of cargo storage needed, (3) means of transportation, and (4) loads to be imposed upon the structure by operating conditions.

Construction—Numerous types of quay walls have evolved through the centuries, depending on materials available, depth of water alongside, progressive growth in size of ships and cargoes and economic use of labour and construction materials. Ancient massive masonry structures were replaced in modern times with open structures and steel sheet pile installations which substituted mechanical power for former mass labour concentrations. The quay walls ranged from hand placed stone on soft silt or clay bottom, supplemented by successive courses of stone as the walls settled, to modern walls supported by deep foundations penetrating the soft strata on hard bottoms. Typical examples showing the evolution of modern quay walls from 1895 to 1948 are shown in figs 4 to 10, inclusive.

Up to the last quarter of the 19th century masonry construction was adopted for the large majority of dock works such as quay walls and locks, and hydraulic lines to a limited extent filled the place later occupied by portland cement. The use of portland cement concrete for all kinds of port construction became almost universal, and its cheapness in comparison with the cost of dressed stone in the large majority of situations restricted the employment of the latter to such purposes as copings and sills and altar courses

in dry docks. Practically all naval docks built prior to 1905 were faced either throughout or on all finished surfaces with dressed stone usually granite. In the few exceptions however, the quay and dock walls were built of and faced with concrete, dressed granite being used only for copings, quoins, sills and similar work.

Reinforced concrete was first used in building jetties, wharves and other dock works about 1895, and its employment thereafter became general. In considerable measure it superseded timber in the building of open wharves, particularly in waters where marine borers such as the teredo and *Limnoria* are present. Rapid setting aluminous cement came into use on the continent of Europe about 1920 and its employment in Great Britain extended rapidly. Pozzolana and trass cements also are employed widely, usually in combination with portland cement.

Excavations for Docks—When a dock has to be made on land the excavation is performed by power driven shovels or excavators employed in preference to hand labour. For large excavations in light soil aerial dragline excavators and various forms of mechanical loaders and conveyors have found economic application. Frequently a large part of the interior excavation of a wet dock or basin is left to be dredged away by floating dredgers or grab buckets after the walls of the dock have been completed and water has been admitted to the area.

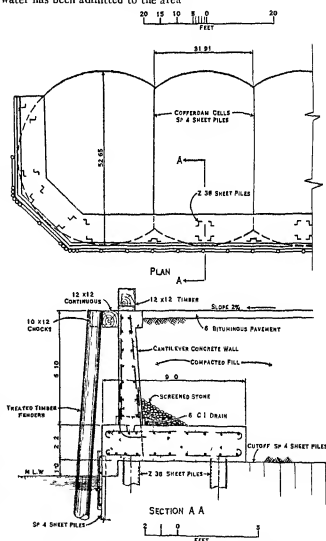


FIG 10—MARGINAL WHARF APRRA HARBOUR GUAM 1948

It is occasionally necessary to construct the lowest portions of dock walls with the water excluded by pumping from suction pits below the foundation level. A method of draining such working area is introduced in the Netherlands and Belgium was to sink filter wells at points outside the area which lowered the normal water level by pumping. Its more modern application, known as the

well point system, comprising perforated pipes connected in groups to one or more pumps, has been universally employed

In many cases a cofferdam has to be constructed, cutting off the entrance works from the river or harbour water. The coffer dam is removed when the works built within it have been completed. Where a dock is constructed partially or wholly on re-

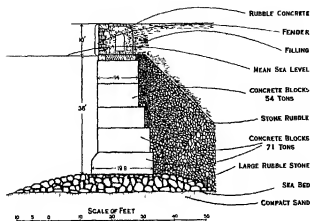


FIG 11—VITTORIO EMANUELE III BASIN QUAY WALLS AT GENOA IT

claimed land, a reclamation bank closing the site and excluding the tide is frequently employed to avoid the use of the more costly sheet pile cofferdam

In some cases, however, the wall forming the outer boundary of the dock has been built without extensive excavation by sinking concrete monoliths from temporary staging erected on the foreshore or sea bed (see fig 11). This plan was adopted to a partial extent in building the enclosing wall of Queen's dock on the Clyde in 1877, Rothesay (Scot) dock in 1904 and Rosyth dockyard basin (1909-15)

DOCK WALLS

Prior to 1900 docks and open basins usually were flanked either by solid upright walls or by wharves of open construction projecting seaward from the quay

The nature of the strata to be excavated and on which the walls are to be founded is ascertained by trial borings and, when practicable, by sinking trial pits. The nature of the foundation has an important bearing on the design of the wall and its method of construction. Ordinarily hard clay (such as boulder clay), compact gravel and sand, as well as most rocks, form excellent foundations. In these cases it is usually unnecessary to carry the base of the wall more than a few feet below the dock bottom, as indicated in fig 12. In less satisfactory ground, such as slippery clay and alluvial material and sand charged with water, however, the foundations may have to be carried down to a considerable depth and the base width increased. Timber bearing piles are sometimes driven to form a foundation for a wall. In other cases a trench has been dredged in the soft material along the line of wall and filled with ballast or stone or even coarse sand to improve the natural foundation.

In U.S. harbours along the Atlantic seaboard, where marine borers have not been prevalent, timber pile foundations upon which timber superstructures are built have been widely adopted. Examples of such timber quays are illustrated in fig 13. The circled letters in the figure refer to the following brief descriptions:

- A. Garrison Avenue, Bronx river, New York city. Front coiled piling filled with rnpap
- B. Harlem river, New York city. Three-inch sheet piling backed with rnpap. Anchor bents ten foot centres
- C. Echo bay, New Rochelle, N.Y. Close piling backed with rnpap. Bents 6 ft 6 in on centres
- D. Oak Point, N.Y.
- E. Hudson river, New York city. Rnpap embankment. Bents of platform ten feet on centres
- F. Astoria, I., N.Y., Astoria Light and Power Co. Crb filled with rubble pockets eight feet square formed by logs
- G. Hudson river, New York city, Interborough Rapid Transit Co.

Slope paved with tnpap. Bents five foot centres

H. Harlem river, 171st street, New York city. Four inch sheet piling, backfilled with rnpap. Guide piles five-foot centres, two anchor piles every ten-foot

I. Rockaway inlet, Barren Island, New York city. Bents ten foot centres, one brace pile to each

J. San Pedro, port of Los Angeles, Calif. Live load allowed 500 lb per square foot. Piles crossosot bents 15-ft centres

K. Missouri river, Kansas City, Mo. Timber and piles crossosot 536 ft long

L. Chicago, Ill., sanitary district. Standard sheet pile bulkhead

M. New York, navy yard, 1912. Platform with six-inch sheet piling. In many cases the firm foundation or rock bottom occurs at

slight depth below the channel bottom, precluding the further driving of wood piles. This difficulty has been met by depositing rnpap or large random rock to depth sufficient to provide the necessary support to the pile structure and by employing a combination of masonry, concrete and timber designs as indicated in fig 14. The key letters of fig 14 refer to the following specific locations and details

A. Savannah, Ga. Twelve-inch reinforced-concrete wall on timber piles, 15 ft 6 in on centres, reinforced concrete deck slab. Live load 600 lb

B. Brooklyn, N.Y., Gowanus canal. Timber platform, with concrete wall on piles and rnpap

C. Chicago, Ill. Plan for bulkhead wall alongside long pier

D. San Diego, Calif. 2,675 ft long. Concrete-incaised piles on seven-foot centres

E. Iloilo, Phil. Cylinders on 12 ft centres. Reinforced concrete on timber piles

F. Chicago, Ill. Long pier bulkhead

G. Charleston, S.C. 4,000 ft long. Untreated timber piles, sheet piling and concrete wall. Reinforced concrete sheet piling, three feet wide, to protect timber work from marine borers

H. New York (South Brooklyn), N.Y. One of several types of wall used by department of docks and ferries

I. Boston, Mass., Northern avenue, Commonwealth pier. Length 645 ft

J. Schenectady, N.Y., New York State Barge canal

K. Amsterdam, N.Y., New York State Barge canal

L. Utica, N.Y., New York State Barge canal

M. Providence, R.I., Field's point. Bents four-foot centres, two brace piles to each bent. Sheet piling six inches and eight inches

N. New York, N.Y., Central Railroad Company of New Jersey, Bronx terminal. Bents eight foot centres, two brace piles to a bent, sheeting six inches

O. Norfolk, Va., U.S. navy yard. Timber platform surmounted by concrete wall on reinforced concrete sheet piling, 55 ft long. Similar wall faced with granite ashlar, built at New York navy yard. Bents 5 foot centres

P. Nowy Port, Pol., commercial railroad

Q. Berlin, Ger., Spree canal

R. Boston, Mass., U.S. navy yard

In locations where rock is encountered at moderate depths and where marine borers are active, recourse is taken to a combination of masonry blocks, reinforced concrete and rnpap construction as illustrated in fig 15 by reference letters which indicate the following essential details

A. Key West, Fla., U.S. navy yard. Reinforced concrete piles and deck. Bents ten-foot centres

B. Albanv, N.Y., New York State Barge canal

C. Los Angeles, Calif. Reinforced concrete piles and deck. Bents 20 ft centres, anchors, four vertical, four brace timber piles

D. Nantes, Fr., on Loire. Reinforced concrete

E. Spandau, Ger., municipal quay

F. Nantes, Fr.

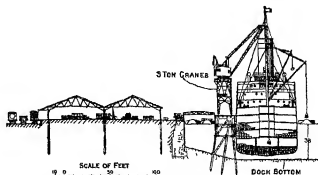


FIG 12—CROSS SECTION OF SOUTH QUAY AND ISLAND JETTIES OF KING GEORGE V DOCK LONDON

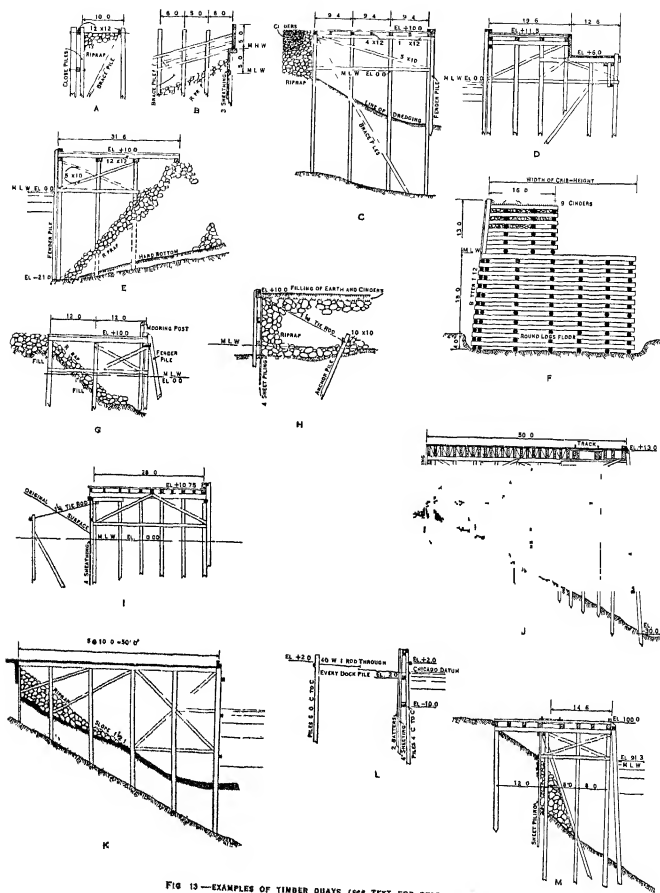


FIG. 13—EXAMPLES OF TIMBER QUAYS (SEE TEXT FOR DESCRIPTION)

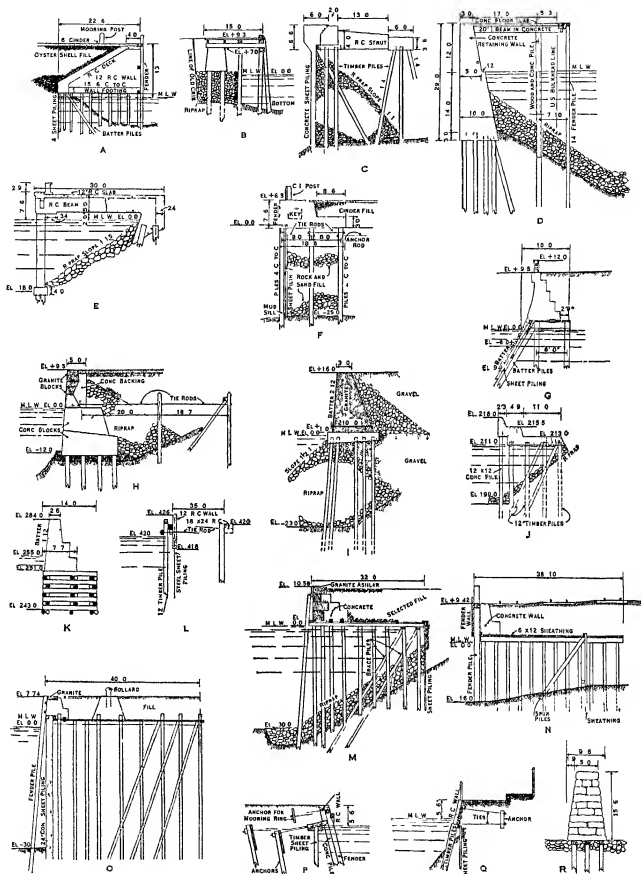
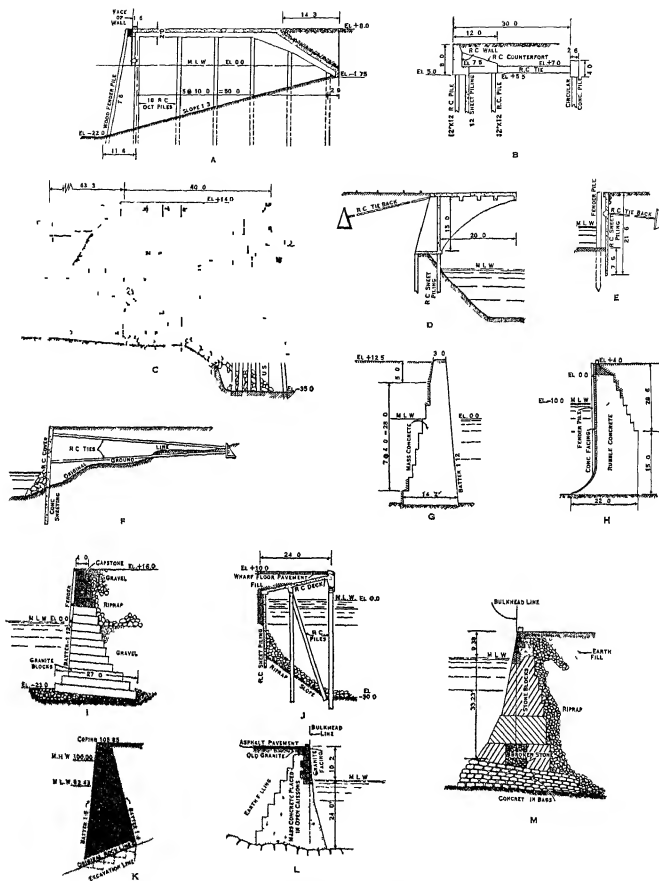


FIG 14—USE OF RIPRAP AND OTHER MEANS TO SUPPORT PILE STRUCTURES (see TEXT FOR DESCRIPTION)



G Bronx, N.Y., Port Morris
 H Oakland, Calif., 2,005 ft long
 I Boston, Mass., Fish pier, Wall around Pier 6
 J Baltimore, Md., Proposed design
 K Portsmouth, N.H., navy yard Loose coursed granite laid by diver
 L New York, N.Y., 16th street, department of docks and ferries
 M New York, N.Y., Cedar street, department of docks and ferries

The wall around a dock serve as retaining walls, and although they have the support of the water in front of them when the docks are in use, when built in the dry they sustain the full pressure of the filling at the back, as well as any surcharge caused by erections on the quay. The completion of the filling behind the wall is thus sometimes deferred until after the dock is filled with water.

The thickness of solid dock walls is increased downward to support the pressure which increases with the depth. This pressure depends on the nature and angle of repose or natural slope of the ground and filling material behind the wall. But the pressure is often increased by the accumulation of water at the back, which, with fine, silty material, exerts a sort of fluid pressure against the wall proportionate to the density of the mixture of silt and water. Thickness toward the base formerly was increased by a batter on the face, as well as by stepping the back. The vertical form given to the sides of later ships however necessitated a corresponding vertical or nearly vertical face for the wall.

The height of a dock wall above the dock bottom depends upon the minimum depth of water needed for vessels and upon the rise of the tide. In tideless seaports and inland ports removed from tidal influence, the height is represented by the minimum depth of water plus a margin of from six to ten feet from the water level to the quay surface. At tidal ports however, an addition has to be made equal to the difference in height between the highest and lowest water levels in the dock or in the open basin as the case may be. At some ports, such as Montreal, Cleveland, Pittsburgh and Portland, Ore., provision against river floods and seasonal stages necessitates especially high coping levels.

Except under the limiting conditions where steel sheet piling can be carried up safely to the grade of the finished wharf, dock walls are constructed of masonry, brickwork or concrete or of concrete with a facing of stone or brick. Most later dock wall building has been in concrete, and when suitable materials are available at or near the site of the work concrete construction is usually cheaper than any other form. Where subsols afford adequate bearing value, the foundations for dock walls, below the level at which open excavation is practicable and economical, are excavated in a trench. The trench is lined with timber sheeting for the support of the sides during excavation and in dry ground and very deep trenches, timber sheet piling or interlocked steel sheet piles are driven to form the sides. Examples of dock walls built in trenches are shown in figs. 16 and 17.

The walls of open basins are often constructed in the dry precisely like dock walls. They differ from dock walls only in being exposed to variations in the pressure at the back resulting from the lowering of the water level in front. If mass concrete walls are to be built in the dry, some form of cofferdam is necessary when the site is covered by water, steel sheet piling is commonly employed for the purpose of enclosing the area to be excavated.

Concrete Block Walls—In the construction of the quay walls lining the basins formed in the harbour at Marseilles, large concrete blocks were deposited on a rubble foundation till they reached sea level. Upon these blocks a solid masonry wall was extended to quay level. This practice was widely followed, particularly in Mediterranean ports, and the size of blocks employed progressively increased. As early as 1871, blocks weighing 360 tons are said to have been used in the construction of quay wall in the port of Dublin. Each block formed a complete section of the lower part of the wall, 12 ft. long and 27 ft. high, and was lifted from the staging on which it was made and deposited under water by floating derricks. An alternate method was employed in the breakwater at Aberdeen harbour, in which canvas bags were laid in a hopper barge and there filled with concrete, sewn up and dropped through the door in the bottom of the barge onto the foundation. Sloping blocks were used early in the construction of a quay wall

at Mormugao Portuguese India and were erected on a foundation layer of rubble to provide against unequal settlement on the soft bottom. The system was employed often thereafter. Later examples are the quay walls of Valparaiso, Chile, and Kilindini (Mombasa, Kenya) harbours.

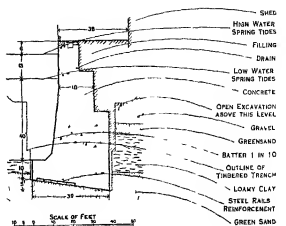


FIG. 16—SOUTHAMPTON ENG. OCEAN DOCK SECTION OF QUAY WALL BUILT IN THE DRY IN TIMBERED TRENCH

Representative designs of concrete block walls are shown in figs. 11 and 17.

Well Monoliths—Brief mention has been made of well monoliths as an alternative for excavation of docks (see also fig. 18). In some instances where dock walls have been constructed on ground above the water line or within an enclosing embankment or cofferdam, the subsoil strata has been of such unpredictable nature that the monolith method has been adopted to penetrate unstable soils. Its principle is derived from the ancient Indian system of well sinking. The cylindrical well foundations built up around iron- or steel framed curbs forming cutting edges were sunk by excavating from within with grab buckets. These angle cylinders arranged in groups of three formed a foundation unit in Queen's dock, on the Clyde in 1877. The rectangular form with four to six cells was later adopted as being more easily adjusted against a tendency to tilt from the vertical. In this case it was necessary only to excavate from one or another of the cells to assure stability.

Similar monoliths were employed at Tilbury in building the walls of the main dock extension (fig. 19) and at Calcutta (1928) where the soil is alluvial and very soft. At Rosyth some of the monoliths sunk for forming the outer walls of the dock were carried down to a depth of 121 ft. below the coping before a

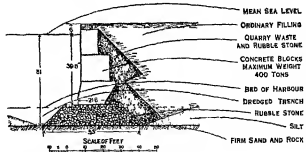


FIG. 17—QUAY WALLS AT ALGIERS

sound foundation was reached. The well spaces were sealed with concrete at the bottom. In some cases the wells are entirely filled with concrete, while in others sand filling is used above the concrete seal. At Karachi, Pak., and Southampton (1933-34), the front wells were filled only partially to reduce the intensity of pressure on the foundations at the toe of the wall.

A wide variety of foundation materials, including pipe piles, drilled in caissons, concrete piles, circular steel sheet pile cells, cast-

iron and concrete box caissons the latter evolved from the early idea of the monoliths, have been used. Their applications are variously suited to the particular conditions encountered and are usually governed by the factors of available supply and relative cost. Numerous combinations of these materials have been employed according to the severity of the conditions.

Of the numerous construction methods successfully employed, the following three are generally recognized as fundamental. Other methods adopted involve variations or combinations of these:

1 Direct driving of large pipes or cylinders, excavating from within and replacing with suitable bearing material. Pipe piles have been driven to a depth as low as 183 ft below tidewater.

2 The sinking of floating caissons by progressive adding masonry, rubble stone or concrete to the structure as it sinks into position.

3 The sinking of open caissons with cutting edges at their bases by the pneumatic method. This method is used where it is desirable to observe the foundation conditions to place the concrete bottom under dry conditions and to avoid disturbance of adjacent structures. Dry working conditions are obtained in a watertight chamber under compressed air.

The construction of a large number of piers for the Central Railroad Company of New Jersey over Newark bay was an adaptation of the open caisson method, in which the caisson was sunk to rest on a prepared foundation of timber piles 7 ft 10 in below mean high water. The pneumatic method is widely used for the foundations of bridges, dams and piers where heavy load concentrations occur. Its practical and economic limit as to depth is 90 to 120 ft.

Sinking by Compressed Air.—Early use of compressed air has been noted in advancing the foundations of quay walls, through alluvial deposits, to solid strata. About 1880 the building of a long line of river quays extending out into the Scheldt was begun at Antwerp, Belg., with the object of regulating the width of the river simultaneously with the provision of deep water quays. The wall was built, out of water, on the flat tops of a series of wrought-iron caissons, 82 ft long and 29½ ft wide, constructed on shore. These were floated out, one by one, between two barges, and gradually lowered as the wall was built up inside a plate iron enclosure erected around the foot of the caisson. Each caisson eventually was sunk by aid of compressed air through the bed of the river to a compact stratum. An extension of the wall carried out in a somewhat similar manner was completed in 1903 (fig. 20).

A dry dock and quay walls constructed in the old harbour at Genoa about 1888 were founded under water in a similar manner by the aid of compressed air. Part of the Broomielaw quay at Glasgow was reconstructed about 1902 on steel caissons carried down by means of compressed air from 54 to 70 ft below quay level. A deep water tidal quay at Le Havre was built upon steel caissons about 141 ft long and 45 ft wide sunk by compressed air through about 57 ft of soil. The wall was constructed of masonry and concrete within temporary caissons raised upon the tops of the permanent caissons, which terminate at the level of the dredged berth more than 40 ft below low water (fig. 21). Compressed air was also employed at Marseilles (fig. 22) for building quay wall foundations.

Quay Walls of Timber Crib Work.—In some North American ports, where firm foundations occur relatively close to the low water datum, walls have been built of timber crib work, sunk in a previously dredged trench or placed directly on a hard bottom. The cribs extended to the elevation of low water and were filled with rubble stone. Above low water mass concrete or masonry walls were raised in the dry on the crib foundation. Examples of these cribbed quay walls, which withstood the ravages of wind,

tide and scour, are found at Montreal, Saint John, N.B., some of the Great Lakes ports, the port of Philadelphia and the harbour of Portland, Me. While they are particularly well adapted to exposed locations and rocky shores where wind and tide extract a heavy toll on lighter structures, they are by no means the answer to unusually violent storms such as that which occurred in the harbour of Wick, Scot., in 1872. This harbour had been rebuilt in 1808 of massive masonry construction. In the storm of 1872 the mammoth waves tore away a section of concrete breakwater weighing 1,350 tons, lifted it and deposited it in a mass inside the harbour. Subsequently investigators estimated the force of the wave to be more than two tons per square foot.

A tropical typhoon on the island of Guam in 1946 generated waves which overtopped the breakwater about 50 ft above average sea level. Gaps were left in the structure which necessitated widening the breakwater and extending its height.

The economic factors of providing for such unusual occasions whether at 10 year or 100 year intervals, and the cost of maintaining excess stability throughout the period must always be considered. Because of the relatively permanent requirements of water front structures, solid masonry is preferable where construction cost is not prohibitive.

Reinforced Concrete Caissons.—After 1905 reinforced concrete caissons with closed bottoms were frequently used in the construction of quay walls, as at President Wilson basin in Marseilles (fig. 22). The caissons were constructed on shore, in a dry dock, or in some position from which they could be launched or lifted by giant cranes and towed into position. After being sunk to their final positions on a prepared bed of rubble or concrete, their filling was completed with sand, stone or concrete to suit the foundation conditions and the requirements of their superstructures.

TABLE II—Typical Applications of the Floating Caisson to Dock and Harbour Installations

| Location | Dimensions (In feet) | | | Weight (in long tons) |
|------------------|----------------------|-------|-------|-----------------------|
| | Length | Width | Depth | |
| Zeebrugge, Belg. | 94 | 24-70 | 28-36 | 1,500-1,600 |
| Marseilles, Sp. | 39 | 31 | 21 | 1,500-1,700 |
| Tuxus, U.S.S.R. | 10 | 31 | 21 | 1,500-1,700 |
| Tokushima, Chile | 33 | 31 | 21 | 1,500-1,700 |
| Rotterdam, Neth. | 131 | 31 | 41 | |

Floating caissons were employed also in the construction of breakwaters at Bilbao, Sp., Bizerte, Tunisia, Algoma, Wis., Welland Ship canal, Ontario, Flushing creek, Long Island, Newark bay, and at ports on Lake Michigan.

Because of its monolithic character and low cost of fabrication, reinforced concrete has many advantages over stone masonry construction for harbour works. A spectacular military example

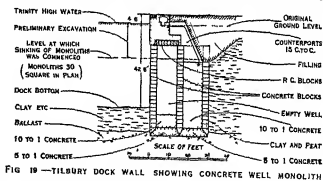


FIG. 19—TILBURY DOCK WALL SHOWING CONCRETE WELL MONOLITH

of its numerous applications was the building of mammoth caissons in England which were towed across the channel in 1944 to the Normandy coast of France and assembled as units of a prefabricated harbour by Allied military forces. Emergency quays thereby provided landing facilities for military equipment and stores in a matter of months, in contrast with a construction period measured in years under former procedures. Each of the caissons was about 204 ft long, 44 ft wide and 40 ft high—a hollow box with

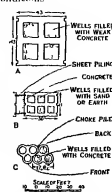


FIG. 18—SECTIONS OF TYPICAL WELL MONOLITHS. A. ROSTON 1910. B. CLYDE ROTHESAY DOCK 1904. C. CLYDE QUEEN'S DOCK 1877.

cross walls and a longitudinal wall on the centre line. Each contained about 1712 cu yd of concrete and 178 tons of reinforcing steel.

Two of these caissons, known as Phoenixes, which were incorporated in the artificial harbours for the Normandy landings were

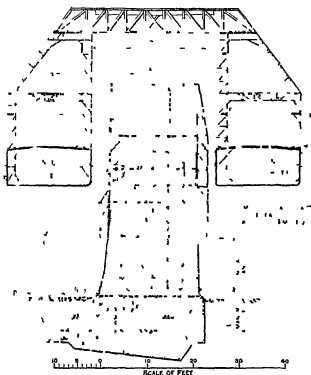


FIG 20—SECTION OF QUAY WALL IN THE RIVER SCHELDT ANTWERP BELG. FOUNDED ON CAISSONS SUNK BY COMPRESSED AIR

purchased from Great Britain in 1951 and towed to Stockholm, Sweden, there they were placed end to end to form a pier in the oil harbour of the port.

Quay Walls on Piled Foundations.—From the latter part of the 19th century, the massive masonry structures employed in quay wall construction gave way to lighter structures composed of piles driven through soft strata to more stable bottom and surmounted by timber or concrete platforms extending approximately to mean low water. Upon these platforms much lighter masonry or concrete walls were erected to retain the fill. Timber piles were used generally in earlier constructions until the development of steel rolled sections, iron pipe piles and concrete piles. Concrete piles or steel piles or a combination of the two, were preferred in waters where marine borers were prevalent.

With the advent of steel sheet piles about 1905, and subsequent rolling of heavier sections capable of sustaining usual quay wall loads, quay wall design was materially modified.

Timber sheet piling had been employed to a considerable extent for retaining the fill behind open pile constructions. Steel sheet piling, however, introduced a new era in dock building. After 1930, steel sheet pile bulkheads in various forms answered the requirements of most quay wall design. In borderline cases, where the induced stresses approached the allowable strength of steel sheet piles, riprap slopes were introduced to relieve the stresses in the piles. As the depth of water in the docks increased to accommodate larger ships various modifications of the sheet pile bulkhead walls became necessary. The most general of these was the relieving platform built of timber or concrete at about the elevation of mean low water. In some instances, where steel sheet piles were in short supply, recourse to the use of concrete sheet piles was taken, as in New York in 1910. Typical examples of progressive development in this modern type of construction are shown in figs 4 to 10, inclusive.

Where highly compressible and unstable soils are encountered at great depth, the so called cofferdam type of construction has

been adopted, consisting primarily of circular cells built up of straight web, steel sheet pile sections. Later designs combined the idea of circular sections with adjacent cell sections formed by straight diaphragms between the cells connected by circular arcs between diaphragms. In some cases the cells penetrated the soft and unstable soils to depths of more than 100 ft and extended to the finished grade of the wharf. In most cases, however, they terminated at about mean low water and were surmounted by concrete gravity walls of adequate dimensions to retain the fill behind the walls. An example of this type of construction is a marginal wharf built at Apra harbour, Guam in 1948 (fig 10). Other notable examples are the ore loading wharf on the Cuvahoga river at Cleveland on the Willamette river at Portland, Ore. and the quay wall at Sparrows Point, Md.

Failures of Quay Walls.—Failure of quay walls may be due to any one of several circumstances among which are the following: faulty design which ignores not only well known principles of the behaviour of soils under stress but also the choice of construction materials best suited to the location, inadequate knowledge of the underlying strata, failure of the builder to observe safe practice in construction procedure, loading the structure beyond the limit for which it is designed, and subsequent dredging in front of the wall beyond the depth originally intended. Many failures occur during construction while others are not observed until after completion of the structure. Partial failures usually are detected first by visual evidence of misalignment of the top of the wall, generally accompanied by settlement. They are usually progressive. Where they have been observed in their early stages, successful remedial measures have been taken, but when allowed to progress, the sea walls have required complete reconstruction.

In the case of massive masonry walls of the gravity type resting on natural soil foundation the movement has usually been a sliding action on its base.

The following typical examples of quay wall failures and some of the corrective measures applied were compiled by Adm. Fred Eric R. Harris for the *American Civil Engineers' Handbook*, T. Merriman and T. H. Wignall (eds.), 5th ed. (John Wiley & Sons).

1. An outward movement was observed during the construction of the Fish pier wall in Boston harbour, the wall resting on an inclined riprap bed, laid on clay overlying hardpan and rock. The movement was arrested by driving piles directly in front of and at the toe of the wall and constructing in the rear of the wall a relieving platform. About 400 ft of wall were involved.

2. A section about 300 ft long of a masonry and timber platform wall built at the New York navy yard failed by outward movement

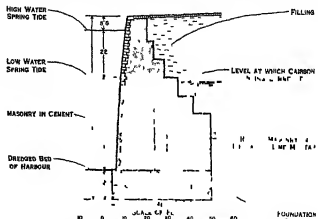


FIG 21—SECTION OF TIDAL QUAY AT LE HAVRE, FR. FOUNDATIONS WERE CONSTRUCTED WITHIN PERMANENT CAISSONS EACH 141 FT LONG AND THE UPPER PART OF THE CAISSON REMOVED

and overturning, the cause being, undoubtedly, improper brace pile connections.

3. A somewhat similar wall in Washington, D.C., built on a very narrow platform without brace pile ties, moved outward ten feet when the backfilling had been carried only to mean tide elevation. When repaired by constructing a timber relieving platform with adequate brace piles, backfilling was carried to grade and no further movement of importance was found.

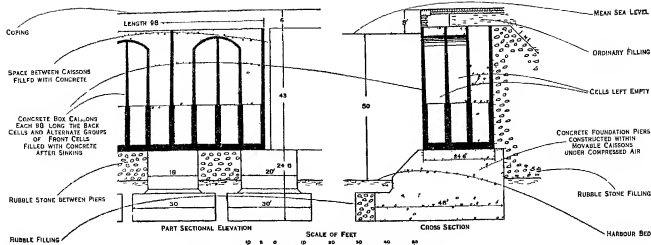


FIG 22—PRESIDENT WILSON BASIN MARSEILLES FR QUAY WALL OF CONCRETE CAISSONS ON DISCONTINUOUS CONCRETE FOUNDATIONS IN DEEP WATER

4. A wall in Charleston, S.C., harbour, 4,000 ft long was located on a salt marsh, the river silt of increasing compactness and density extended to a depth in excess of 90 ft below tide. The depth of water at the face of the wall varied from nil to approximately eight feet. The support for the wall consisted of a timber platform and brace piles with sheet piling, driven at an inclination. Filling of river silt was placed behind the wall by hydraulic dredging. In two locations the filling material blew out underneath the sheet piling, pushing out the bottom of the sheet piling. This was corrected by loading the toe of the wall with riprap and, in some instances, by driving heavy vertical sheet piling inside and behind the wall platform.

5. A platform bulkhead built in New York harbour, consisting of a timber platform with sheet piling on the inside with brace piles at 5-ft intervals, with 15 ft depth of water at the sheet piling and 30 ft depth along the face, gave evidence of outward movement when the depth of water was increased by dredging to 24 ft. This was corrected by placing two inch round steel anchors every 10 ft and carrying these back 40 ft inshore of the sheet piling to anchors of timbers, deadmen and piles, and placing riprap along the slope decreasing the depth of water at sheet piling to 12 ft.

6. A wall built at the navy yard in New York, about 1885, of gravity type, consisted of heavy granite blocks with massive counterforts, laid by divers on a timberwork above tide level. It was designed at a time when the draught of the vessels did not exceed 20 ft. With the increase of draught of vessels, the basin directly in front of this wall was dredged out, finally, to a depth slightly in excess of 30 ft. A somewhat similar wall in another locality failed by outward movement and overturning. The wall in question moved outward and gave every indication of rapid failure. It was repaired by stopping off the ashlar work to low water, driving sheet piling directly in front of the wall and tying this back in turn by timber ties to a platform behind the wall provided with vertical brace piles, filling the space between the face of the wall and the sheet piling with riprap, building a new wall directly on top of the sheet piling and backfilling the work.

7. A crib in the Delaware, Lackawanna and Western Railroad Co. yard, Hoboken, N.J., the top of which had given way and needed renewal, was repaired by constructing a concrete wall carried down to a level where the crib was still sound.

8. A sea wall built on a timber platform, the protective face of which under water consisted of three lap, two inch yellow pine treated with creosote, began to fail because of the destruction of the wood by the teredo. Eight-inch grooved and tongued reinforced concrete sheet piles were driven and a reinforced-concrete face put on top of this and the structure tied back by the rods.

ENTRANCES AND LOCKS

Gate Entrances.—Entrances with a single pair of gates closed against a raised sill at the bottom and meeting in the centre have to be made long enough to provide a recess behind the gate on each side wall to accommodate the gates when they are open and to form an abutment in front to bear the thrust of the gates when closed against a head of water in the dock. A masonry or concrete floor is laid on the bottom in accommodation of the sill serving as an apron against erosion. Entrances have the advantage of occupying less room than locks, and they are less costly. They have the important disadvantage of being accessible for a limited period only on each side. They have seldom been included except as auxiliary passages in the construction of large new docks.

Locks.—Locks differ from entrances in having a pair of gates

at each end of a lock chamber. Dock locks are similar in principle to those on canals. The lock chamber has its water level raised or lowered when gates are closed at both ends by passing water through large sluiceways or culverts in the side walls. In most large modern locks, an intermediate pair of gates is provided in the chamber in order to divide the lock for the accommodation of small vessels.

Inner and outer sills of dock locks are frequently constructed at the same level, the advantage in the case of two or more pairs of gates is that they may be interchangeable.

The foundation for sills, side walls and floors of a lock generally are constructed in cofferdams built across the entrance channel in which the excavations are kept dry by pumping. Under the sill and adjacent to the sills the foundations usually are carried to a lower level and, if possible, to an impervious stratum to prevent the infiltration of water under pressure. Frequently, sheet piling is driven across the lock site and under the side walls to cut off the flow of water. A physical concave recess is formed in the wall in which the heel post of the gate turns.

The side walls of a lock chamber are very similar in construction to dock walls. They are usually built of concrete and have been frequently in the form of an inverted arch which resists any forward movement of the adjacent wall, the toe of which abuts against it.

A feature in the design of modern locks and entrances is the rectangular form of the entrance corresponding to the shape of the midsection of modern ships. Some of the earlier entrances were constructed with inverted arch floors, the depth being greater at the centre than at the sides. In soft alluvial soil, the use of well monoliths in the foundations was found advantageous at King George dock, Calcutta, and at Tilbury (1938). Large caissons were employed for constructing under compressed air the foundation of gate chambers, lock heads and portions of the side walls of the Florida lock at Le Havre. The large lock at New Orleans, La., built in fine quicksand was supported on 24,000 piles.

The entrance lock at Ymuden, Neth., opened in 1930 is a concrete structure resting on concrete piles. The lock has a floor of reinforced concrete under and near caisson sills, but in the main chamber the canal bed is left uncovered between side walls, the

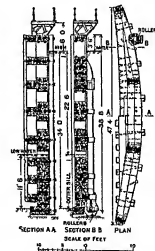


FIG 23—TIMBER DOCK GATES ALEXANDRA DOCK HULL ENG

foundations are enclosed in sheet piling. The lock was built on fine water logged sand the excavations being kept dry by means of a well point system. In a few other cases, including one of the large docks at Bremerhaven, Ger., an artificial floor was avoided except at the ends of the lock chamber.

DOCK GATES AND CAISSONS

The entrances and locks at wet docks and the entrances at dry docks are closed either by gates or caissons. Gates formerly were built of timber, greenheart generally being used when obtainable. Until about 1915 practically all the gates of Liverpool were so constructed even for such a wide opening as 100 ft. at the Canada lock. The difficulty of obtaining very large greenheart timbers and its high cost, plus the convenience and economy of steel construction, resulted in almost universal use of mild steel for gate building. During the second half of the 19th century, many gates were built of wrought iron until the general adoption of mild steel for construction purposes superseded it. In steel gates the heelpost (*re*, the vertical closing piece at the hinged end) the mitre post at the meeting end and the sill piece which close against the fixed sill of the gate timber are all usually built of greenheart or faced with it.

Wooden gates consist of a series of horizontal framed beams made thicker and placed closer toward the bottom to resist water pressure which increases with the depth. The beams are framed and fastened to the steel posts and mitre posts at the ends, and there are usually intermediate uprights. Watertight planking is fixed on the pressure face.

Steel gates usually have both an outer and inner skin of plating braced vertically and horizontally by steel plate ribs and girders. They are frequently built with buoyancy chambers which relieve the gate anchorage at the head of the heelpost of considerable horizontal stress due to the weight of the gate. The pivot support at its foot likewise is relieved of all weight except that necessary to prevent the gate's floating out of its seat. They are consequently much easier to move in the water than are wooden gates. Wooden gates, however, are less likely to be seriously damaged if rammed by a vessel. All anchorages and supports of a steel gate should be made strong enough to sustain its weight in the event that the buoyancy chambers become waterlogged.

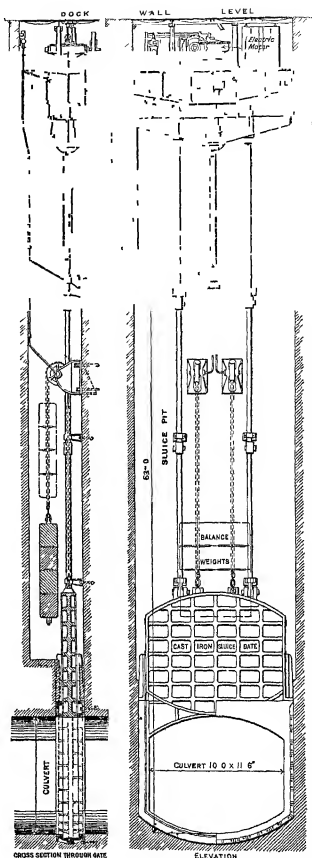
The semibuoyant type of gate generally employed in modern docks dispenses with the roller and roller path under the gate near the mitre posts formerly provided to sustain the weight. The buoyancy of the gate is maintained at a constant value by constructing the buoyancy chamber in the lower part of the gate. All chambers formed by skin plating above the watertight compartment are opened on the outside face to the free flow of the tide. Thus, so long as the buoyancy chamber is submerged, the unbalanced weight remains practically unchanged whatever the depth of water may be. In this way, the unfloat weight of the gate can be reduced to a few tons.

Formerly, dock gates were sometimes made segmental in plan on both faces with the inner face forming a continuous circular arc. The width of the gate leaf at its centre is usually made one-eighth of its length.

Storm gates pointing in the reverse direction to the impounding gates and placed outside them are occasionally employed in entrances subject to extraordinarily high tide or strong wave action. Strut gates are swung into position at the back of the impounding gates to support them against pressure of waves in exposed locations.

Single-leaf semibuoyant gates hinged on a horizontal access below the level of the sill have been employed in several dock entrances. The gate is lowered into the water to open the entrance until it lies flat on a platform or apron outside or below the sill level. The train ferry dock at Dover, opened in 1936, is provided with horizontally hinged gates. As this is a wet dock and is designed to maintain the water surface inside the gate at a level which may be higher or lower than the tidal water outside there are two gates, one behind the other, capable of being lowered in opposite directions.

Sluice Valves.—Valves or sluice gates in various forms are



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FIG. 24.—SLUICE GATE AT CONGELLA DRY DOCK (DURBAN U. OF S. A.) OPERATED BY A 25 H.P. ELECTRIC MOTOR. TOTAL WATER PRESSURE ON THE SLUICE DOOR (EITHER SIDE) IS 170 TONS.

used for controlling the water levels in locks and docks. Valves were formerly built into the gites in some cases but as the volume of water to be dealt with grew larger it became usual to build culverts with controlling gates in the side walls of the lock or entrance. Gate sluices have since continued to be used in some docks for the purpose of sluicing silt deposits from the sill apron. An old form of sluice gate is constructed of timber, usually greenheart, and is raised and lowered over the culvert mouth in the sluice chamber by hand power or electric motor. Cast iron gates faced with gun metal and working against cast iron frames are often employed and are usually similarly operated. A double faced sluice gate at the Congella dry dock, Durban, U. of S. A. is illustrated in fig. 74. Balanced cylindrical sluice valves, in which the water flows between the bottom edge of a steel cylinder and its annular seating when the cylinder is raised, are used in some cases. Roller gate sluices of the Stoney pattern are frequently employed in large culverts as at the locks of the Panama canal, and "butterfly" or balanced flap sluice valves turning about a horizontal axis are occasionally used in culverts of moderate dimensions. Cylindrical and "butterfly" valves both possess the advantage (in that they are balanced or in equilibrium, so far as water pressure is concerned) of eliminating friction at the meeting surfaces. In roller sluices the friction is reduced to insignificant dimensions. All dock sluices operated by electric motors or hydraulic rams should be fitted with means for hand working when necessary. Stop planks for emergency use are often provided in secondary sluice gates.

Gate Machinery.—The early practice was to attach two chains to each gate hauled by hand winches or some form of power machines. Direct acting hydraulic rams placed in covered pits just below the coping level of the lock were first introduced about 1880 at the Barry docks. This system, in improved form, became widely used in Great Britain (see fig. 25). On the continents of Europe and North America, electrical power has generally been employed for operating gate machinery. At the Panama canal, a large horizontal spur gear driven by an electric motor operates the gate. Another widely used form consists of a connecting rod in the form of a rack which is engaged by a worm gear driven by an electric motor. In both cases, operating machinery is placed in pits at the side of the lock.

Dock Caissons.—Caissons for closing the entrances of wet docks, dry docks and locks are constructed with buoyancy and ballast tanks for the purpose of floating or sinking the caisson or adjusting the unbalanced weight. The contained water ballast is varied at will by means of valves and pumps located within the

caisson. Rolling caissons having wheels fixed to the underside on which they travel over rails on the floor of the entrance. In some cases the wheels or rollers are attached to the floor and the rails to the caissons.

The second and third types require a long recess or camber formed in the side of the entrance into which the caisson may be

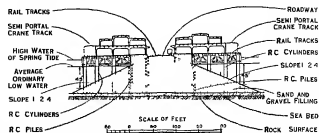


FIG. 26—CROSS SECTION OF OUTER BERTHS BALLANTYNE PIER VAN COUVERUC

withdrawn to open the passage. In a dry dock at Dundee, Scotland, floating caissons are hinged at one end and swing out into a recess. In the dock wall, a rolling caisson was used at the Garvel dry dock at Greenock, Scot., in 1874. Others are installed at the entrance of the Bruges ship canal, the Congella dry dock at Durban (1925), the Kruisschans lock at Antwerp (1927) and the Ymuiden lock at Amsterdam (1930). The caissons which close the combined lock and dry dock at St. Nazaire (1931) and the locks at Bremerhaven (1931) and Dunkirk (1940) are supported on a submerged roller carriage at one end and slung at the camber end from an overhead roller carriage travelling on the side walls of the camber chamber. For closing large dry docks, sliding caissons have been adopted in later cases as indicated in Table III.

A floating caisson is occasionally arranged to draw back into a chamber and in this form differs only slightly from the sliding caisson. Sliding or rolling caissons, although more costly than simple floating caissons, have been favoured because of their ease of operation through mechanical means. They are, however, subject to maintenance and occasional repairs.

Relative Advantages of Gates and Caissons.—In general practice, the various types of mechanically operated gates including the sliding, rolling or hinged arrangements, have been found easier to operate. In wet basins and the older graving docks, they have been generally employed. As indicated in Table III, the great majority of graving docks are provided with caisson gates, which consume more time in sinking into their recesses, but the relative infrequency of operation in graving docks compared with that of wet basins reduces the importance of this factor for graving docks. Floating caissons further obviate the necessity of providing recesses in the structure and require almost no mechanical maintenance.

EQUIPMENT OF DOCKS

Docks are essentially gateways of import and export commerce and are arranged for the transfer of cargoes and passengers between ships and radiating lines of distribution. In addition to the facilities needed for embarking and discharging of cargoes at the water's edge (local accommodations, such as transit sheds, passenger terminals and land loading equipment), provision must often be made for the transfer of passengers and commodities by rail, highway and air to points throughout the territory served by the port. These provisions include highways, railroads and air terminals situated outside the immediate area of the port itself.

Within the confines of the port area, warehouses, transit sheds, special equipment for loading and discharging various classes of cargo and other auxiliary appearances are required for the efficient handling of cargoes. Among the items of auxiliary equipment are power for dock operation, trucks, cranes and hoisting gear for the handling of cargoes from ship to transit shed, warehouse, rail and highway. These facilities constitute a complete self-contained system of operation independent of other commercial establishments but arranged to co-ordinate with the latter.

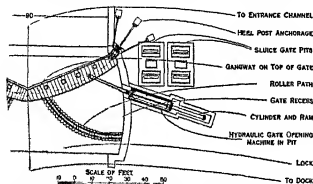


FIG. 25—HALF PLAN OF GATES OF 90 FT ENTRANCE LOCK AT CARDIFF DOCKS SHOWING ROLLER PATH AND GATE OPENING MACHINE

caisson. Caissons are fitted with greenheart or oil contact faces to which rubber hinging strips are frequently added providing elasticity needed to form a watertight joint against masonry sills and seats. There are three general types of dock caissons:

1. Floating caissons which are either in ship form or rectangular and are moved without guides, or rollers.
2. Sliding caissons provided with greenheart or oil contact pieces which rest on sliding ways or smooth masonry over which the caisson is drawn.

for effective distribution of cargoes.

In effect such marine terminals are links between land and water transportation systems. They may be bottlenecks or channels of sufficient dimensions and facilities to afford the smooth flow of commerce between two means of transportation. A terminal may be generally local where the destination of ship-borne cargo is close to the terminal location and the outbound cargo finds its origin within the locality. Or, the terminal may serve for the transfer of water-borne commerce to widely dispersed territory involving further transportation by land or inland waterway. In general, marine terminals are a combination of the two extremes. A marine terminal in a large city like New York is an example of diversification and is confronted with the restrictions of location, enormously high real estate values and consequent high taxes. Mobile Alh, on the other hand, is relatively free from these burdens. While each port is a problem of itself, certain items of equipment are common to most ports and can be adopted generally.

Railways and Roads—In order to deal expeditiously with cargoes brought into and dispatched from docks, numerous railway sidings are arranged along the quays. In ports with a large railway traffic classification yards and storage sidings are usually located within or near the dock area in order to avoid congestion on the quays.

The layout of railways in a dock area presents a problem similar to that of the freight yard of a medium-size city. At Savannah, the railway and classification yard is singularly arranged to accommodate five tributary railways. The warehouses are arranged in several rows of single story buildings with paved roads on one side and depressed tracks on the other. The Boston and Maine railroad marine terminal, Mystic Pier No. 1, Boston, has double tracks on the wharf apron and depressed tracks within the transit shed which divides the building into two sections. Access for freight movement by motor trucks across the depressed tracks is afforded by a collapsible bridge at the floor level.

Growth of motor highway transport made it necessary to build permanent connections from adjacent highways by means of ramps and overpasses for direct access to the loading floor of the transit sheds.

Warehouses and Transit Sheds—The arrangement of transit sheds follows in general the pattern of a one story building with sufficient height about 20 ft., for the stacking of incoming cargo and the operation of fork lift trucks. In the most modern application, depressed tracks run the whole length of the building along its centre line and afford the handling of freight directly onto the car floor. Clear space on each side of the track is provided for the operation of motor trucks. The transit floor, therefore, must be relatively free of columns supporting the roof, which in most cases is carried on long span trusses. Where double sided piers and quays are adopted, as in the case of railway marine terminals, widths are from 300 to 500 ft., usually in order to provide ample space for the modern facilities of transit sheds. Fig. 26, illustrating the Ballantyne pier at Vancouver, B.C., and fig. 27, showing a cargo pier at Philadelphia, are typical examples. This

type of construction is common in the Atlantic ports.

Warehouses built in connection with dock facilities follow a wide range of design depending upon the type of cargo and the length of time the cargo is likely to remain at the port. They range from one story sheds to warehouses of eight or nine floors. For the storage of perishable goods, refrigerator warehouses have been constructed in many of the larger American ports.

Elaborate and costly plants for loading, discharging and storing special classes of cargo in large quantities have been established in many of the large ports of the world. Among them are bulk handling facilities for coal, grain, ores and oil. The bulk handling of wheat at such ports as Montreal, New York, Vancouver, B.C., and Port Arthur, Ont., necessitated the building of vast granaries and elevators holding more than 100,000 tons and capable of loading it into the ships at the rate of 3,000 tons per hour. For the discharge of grains, pneumatic and bucket elevators, the working of which is almost entirely automatic, are provided in many ports. Floating pneumatic elevators for discharging grain from ships into lighters or shore granaries are commonly employed. Appliances for the shipment or discharge of ores have been developed to a high standard of efficiency in some of the lake ports of the United States. Hoists can unload ore boats of the Great Lakes at the rate of 2,400 tons per hour.

Handling of Oil—Docks for oil tankers are usually located remote from other cargo operations and at points where tankers may be towed away from their berths in case of fire. The sea transport of petroleum in barrels is small compared with bulk cargoes, which in the larger tankers amount to the equivalent of 250,000 bbl. or more. Large tankers are loaded by pumping from large storage tanks or reservoirs through force mains. Such ports as Los Angeles, Calif., Corpus Christi, Tex. and Abadan, Iran, are prominent in the shipment of bulk cargo. The large bulk of the maritime trade of Los Angeles in petroleum products was an important factor in the development of the port. The berths at which tankers load and discharge are isolated from other structures and moored to the jetties or dolphins connected with the shore by light piled structures upon which pipe mains are carried. Provisions for bunkering of ships using fuel oil is commonly afforded by a special pier. Wharves are isolated from the tanker berths, usually in the lower reaches of the dock area and preferably seaward from other piers. Efforts are usually made to prevent a flow of oil beyond the limits of the oil dock area.

Coal Shipping Ports—At docks whose principal export trade is coal, the arrangement of quays and berths is planned with special reference to the running of coal cars to and from the shipping points. In the ports of northeast England high level coal hoists are much used, mainly because of the high elevation of the ground in the neighbourhood of the shipping berths, as for instance, on the river Tyne. At many high-level hoists such as those at Dunston (Gateshead) on the Tyne and at Blyth, which are built parallel to the river bank, trains of cars are brought onto the wharf and discharged successively by means of chutes into vessels lying alongside. In situations where the elevation of the surrounding ground is insufficient to provide for gravity discharge

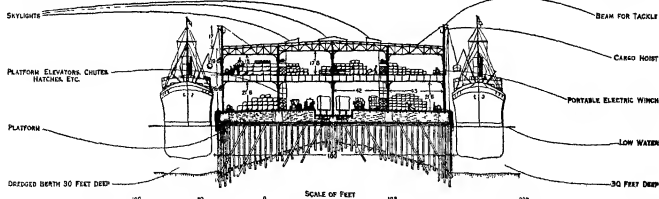


FIG. 27—PLAN OF CARGO PIER PHILADELPHIA, PA. SHOWING ARRANGEMENTS FOR BERTHING CARGO

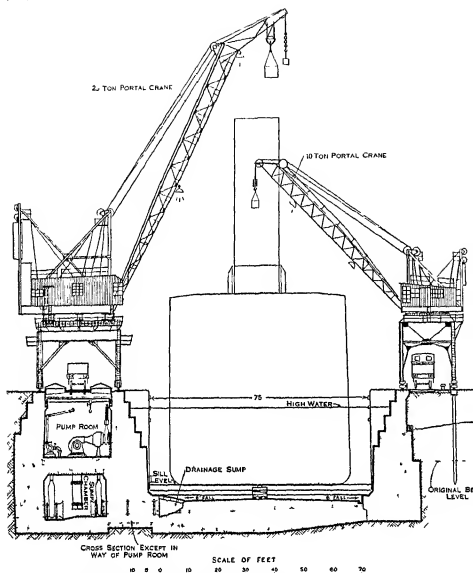


FIG 28.—CROSS SECTION THROUGH PUMP ROOM OF DRY DOCK AT THE KING'S DOCK SWANSEA WALES

from hoists to the hatchways of large modern vessels, hydraulic hoists are often provided, as in the docks of south Wales and Scotland as well as at English northeast coast ports. (Electric hoists are sometimes used in American and continental ports, but in Great Britain hydraulic hoists are generally employed.) Cars are brought to the shipping points at quay level or over a graded gantry structure raised sufficiently high above the quay to avoid obstruction of the quay space.

The coal hoist is contained in a steel latticework tower erected on the dockside. The tower may be either fixed in position or capable of limited movement along the quay to suit the position of a ship's hatchway. The loaded car is raised on a cradle or platform to the required height for the discharge of the coal through adjustable steel chutes into the ship's hold. In some ports the practice is for cars to discharge through bottom doors, in others the cars are fitted with end doors and are tipped on a cradle in the hoist. The running of cars to and from the hoist is assisted, wherever possible, by suitable grading of the tracks. Empty cars are sometimes run off from the hoist at a higher level than the loaded cars roads and travel by gravity to the empty sidings. Electric and hydraulic capstans are also used for working the cars at shipping places.

Electric conveyors are much used in the shipment of coal, in some cases raising it from quay level. They are also used at some coal wharves in order to increase the height of the point of delivery of the coal.

The wharf or jetty on which the coaling hoist is erected is frequently constructed over and in front of a riprap slope to avoid the necessity of building a continuous deep water wall. Appliances to minimize the breakage of coal in falling from the chute into the ship's hold are commonly used at ports where grading of coal is important.

The United States port railway freight cars are of much larger capacity than those of Europe. The shipment of coal is effected both by hoists and conveyer belts as in the United Kingdom, but the tipping arrangements provided for the cars are on a much larger scale, and it is customary to discharge them by means of oscillating "tipplers" or "dumpers" into large hoppers whence the coal is delivered to the ship, either directly or over conveyer belts, through chutes as required. The large hoppers serve as reservoirs to equalize the rate of supply. In some cases the coal is dumped from railroad cars on the low level into very large pier cars which are raised by hoists and are tipped over hoppers at a high level. A coal shipping installation on the belt system, put into service at Baltimore in 1918 by the Baltimore and Ohio railroad, employs self trimming loaders which shoot the coal at high velocity in any desired direction between decks. Somewhat similar mechanical trimmers are in use at the several other American coal ports.

By these means, in conjunction with highly developed arrangements for dumping cars and belt feeding the rate of shipment of coal has been augmented greatly. The Baltimore pier is double sided, 700 ft. long, and has four main coal loading towers. More than 40,000 tons have been loaded there in one day. The use of the American type of large coal cars and mechanical trimming enables ships to be loaded with coal at some of the best equipped U.S. ports more rapidly than in British ports, where the time rate for a complete cargo often does not exceed 600 tons per hour and is usually less because of delays in trimming the coal between decks. (See also BUNKERING OF SHIPS.)

Cranes.—Docksides cranes for general cargo purposes are frequently of the portal type, travelling on rails laid upon the quay with space between the legs (which carry the crane platform) for railway cars to pass under. In some docks where warehouses are near to the face of the dock wall, travelling cranes of a semi-portal type are employed, one pair of the crane legs travelling on rails laid near the quay edge and the other pair on elevated rails fixed to the wall of the building. As a result nearly the whole quay space is left free for the passage of transport. This has become increasingly important as more goods move by large trucks.

Cargo cranes must be raised high enough above the quay surface to enable their jibs to command the hatchways of ships rising high above the water level. For general purposes cranes of 1½, 3 and 5-ton lifting capacity are most commonly used, but for special purposes much more powerful travelling cranes are provided. Floating and fixed cranes of great capacity are employed for dealing with exceptional loads. Some floating cranes lifting

250 tons are in use and at least one fixed crane that at the Philadelphia yard, is capable of lifting 350 tons.

Some modern dockside warehouses have been equipped with electric cranes travelling on the flat roof of the building and arranged to work cargo to and from the several floors of the warehouse through hatchways formed in them and in the roof, as at the Gladstone docks, Liverpool.

In New York and some other ports of the United States, particularly on the Atlantic coast, quayside cranes are in ship cargo use to a limited extent only. The bulk of the working of general cargo is effected by a process called "burtoring." This consists of the joint working of the load by means of a ship's derrick and a fixed cargo mast or hoist attached to the wall of the pier shed which is built out close to the water front.

Electric current for dockside cranes is taken either from conductors in conduits laid below the quay surface or fixed to the walls of quayside buildings, or by means of flexible cables from plug boxes at points on the quay. (See also CRANES.)

DRY DOCKS

There are two kinds of dry docks. The first is a fixed dock, commonly known as a graving dock, for the graving or scraping of a ship's bottom. Graving docks are wet docks or basins which may be unwatered and made dry by means of a closing gate and pumping equipment to extract the water. One or more vessels are brought in afloat, the gate is closed and the water is pumped out, exposing the entire hull of each vessel and making it accessible for repairs.

The second type is the floating dry dock, a movable marine structure which can be sunk or raised at will by varying the amount of water ballast. A ship is brought into the partially submerged dock, whereupon both the ship and dock are raised until the entire ship is above water. Floating docks range in lifting power from 300 tons to 100,000 tons.

GRAVING DOCKS

Graving docks are employed both for the building and the repair of ships in principal ports throughout the world. The locations and controlling dimensions of typical graving docks are given in Table III. Notable examples of graving docks are found

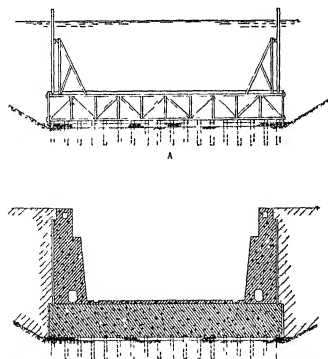


FIG 29—ORIGINAL TREMIE METHOD DEVELOPED BY FREDERIC R. HARRIS TO BUILD GRAVING DOCKS. A TREMIE CONCRETE FORMS. B FINISHED CONCRETE DOCK.

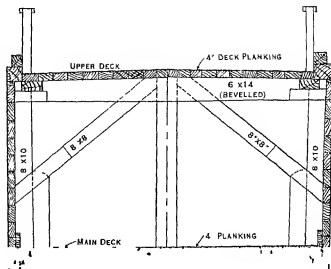


FIG 30—TIMBER CAISSON GATE FOR GRAVING DOCK AT SAVANNAH, GA.

in such U.S. ports as Boston, New York, Brooklyn, Bayonne, Philadelphia and Norfolk, and also at Pearl Harbor, T.H. These are in general concrete structures of dimensions up to 1,100 ft long, 150 ft wide and 42-ft depth below mean low water, equipped with floating caisson gates, inlet and outlet conduits, pumps, compressors, electric substations and the usual utilities employed in shipbuilding and ship repairing.

When a ship is afloat in it, a fixed dry dock or graving dock is similar in general appearance to a wet dock closed by a tidal gate. There are two basic differences. First, the gate by which the water within the dock is controlled is arranged to retain the water

in a wet dock and exclude it in a graving dock so that repairs may be made to the hull of a ship. Secondly the graving dock is made dry by pumping water out to sea and is filled through intake channels from the sea. When ships were small and shallow, they could be put in a cradle and hauled out of the water on rollers on a sloping shipway, but when they became larger, floating dry docks or graving docks were required to serve them. The material of graving docks was at first timber, but as they grew in size strength requirements and also material at hand dictated the use of massive stone masonry and later, reinforced concrete. Fig. 28 illustrates King's dock at Swansea.

Experience in the building of early graving dry docks showed that even these relatively small structures were completed only

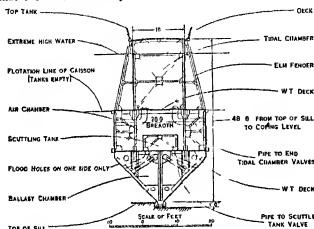


FIG. 31—FLOATING CAISSON FOR EMERGENCY USE AT ROSYTH, SCOT.

after years of effort—ten years was not an unusual period. The history of graving docks was also marked by such disasters as the collapse of the finished dock at Pearl Harbor in 1914, when the bottom of the 1,000 ft long dry dock suddenly let go.

This costly lesson demonstrated that a large graving dock must have a bottom sufficiently heavy to withstand the water uplift. Consequently at Pearl Harbor the 1,000-ft dock was rebuilt in sections after the 1914 disaster. Each concrete section block, weighing about 8,000 tons, was built on a 3,500-ton floating dry dock. As the concrete block developed in weight the dock was gradually forced down. When a bottom block was completed the dock was sunk further so that a buoyant steel tank could be floated in and attached to the block, whereupon the block, acting as a bottom to the steel tank, was towed away and sunk in place. This experience indicated that graving docks thus built would involve not only extra cost for the complicated equipment but also a longer time period than could be allowed. Excavating an area 1,100 ft long and 150 ft wide to 60 or 70 ft below the water surface and excluding the water therefrom is difficult and hazardous.

In the construction of later graving docks the difficulty was overcome by the adaptation of the tremie method of depositing concrete previously used in subway and tunnel work. It was employed in the Detroit River tunnel in 1906 and first applied to a graving dock in Erie basin, New York. The tremie method is a means of depositing concrete under water through a large pipe to avoid the disturbance of the mixture which would occur in depositing it through a considerable depth of water. It was further developed in the construction of numerous large graving docks during World War II and is characterized by placing steel tremie form units on a previously prepared subgrade. In construction of the Erie basin dock, the concrete was poured in one continuous operation by means of tremie pipes. Steel sheet piling suspended along the back line of the side walls with the lower ends in the tremie concrete was braced across the proposed dock. Backfill was placed on the shelf behind the sheeting after the tremie concrete had set. Gravel ballast was then placed in a pile at the centre for added weight to counterbalance the hydrostatic pressure, and the cofferdam was unwatered for completion of the dock in the dry. As the sidewalls were built up, the gravel ballast was gradually removed for use as coarse aggregate in the wall concrete.

This dock was completed and in use in less than two years at a cost within the original estimates, in contrast with earlier docks which required ten years to build at an unprofitable cost. The method was modified in subsequent docks by building the side walls in sections by means of short, narrow cofferdams which were dewatered separately. This permitted the retention of full water head in the central part of the dock, thereby avoiding the transverse bracing and need for ballast.

Still further modifications were made for smaller and shallower docks at Pearl Harbor and Mare Island. The dock dimensions were such that a single line of sheet piling was used above the tremie floor

TABLE III—Typical Graving Docks

| Port | Name | Dimensions (in feet) | | | | Type of gate* |
|--|-----------------|------------------------|---------------|----------------------------|--------------------------------|---------------|
| | | Length from outer wall | Width (clear) | Depth below mean low water | Depth at quay wall or bulkhead | |
| Tracy, Cal. | Gladstone | 1,050 | 100 | 43 1/2 | | S |
| Bombay | | 1,000 | 100 | 40 1/2 | | E |
| Rosyth | H. M. dock yard | 890 | 105 | 40 | | H |
| Panama canal | Balboa | 944 | 110 | 42 1/2 | | H |
| Boston | U. S. navy | 1,100 | 120 | 43 | | T |
| Saint John | New Brunswick | 1,100 | 115 | 47 | | T |
| Durbin | C. magdalen | 1,100 | 110 | 47 | | T |
| Esquimaux B. C. | Victoria | 1,150 | 115 | 40 | | T |
| La Havre | | 1,025 | 115 | 55 1/2 | | T |
| London | Tilbury | 1,100 | 110 | 37 1/2 | | T |
| San Nazair (a railroad built and dry dock) | | 1,138 | 161 | 43 1/2 | | R |
| Southampton | Kemp (cons. V) | 1,300 | 135 | 45 1/2 | | T |
| San Francisco | Kemp (cons. V) | 1,000 | 100 | 41 | | T |
| Pearl Harbor | D D 1 | 1,010 | 133 | 45 | 47 | T |
| Pearl Harbor | D D 3 | 1,100 | 110 | 41 | 25 | T |
| Pearl Harbor | Graving dock | 675 | 93 | 27.0 | 30 | T |
| San Juan P. R. | D D 1 | 407 | 93 | 27 | 30 | T |
| Mare Island | D D 1 | 610 | 131 | 47 1/2 | | T |
| Philadelphia | U. S. navy | 1,100 | 150 | 14.4 | 39 | T |
| Philadelphia | D D 4 | 1,100 | 150 | 17.0 | 45 | T |
| Philadelphia | D D 5 | 1,100 | 150 | 17.0 | 45 | T |
| San Diego | D D 1 | 1,100 | 150 | 17.0 | 45 | T |
| San Diego | Destroyer base | 603 | 90 | 11.6 | 45 | T |
| Norfolk | D D 1 | 1,100 | 150 | 14.7 | 47 | T |
| Charleston | D D 8 | 1,100 | 150 | 17.0 | 30 | T |
| Bayonne | Naval dry dock | 1,100 | 150 | 17.0 | 45 | T |
| Philadelphia | D D 5 and 6 | 1,100 | 150 | 10.5 | 41.3 | T |
| Graving dock | | 611 | 90 | 4.75 | 25.86 | T |
| New moon | Graving dock | 175 | 71 | 24 | 35 | T |
| Veracruz Mex | Graving dock | 1,100 | 150 | 17.0 | 45 | T |
| San Juan | Graving dock | 1,100 | 150 | 17.0 | 45 | T |

*S, sliding gate; T, floating gate; H, hinged gate; R, rolling gate.

with a wale and diagonal braces embedded in the tremie floor. The tremie slab extended beyond the walls to form a shelf which picked up the weight of the backfill. Fig. 29 illustrates the original tremie method and is taken from the U. S. patent issued to Frederic R. Harris in 1944.

Reinforced concrete dry docks of this type at Boston, New York, Bayonne, Philadelphia, Norfolk, Veracruz, San Francisco and Pearl Harbor became typical of generally accepted practice (see Table III). These graving docks were founded on steel H piles with concrete floors up to 20 ft thick. Reinforcement was attached to prefabricated forms placed under close tolerances as deep as 70 ft below mean low water by divers and the submerged concrete was poured through adjustable tremie pipes terminating at the desired levels. Internal flooding and dechuck conduits, together with floating ship-type caisson gates, afforded utilization of the dock functions at all stages of tides. The graving docks at Brooklyn, Philadelphia and Norfolk afforded a clear docking space of 1,100 by 150 ft and were intended to accommodate the largest vessels afloat, including the "Queen Mary" and the battle ship "Missouri." Alternative methods involved the use of well points and deep well pumps. The graving docks at Callao, Peru, San Juan, P. R., and Veracruz employed well points, and deep well pumps were adapted successfully to the construction of graving docks at San Diego and at Long Beach in California.

Caisson Gates—Graving docks are closed at their entrances by caisson gates of four general types, of which two are most prevalent

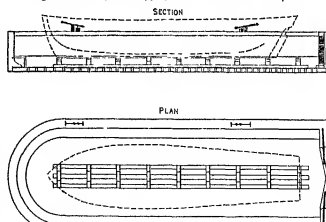
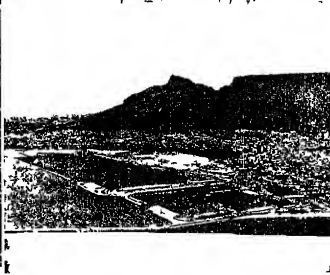
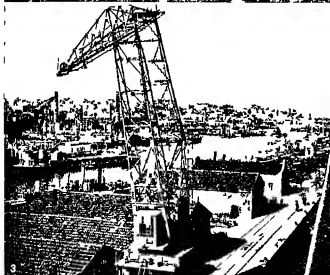
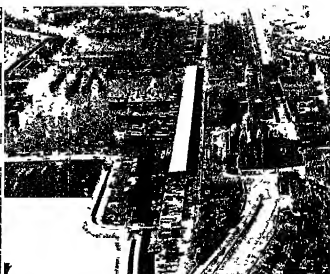


FIG. 32—FIRST PATENT FOR A FLOATING DRY DOCK IN THE U. S. ISSUED TO J. ADAMSON DEC 13 1916



THE TILBURY DOCKS (1) THE MARSAILLES DOCKS (2) THE DUNGEN DOCK (3) THE DOCKS OF LISBON (4) THE DOCKS OF SOUTHAMPTON (5)

EUROPEAN, AUSTRALIAN AND SOUTH AFRICAN DOCKS

- 1 Tilbury docks on the Thames river below London England
- 2 Docks at Marseilles France showing the southern basin
- 3 The docks of Lisbon, Portugal, on the Tagus river near the Atlantic Ocean
- 4 Docks at Southampton England
- 5 Wharves for the harbour ferry service and for overseas shipping at Sydney Australia
- 6 General view of the Dungen dock Capetown Union of South Africa, showing reclaimed shore in the centre Devil's Peak and Table mountain are in the background

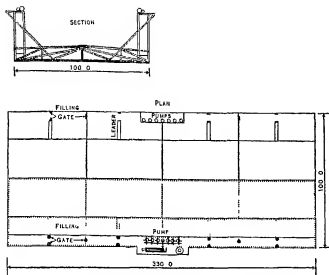


FIG 33—OLD BALANCED OR GRAVITY FLOATING DRY DOCK

sliding gates and floating or ship type gates. Table III shows that relatively few sliding gates were adopted (usually in docks built prior to 1937) and that the great majority were of the ship type. They are built variously of timber, cast iron and steel, according to the available supply and economy of materials. While a timber gate built in 1942 continued in active use at Savannah (fig. 30), all welded steel gates, if properly maintained with protective coating, were found to be more economical. Riveted steel caissons remained in service after more than 50 years without special protective measures. Where sliding gates have been provided at the dock entrance, the ship type caisson has been utilized for dividing the dock internally into two compartments for occasional use. Fig. 31 shows an early form of steel floating gate.

FLOATING DRY DOCKS

A floating dry dock is a buoyant structure designed to raise and support ships out of water and to lower them again to floating condition at will, so that their underwater portions may be inspected, painted or repaired.

An early primitive method of exposing a ship's bottom for cleaning or repairs was adopted about 1700 in the harbour of Kronstadt, Russia, during the reign of Peter the Great. An English ship was in need of repairs, and since no facilities were available in that harbour, the captain bought an old hulk which he gutted completely and to which he fitted a watertight stern gate. He then berthed his ship inside the hollow shell thus formed, closed the gate and pumped out the water. He was then able to make repairs to the underwater body of his vessel. This type of dock continued in use for more than 200 years and was known as the "Camel" dock, after the name of the Kronstadt hulk.

In 1785 Christopher Watson built a timber dock similarly equipped with gates for the express purpose of docking a ship in the dry while resting on the bottom of the Thames river at Rotherhithe. Its principle of operation was much the same as that of the "Camel" dock.

As early as 1809 a design for an iron floating dry dock was patented, but none had been built. A patent issued to J. Adamson in 1816 (see fig. 32) originated from the wreck of an old hull lying on a sloping beach. Its stern was removed and gates similar to those of a canal lock were provided to close the opening. With the gates open, the structure resting upon the bottom was practically submerged. At high tide the ship to be docked was floated in. As the tide receded the water left the dock and the gates were closed preventing its return. The structure patented by Adamson was not strictly speaking a floating dry dock, since it lacked lateral or longitudinal subdivisions to confine the water inside the dock. As designed, pumping would cause the water to flow to the lowest corner and it would be impossible to keep the dock and the vessel on an even keel without exterior bracing.

It is probable that the inventor intended the dock to rest on the bottom. An extra high tide, however, must either flow over the sides or float the structure. In the latter case it became the first floating dry dock, as the title of the patent indicates. This may have occurred at first against the will rather than from the intent of the inventor. Primitive as this form of dock was and

limited as was its use, one of precisely this construction was still in use in Weshawken cove, Hoboken, for dry-docking and repairing of canal boats at the turn of the 20th century.

Fig. 33 illustrates the first hollow floating dry dock, built in Brooklyn and the oldest floating dry dock in use during the first part of the 20th century at Erie basin, Brooklyn. As originally constructed, this dock had a gate at each end and was intended to operate after the principle of the dock invented by Adamson, but when completed the gates were found impracticable and were removed. Thus it became the first U-shaped hollow dock. Built between 1845 and 1850, this dock was 330 ft long by 100 ft wide. It was known as the old balanced or box dock and it was the largest floating timber structure constructed up to that time. When it was found difficult to handle such a single large floating structure with a ship upon it, the development took an opposite turn, and a number of small floating structures were built to be connected together and used as a single dock. The resultant dock became known as the sectional floating dry dock. Each section was short enough to be docked on the other section. The floating sections, each a small box dock, were connected together on each side by locking logs, designed to permit a limited amount of motion between the sections, while keeping them in alignment, particularly while sinking. These docks were found to be very practical, and large numbers of them continued to be built where timber was plentiful (see fig. 34).

About the same time the U. S. navy built its first hollow-sided and hollow-pontooned dock of timber in the navy yard at Portsmouth, N. H., in 1848. This dock was not a complete success as, being a timber dock, it would not of itself sink low enough to allow a ship to enter. Docks had to be fitted within the side walls above the normal water line to form a chamber into which water could be pumped in addition to that which would flow into the dock by gravity.

In the meantime various other methods of raising ships were attempted, including primitive methods which were forerunners of marine railways and systems of hydraulic cylinders.

One of the early devices for raising a ship out of water for examination and hull repairs consisted of two rows of cast iron columns, each column containing a hydraulic cylinder acting as a jack. Upon each pair of columns was placed transversely an iron girder. Above the resultant series of iron girders was floated an iron pontoon, which when sunk into position formed a movable platform controlled in depth. The ship to be docked was floated directly above it. As the hydraulic jacks were set to work the girders, pontoon and ship were raised high enough for the water to flow out of the pontoons, making them buoyant. The pontoon and ship were towed clear, the girders were allowed to sink, and another pontoon was placed upon them for a repeat performance. Among various locations where the system was applied was the Victoria dock in London.

In the latter half of the 19th century docks began to be built in England from the designs of George Rennie, James Campbell and others, which were worked at Cartagena, Sp., Saigon, Indochina, Bermuda and other places. The designers' attention became more and more concentrated on the self-docking problem, which problem the sectional dock had so effectively solved for the timber docks.

The Campbell design became the most popular and was used for the 60,000 ton Southampton dock, which was built to serve the largest Atlantic liners and battleships. However, the advent of broad decked carriers during World War II made even greater demands on the floating dry dock. Floating dry docks presented particular advantages

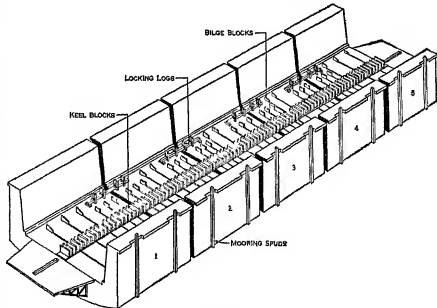


FIG 34—TIMBER SECTIONAL DRY DOCK

for the United States with its far flung advance bases where repair operations had to be carried out. The ease and rapidity with which floating docks can be constructed, the ability to tow them from port to port and their adaptability to localities where graving docks cannot be constructed in the time & funds for emergency repairs to ships.



FIG 35—PLAN OF TROUGH DOCK SHOWING BULKHEADS

The military dry dock follows the fleet. Shortly after a front-line naval base is established the dry dock and repair auxiliaries move in. To meet the requirements, dry docks are designed for towing, long distances at sea, and provisions are made for the housing of large crews. The docks carry into aircraft batteries, self-contained power plants and medium tools and are equipped to be moored offshore.

There are two basic types of floating dry docks, the trough dock and the sectional dock, and all forms of floating dry docks are modifications or combinations of these two.

Trough Dock.—The trough type, having a continuous structure from end to end, possesses longitudinal bulk in strength of its own. This means that it can distribute and equalize one of the nonuniform weight distribution of the average ship is carried by the relatively uniform lift of the dock. This longitudinal girder strength of the dock itself is also effective in distributing and equalizing the nonuniform weight of the ballast water in the different dock compartments, which nonuniformity is incident to unequal flooding, or pumping, (see fig. 45).

Small trough docks are made in one piece. When in need of inspection or repair they are docked in other larger dry docks. Larger sized trough docks are usually built in three or more parts, bolted together for longitudinal rigidity but are arranged so that, when required, the several parts can be self-docked.

Harris Three Piece Trough Dock.—In the Harris steel trough dock (fig. 36) self-docking is accomplished by providing two detachable end sections built to slide under and lift the long center section. The end sections when rotated through 90°, are short enough to be docked on the center section in conventional manner. All docks of this type are built with rounded bottoms to increase the stability.

In addition to the safety deck, the Harris dock is provided with an unroofed, watertight chamber in the pontoon for the full length of the dock center line (fig. 37). The buoyancy of this space is so proportioned as almost to float the weight of the dock structure, thus enabling the safety deck to be placed at a considerably higher level than in a dock with no buoyancy chamber. By lessening the differential between external and internal water level, the buoyancy chamber reduces the maximum water pressure on shell plating and frames and hence cuts down the weight of the structure. The sides of the chamber form effective longitudinal strength bulkheads and separate the ballast water into two sections.

Ship Shaped Trough Dock.—The bureau of yards and docks of the U.S. navy department has built numerous ship shaped trough docks of a military type, especially designed for towing. The docks have closed bows and at the after ends low hinged gates. With their ship lines, high freeboards and rudders, they tow fairly well at sea and, with self-contained power plants, cranes, workshops, ground tackle and complete ship facilities, are ready for immediate service upon arrival at destination. They typify the one piece trough dock of military design.

Sectional Dock.—The true sectional type dock, usually of timber construction, is as its name implies a series of separate sections with no longitudinal girder strength between them. The buoyancy or flotation effect of each section is applied independently in lifting the ship, as in the case of the trough dock, the section is subdivided into compartments by longitudinal and transverse bulkheads, and each section carries its own pumping plant. In order that each individual section



FIG 36—HARRIS THREE PIECE TROUGH DRY DOCK

may have adequate stability when disconnected from the remainder of the structure an assembled sectional dock requires more watertight subdivision in the form of transverse bulkheads than does a trough dock of the same length.

In a simplified form the several sections are interconnected by heavy timber working logs, or equivalent metal devices so arranged as to hold the sections in close alignment in the horizontal plane while permitting vertical slip and down. Locking logs contribute nothing to constructional strength.

In some sectional docks fore-and-aft steel trusses are introduced in

the wing walls. The sections are pin connected to each other at the ends, thus providing a certain amount of over-all girder strength.

Sectional docks are always of the "self-docking" type, that is the fore and aft length of each section is less than the width between wing walls. This being the case, a section when swung through 90° can be docked for inspection or repair upon one or more of the remaining sections. Outriggers are arranged to fold back on the dock during docking of the end sections.

Renne Dock.—The Renne type of floating dock (fig. 38) is a combination that affords the advantages at least in part, of a solid trough dock and a sectional dock. It consists of a number of transverse pontoons which are secured to the underside of continuous wing walls running the full length of the dock. The pontoons or sections may be of timber or steel. The wing walls are almost always of steel construction, a pair of longitudinal steel distributing girders. One advantage of the Renne construction is that pontoon sections may be taken out for repair by unbolting them from the walls, and docked in the remainder of the connected up dock. The combination of timber pontoons with steel wing walls makes unnecessary, in whole or in part, the ballast required for buoyant timber. Steel walls do not dry out and open up as do timber walls, while timber pontoons usually require less maintenance than steel.

One disadvantage of the Renne dock as compared to a solid trough dock is the decrease in depth of the longitudinal distributing girder which in the Renne dock, extends only from the top to the bottom of the wing walls, while in a trough dock it extends from the top of wing walls to the bottom of the pontoons. In the trough dock, a portion of the structural material of the pontoon is included in the strength make-up of the fore and aft girder. The entire dock forms a one-piece "U" or channel shaped distributing structure. In the Renne construction, the connecting bolts and gaskets between walls and pontoons are lines of weakness.

The Renne type of dock, with timber pontoons and steel wing walls, is also known as a "Donnelly" dock, the combination of steel walls and timber pontoons in the Renne dock having been patented by an American, William F. Donnelly. Donnelly docks were often built in two parts or sections hinged together at top of keel block level. One

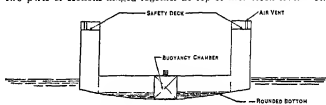


FIG 37—SECTION THROUGH HARRIS STEEL TROUGH DOCK

section consisted of six timber pontoons joined by a pair of wing walls while the other was a shorter section of four pontoons.

Advance Base Sectional Dock.—The special military requirements of maximum size docks for use at remote or overseas bases brought about the development of the large, steel, advance base, sectional dock in which each section is ship shaped for seaworthiness and for ease, speed and safety in towing. When the sections are assembled and the wing walls in alignment, the walls are joined together at top and bottom by welded connections, making each side wall a longitudinal distributing girder. The assembled structure then becomes virtually a Renne type dock, as shown in fig. 39.

Docks of this type were considered desirable because, for the capacity required, a solid trough dock would be too large to tow with reasonable speed or safety and would, in the process of transportation to distant overseas bases be placing "too many eggs in one basket."

Advance base sectional docks were originally planned to be built in various U.S. continental locations and then prepared for towing to some predetermined location with sections in sufficient number so that even with loss of one or two sections by reason of enemy attack, a sufficient number would reach destination for assembly into a usable floating dry dock.

At sea, while being towed as single sections, the two hinged wing walls can be folded flat on deck, thus reducing wind resistance. Each section has its own diesel power plant for generating electricity to be used in pumping the dock and for other services. Sections were originally designed to be self-propelled but, as built, propulsive machinery was not installed. Skags are used to prevent yawing, and towing speeds of eight knots or more have been found possible over long distances. At destination, the walls are raised to their erect position after which the sections are assembled alongside each other, one on top after which the sections are assembled alongside each other, one on top and joined into a rigid structure by heavy plates welded at top and bottom of the wing walls. Unlike the pure sectional dock, the advance base type, by virtue of its heavy welded connections, possesses ample girder strength and carries travelling cranes on top of its walls. The assembled dock contains quarters for officers and crew, shops, storage spaces and provisions for many special services. Single pontoons may be unbolted from the wing walls and self-docked in the remainder of the dock.

Reinforced Concrete Dock.—The primary construction advantages of reinforced concrete for floating dry docks are the availability

of experienced labour, equipment, reinforcing steel and the ingredients of concrete.

Because of the greater structural weight of concrete docks, less floodable space is required to maximum submergence, and as a consequence the safety deck can be located at or near the pontoon deck. This results in short pump and valve shafts and permits the installation of an additional deck in each wing wall which can be used for working and storage spaces, a matter of importance in self-contained military docks where deck space is at a premium.

From other points of view the use of a heavy material is a handicap in a structure utilizing buoyancy for lifting. The ratio of useful lift to dock weight is low in concrete compared to that of steel or timber. Because of its greater weight, it is difficult to provide sufficient longitudinal strength in a long concrete dock to resist sea movements. Self-docking is also difficult to incorporate in a concrete dock but experience has shown that underwater maintenance is low. The field of usefulness of concrete docks remains in trough docks of small or medium size which can be readily towed.

Inclination Dock—The strongest and at the same time the lightest form of self-docking dock is the inclination dock. It is so positioned that any part of its underwater structure may be exposed by tilting so that more than half the bottom is exposed. This dock is a one piece trough dock of considerable longitudinal stiffness, its large twin buoyancy chambers render it practically unmovable by a bomb hit, and, in addition, the absence of heavy self docking gear makes it the lightest of all dock designs (see fig 40).

Mobility of Floating Dry Docks—The mobility of this type of dock is attested by several examples. One was that of a British one-piece inverted steel floating dry dock, 684 ft long, 144 ft over walls at

origin to shipside or from ship to destination. Many items are set on pillets and hauled to and from highway or rail carrier by self-propelled hydraulic lift units that will hoist a ton or more, move it as needed and raise it 15 feet or higher. Pier sheds and transfer facilities are built to accommodate operation of large trailer truck units, which

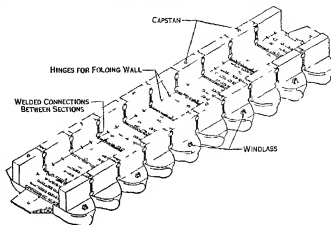


FIG 39—ADVANCE BASE SECTIONAL DOCK

require space for turning rather than straight on and off travel on rails. This has the advantage of more direct movement to shipside and of moving units in and out with much greater facility than by rail.

Greatly increased bulk transit resulted in construction of much larger capacity vessels than have been in use. General cargo ship size has been limited by the tonnage destined for one area that can be economically assembled. Depth of vessels has been governed by available world channels for all but a few ships planned for operation on specific routes. However, for bulk materials where large quantities move between specific ports, the economy of large tonnages is apparent. Ship crews, time in port and other factors are about the same for large ships as small ones. Speeds can be greater and cost per unit moved greatly reduced.

By mid-19th century, tankers as much as 780 feet long and others with a beam width over 100 feet had been launched, carrying more than 400,000 bbl of petroleum from major oilfields to use areas of North America and Europe. Bulk ore carriers had moved into the 65,000-ton class.

This trend to much larger cargo ships indicated that all new facilities had to be made correspondingly larger. Wet basin entrances in tidal harbours, dry docks and channels had to be larger and of deeper draught. Many docks would require deepening alongside as well as revised and enlarged space and handling facilities (See also DOCKYARDS AND NAVAL BASES, HARBOURS).

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DOCK WARRANT,

English law, a document by which the owner of a marine or river dock certifies that the holder is entitled to goods imported and warehoused in the docks. In the Factors act, 1839, it was included in the phrase "document of title" and defined as any document or writing, being evidence of the title of any person therein named to the property in any goods or merchandise lying in any warehouse or wharf and signed or certified by

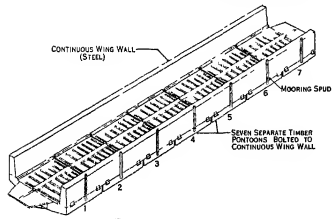


FIG 38—RENNIE DOCK

pontoon deck level with a clear berth of 105 ft 6 in. for docking and a maximum depth of water at the pontoon deck 40 ft. The normal lift power was 30,000 tons. The dock was built by Camel-Laird & Co at Bergenhead, Eng., in 1912 for the dockyards at Portsmouth. After doing service at Portsmouth it was towed through the Irish sea around the north of Scotland to Scapa Flow during World War I. Later it was towed to Alexandria, Egypt, for service in World War II, remaining there until prepared for towing in 1946, when it was again towed to Port Royal, arriving there July 6, 1946. It was further towed from Port Royal to the dockyard at Bermuda, arriving there Aug. 28, 1948. These various migrations attested the seaworthiness of the dock after 36 years of active service. When it was inspected in 1950 the framework was found to be structurally sound and well protected, the side walls showing the ravages of wind and weather only where replacements had not been made. On July 11, 1951, this floating dry dock began another 3,000-mi voyage from the dockyard at Bermuda to Falmouth, Eng.

A floating dry dock of self docking type, although wider than the

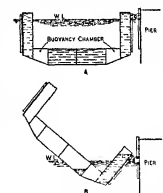


FIG 40—HARRIS INCLINATION DOCK. A. SUBMERGED PRIOR TO SELF DOCKING AT THE MOMENT THAT THE TWO LOCKING PINS ARE SHIFTED FROM THE PIER SPUDS TO THE DUPLEX SWIVEL JAWS ARE IN THE DOCK SPUDS. B. HEeled OVER SO THAT MORE THAN HALF ITS BOTTOM IS EXPOSED.

pleted, the structure was righted again from the 90° position by a reversal of the operation and proceeded on its journey from its shipyard base on the Atlantic seaboard to its Pacific station.

Modern Trends—Trend in waterfront construction in the 1950s was to larger facilities to accommodate (1) changed methods of transferring cargo from shore to ship and (2) much larger bulk cargo carriers.

Highway truck and trailer units move much cargo direct from

the person having the custody of the goods. It passes by indorsement and delivery and transfers the absolute right to the goods described in it. A dock warrant is liable to a stamp duty which may be denoted by an adhesive stamp, to be cancelled by the person by whom the instrument is executed or issued.

DOCKYARDS AND NAVAL BASES Every navy, both in peace and in war requires dockyards and bases where repairs can be executed and ammunition, fuel and stores supplied and where the needs of the personnel can be provided for. This is true also for the mercantile fleets which are served impartially by the great commercial ports and repair yards of the world but the term "dockyard" is usually now applied only to the national establishments for the building and upkeep of warships. In its full sense a dockyard is an establishment which builds and equips warships and has complete facilities for docking and repairing them. It supplies and perhaps manufactures armaments and ammunition provides general and victualling stores and fuel and also contains training, medical and other establishments for the service of the personnel. It is, however, only the few large home dockyards in each country which are so completely equipped, and even in these only a small proportion of warships are actually built. Government dockyards are used mainly for fitting out and commissioning new ships and for the upkeep of the fleets. In most countries, private firms manufacture guns and armour, engines and boilers and often carry the building of ships to the final stages before delivering them to the government establishments for completion. Other dockyards (e.g. Malta) have no special facilities for building ships but are very completely equipped for the maintenance of a large fleet. Others again though maintaining the status of dockyards, are capable only of minor repairs and of supplying stores, ammunition and fuel, these smaller establishments are really fortified naval bases or fuelling stations (q.v.).

Every government dockyard is a naval base, but the converse is not true. A modern fleet must have a base from which to operate, and the first requirements of a base are a safe harbour for the auxiliary craft attendant upon the fleet and a protected fleet anchorage where the ships can, without molestation, replenish with fuel, stores and ammunition and give rest and recreation to the crews. Every dockyard or naval base must be defended by sufficient fixed and mobile local defenses to protect it from attack by submarines or torpedo craft, from predatory raids by a few cruisers and from attack from the air. The security of any dockyard or base however, must depend, ultimately, upon the ability of the fleet which it serves to maintain the command of the sea.

EUROPE AND ASIA

Great Britain and Commonwealth—Until the beginning of the 16th century England had no regular establishment for the navy and possessed neither arsenals nor dockyards. The fleet was composed of a few "king's ships" supplemented by ships provided by the seaport towns. These towns were charged with the maintenance of the fighting ships when they were laid up, and there are evidences of dockyards, or of something answering thereto at the Cinque Ports as early as the 13th century. In 1238 the keepers of the king's galleys were ordered to build a house at Winchelsea for the safe custody of the vessels. In 1243 the sheriff of Sussex was ordered to enlarge a house at Rye in which the king's galleys were kept, and ten years later the bailiffs of Rye and Winchelsea were ordered to repair these buildings. As the fighting ships developed from the galley to the larger sailing ships there appear to have been depots for both ships and stores maintained at Southampton and Portsmouth, and Henry VII, who laid the foundations of British sea power, built the first dry dock at the latter place in 1495. Henry VIII in 1509 purchased land at Woolwich and Deptford upon which the building of the first royal dockyards was started, and in 1540 the royal dockyard at Portsmouth was founded around the site of the dry dock of Henry VII. Queen Elizabeth I started the dockyards at Chatham and Sheerness, and both were considerably extended by Charles II after the Restoration. Plymouth although its ships played no great part in Elizabethan times did not become a royal dockyard

until 1689 when William III commenced the Plymouth dock at Devonport. The small dockyard at Pembroke was founded in 1814 and was followed by the establishment at Haulbowline (Queenstown).

Until 1832 the royal dockyards remained under the control of the navy board, which had been founded in 1546 by King Henry VIII. The admiralty was responsible only for the fleet at sea, and this dual control of the navy had many disadvantages. It led to extravagance and allowed mismanagement and corruption which several times in the history of the country, came near to bringing about national disaster. With the Reform bill in 1832, the admiralty and the navy office were amalgamated and the present system of dockyard administration came into being. During the 19th century a gradual change came over the dockyards with the transition from sail to steam, and many additions were made to meet the needs of the modern fleet. The most important improvements at any one period were brought about by the Naval Works Act of 1895, which sanctioned a large number of new works. The defensive harbours were commenced at Portland, Dover and Gibraltar and also dockyard extensions at the latter place. At Devonport dockyard the great Kevham extension was started, and new works were put in hand at Hong Kong and Simonstown, South Africa. At the same time the building of naval barracks at the three home ports began, together with new hospitals at Chatham, Haslar and Haulbowline, and colleges at Dartmouth and Keyham.

The growing German menace in the North sea in the opening years of the 20th century compelled the admiralty to seek a new base on the east coast, farther north and easier of approach than Chatham. In 1903 the government approved the creation of a new naval dockyard at Rosyth on the Firth of Forth. Though the outbreak of World War I found this base far from complete, it eventually became invaluable as a first class dockyard with three big graving docks. Between the wars it was reduced to a care and maintenance basis but rapidly expanded again in 1939. When hostilities ceased, it was decided to keep it in active operation.

In addition to Rosyth, the main British naval bases in World War I were the large dockyards at Portsmouth, Plymouth, Chatham and Malta with smaller establishments at Sheerness, Portland, Haulbowline and Pembroke. The dockyards at Gibraltar, Hong Kong, Bermuda, Simonstown and Sydney, Austr. all proved their worth, as did such minor bases as Colombo, Cey, Wei hai-wei, China, and Bombay and Calcutta, India. The ports of Harwich, Dover and Immingham acted as bases for light forces, and Scapa Flow, as the munition operational base for the grand fleet, was equipped for storing and minor repairs, with Ciomarty as a second base.

With the outbreak of World War II all these bases, with the exception of Wei hai wei and Haulbowline, which had been surrendered to China and Ere, respectively, were available and, in addition, the great new dockyard at Singapore which had been constructed to meet the Japanese threat—though it was soon to be overrun. But these facilities were not enough, and during the course of the war new repair bases manned by the admiralty were set up at home and abroad at Lyness in Scapa Flow, Corpcach and Dunstaffnage on the west coast of Scotland, Alexandria, Egypt, where a large floating dock was moored, Massawa, the old Italian naval base on the Red sea which was equipped by the U.S. in 1942 but manned from England, Kilindini in East Africa, Durban, U.S.A., which possessed the only battleship dock in the Indian ocean, Freetown, Sierra Leone, where a floating dock was put into operation in 1943, Trincomalee, Cey, and Brisbane, Austr. Ten minor bases were established by Canada on the Atlantic and Pacific coasts to supplement the three main bases at Halifax and Sydney, N.S., and Esquimaux, B.C. Facilities were also developed in places where they already existed such as Bombay, Calcutta and Vizagapatam, India, Cape Town, U.S.A., Diego Suarez, Madagascar, etc.

A new development, known as a floating base or fleet train, was used for the war in the Pacific and enabled the fleet to remain at sea for months at a time. It consisted of floating workshops, storeships and carriers of every kind, vessels which could act as

floating docks for minor craft, oilers and amenity ships which included a floating brewery.

At the end of hostilities the majority of these temporary bases were closed down, but, with the growth of dominion navies and the necessity for commonwealth bases and repair facilities to be as widely dispersed as possible, certain developments overseas continued. In South Africa, where the British admiralty retained the use of Simonstown, the Union government established a small dockyard and base for its own navy at East London and took over Salisbury Island in Durban by Durban itself and Cape Town, with an even larger graving dock, reverted to commercial use but could readily be adapted as naval bases of first importance.

Though Canada officially closed down its temporary wartime bases in Sept. 1945, the dock at Saint John, N.B., remained available for vessels up to and including aircraft carriers, while the three main Canadian bases continued to be actively employed. The dockyard and naval base at Auckland, N.Z., was developed to refit ships as large as the latest cruisers, and the dockyard at Sydney formed the main base for the Australian squadron. Brisbane remained a minor base without a dockyard, but, on Jan. 1, 1950, Manus in the Admiralty Islands was commissioned in the name of H.M.A.S. "Seeadler" as an advanced royal Australian navy base. When the Japanese were expelled in 1944, this island was converted into a naval base for the U.S. 7th fleet, and two huge floating docks, warehouses, machine shops and living quarters were set up. The U.S. disposed of this base in 1947, selling many of the installations to Australia for \$1,250,000. On the other hand the dockyard at Bermuda which had served the navy for many years was officially closed down as uneconomical on March 31, 1951. But Singapore, at the opposite end of the world, continued to develop after it was freed from the Japanese.

Dockyard Administration—The system under which British dockyards are administered is uniform for all, whether the yards are large or small, at home or abroad. The control of all dockyards is vested in the controller of the navy (the third sea lord). At the admiralty, working under the controller, are the director of naval construction, by whom all ships are designed, and the engineering, ordnance, torpedo, electrical and other technical departments, each responsible for the design of its own material. The director of dockyards, also working under the controller, is the admiralty official under whose instructions the work in the dockyards goes on, involving the control of an army of artisans and labourers. Instructions emanate from the admiralty, the details are left to the dockyard officials, and in practice there is considerable decentralization.

Each dockyard is under the charge of an admiral or a captain superintendent, according to its size. His deputy as a rule acts as king's harbour master and is responsible for the berthing and moving of ships in the port. The chief dockyard officers are the constructive manager, the engineer manager, the naval store officer and the electrical engineer, whose names explain their duties, the civil engineer, in charge of all buildings, docks, basins, etc., the cashier, expense accounts officer, and medical officers. Technical matters regarding guns and torpedoes are supervised by the captains of the local gunnery and torpedo schools. There being close personal communication between responsible officers, rapid decisions can be taken in matters arising between the departments as the work progresses, and operations are thus conducted with ease and efficiency.

France—The French coast is divided into three *arrondissements* having their headquarters at the naval ports of Cherbourg, Brest and Toulon, which are also building and fitting out yards. Corsica has naval facilities at Ajaccio, Porto Vecchio and Bonifacio. On the North African coast there are docking facilities at Algiers and fortified bases at Oran and Bizerte. There are naval establishments at Saigon and Haiphong in Indochina, at Diego-Suarez in Madagascar and at Dakar in French West Africa. There are also minor naval bases in the West Indies and at Tahiti and New Caledonia in the Pacific.

In each *arrondissement* the vice admiral, who is the naval prefect, is the representative of the minister of marine and has full

direction and command of the arsenal. He is commander in chief and governor designate in time of war, but his authority does not extend to ships belonging to organized squadrons. The naval prefect is assisted by the "major general," who is usually a rear admiral and directly concerned with the dockyard and material. There are also directors of stores, of naval construction, of the medical service, of naval ordnance and works as well as of the submarine defenses which include torpedoes, mines and torpedo boats. The prefect directs the operation of the whole base and is responsible for the efficiency of ships there in reserve.

Germany—In the first years of the 20th century two great modern dockyards were built at Wilhelmshaven on the North sea and at Kiel in the Baltic, with a ship canal connecting the two. Smaller establishments were maintained at Cuxhaven, Bremerhaven, Flensburg, Swinemünde, Danzig and at Kiaochow in the far east. The last two were lost to Germany following World War I and Swinemünde as a result of World War II. All German bases had reached a high degree of efficiency by 1939, when private shipyards such as those at Elbing in East Prussia at Bredow near Stettin at Bremen and at Hamburg were also used for warship construction. At the end of hostilities all these ports had suffered considerable destruction from air bombing, and the task was completed by Allied authorities. The enormous graving dock at Wilhelmshaven, for instance, reputed to be the largest in Europe was destroyed in 1948 together with workshops and wharves. Within the limits allowed of 7,000 gross register tons and speed of 12 knots, merchant ship building was being carried out at Stralsund and Wolgast, with Warnemünde as a repair yard.

Italy—In 1939 Italy was well equipped with modern dockyards, the most important of which was Spezia with several large docks and building slips. At Naples there were more docks with building slips at Castellamare across the bay, and similarly at Taranto and Venice. A small naval base existed at Maddalena in Sardinia, and in the Adriatic the former Austrian dockyards at Trieste and Pola had also been developed. Most of these ports were severely damaged during World War II, at the end of which the naval tonnage permitted to Italy was reduced to 67,500. Spezia and Taranto remained the main fleet bases, Trieste and Pola were lost and both Venice and Messina decreased in importance.

On the other hand, Augusta in Sicily was developed and merchant ship building made good progress at Taranto and Naples and in the Ansaldo yards at Genoa, Spezia and Leghorn.

Japan—From the first dockyard established at Yokosuka in 1865 expansion was rapid and, by the end of World War I, facilities were available to build and dock the largest and most modern ships. Besides Yokosuka, two large modern dockyards were constructed at Sasebo and Maizuru in addition to several minor but up-to-date bases in the outlying islands. As a result of World War II all these outlying bases were surrendered and Japan's entire fleet was destroyed, although damage to shipyards had been comparatively light. Many large naval docks, nevertheless, were destroyed by U.S. authorities, though Japan was allowed facilities to develop merchant ship building at such ports as Tokyo and Yokohama.

U.S.S.R.—Important dockyards exist at Leningrad and Nikolayev, with lesser establishments at Archangel, Kronstadt, Sevastopol, Odessa and Vladivostok. Most of these dockyards received extensive damage during World War II, but were probably repaired from German reparation deliveries of machinery and equipment. The efficiency of Soviet dockyards after the war was unknown, but they were likely to have benefited both from replanning and reequipment. As a result of their occupation of eastern Germany, the Russians were also likely to have profited from German shipbuilding methods and techniques.

Spain—Schemes for improving the old dockyards at Ferrol, Cartagena and Cadiz were making slow progress at mid 20th century, but the fleet was being steadily modernized. At both Ferrol and Cartagena there were large dry docks and building slips. The dockyard at La Carraca (Cadiz) had four dry docks but no building slips and was used chiefly as a base for small vessels. Smaller naval establishments existed at Port Mahon (Balearic Islands),

Pinia and T. S. Phelps (Cunary Islands) while considerable commercial building and repairs continued to be carried out in private yards at Buckton, Giron, Santander and Bilbao.

Minor Naval Powers—Naval dockyards are maintained by all the powers that possess fleets, but those in European waters which have not been mentioned above are of secondary importance and are capable of serving only the small navies that they maintain. In South America although the dockyards themselves are small the largest capital ships can be docked at Buenos Aires and Puerto Belgrano in Argentina, at Rio de Janeiro in Brazil and at Iquique in Chile.

(S T II W, G M S S)

UNITED STATES

Within three years after the creation of the navy department in 1798 the first naval shore facilities were established at six navy yards—(1) Portsmouth, N.H., (2) Charleston (Boston), Mass., (3) Brooklyn, N.Y., (4) Philadelphia, Pa., (5) Washington, D.C. and (6) Gosport (Norfolk), Va. The Washington yard, where the first marine railway was erected in 1822 was subsequently converted to a naval gun factory and discontinued shipbuilding and all except minor repairs. The Norfolk yard had been built by the British before the Revolutionary War. In 1836 a seventh yard was established at Pen-ang, Fla. The first dry docks, begun in 1827 at the Boston and Norfolk yards, received their first ships in 1833. With the admission of California to the union the west coast base became necessary, and Mare Island navy yard, California, was opened in 1854. A second west coast yard, at Bremerton, Wash., on Puget sound, was added in 1897. Another west coast yard was established at Charleston, S.C., in 1901. All these yards possessed ship repair facilities. Naval stations established in the 19th century included those at Sackets Harbor, N.Y., Key West, Fla., New Orleans, La., Port Royal, S.C., and New London, Conn. The treaty with Spain at the close of the Spanish American War of 1898 gave the United States overseas naval stations at Guam, Guantanamo (Cuba), San Juan and Culebra (P.R.) and in the Philippines. In 1912 a destroyer base was established at San Diego, Calif. The dockyards, evolved over a period of a century during which the navy grew from an assortment of frigates and sloops of colonial design to a complex organization of many types of large and small combatant ships and auxiliaries, were not able to keep pace with naval progress. By the time the naval expansion program of 1938 began, most yards were crowded, and facilities were obsolescent in varying degrees. There was only one dry dock on the Pacific coast capable of handling existing battleships and carriers, necessitating utilization of commercial facilities at Hunters' point in San Francisco, Calif., and the development of the Terminal Island navy yard at Long Beach, Calif.

The first major naval expansion after World War I was the result of the 1938 Hephburn board report, which recommended three major air bases on each coast, one in the Panama Canal Zone and one in Hawaii with outlying operating bases in the West Indies, Alaska, and the Pacific island possessions, some new submarine bases and many other additions or improvements made necessary by the increase in numbers of both ships and planes. Construction of docks and naval bases is under the jurisdiction of the bureau of yards and docks.

During the period of naval expansion commencing in 1938 and ending with the victory over Japan in 1945 the U.S. navy expended more than \$9,000,000,000 for bases within the continental United States and overseas. At the peak of the World War II construction program, the navy possessed almost 7,000 shore activities in nine major categories, including these approximate numbers of units: shipbuilding and repair, 200, naval air, 150, ordnance, 200, procurement and supply, 850, personnel, 1,600, medical, 150, marine corps, 400, coast guard, 1,600, miscellaneous special services, 950. By mid-century, the naval shore establishment represented an investment of about \$12,000,000,000.

The bulk of work at U.S. navy yards has always been carried on by civilians. The industrial work of the yard was at first under a civilian chief constructor and later under a technical staff officer of the navy who served as manager. Formerly, a line officer, usually a rear admiral, was assigned to each yard as commandant.

After World War II the former manager was elevated to command of the shipyard, while the former commandant became commander of the naval base, in which the yard was the principal element.

While the shipyards carried on most of the repair work for the fleet the construction of new warships was shared with private shipyards at a rate increasing with the number and complexity of types in use. Naval shipyards built practically all the navy's ships in the early days. During the days of sail there was little change in design and the yards were able to handle the comparatively simple shipbuilding operations. With the advent of steam and, later, electrical and diesel power, the navy turned to private industry for the boilers, generators and other elements of a ship's engineering plant. There was a period when most heavy vessels were built in private yards, in fact, only 2 of the navy's first 30 battleships were built in navy yards. With the design of heavy battleships and carriers used in World War II beyond the scope of many private yards, more large ship construction was turned out in navy yards, but private yards built most of the destroyers, escort vessels, amphibious craft, transports and supply ships. One important reason for contracting with private shipyards for much of the shipbuilding program is to keep the navy's shipyards open for repair work, particularly in wartime.

Usually, each shipyard is responsible for the continued repair of certain designated ships which are assigned that yard as their home yard although this procedure is modified during wartime when each yard is assigned particular functions in accordance with its location and the changing situation. For instance, during World War II, Pearl Harbor usually handled only emergency repairs of battle damage which enabled ships to resume operations or return to the mainland for complete overhaul. The west coast yards at Puget sound, Mare Island, Hunters' point and Terminal Island handled very little new construction, in order to concentrate on major repairs. The big east coast yards combined much new construction with repair work, except for Portsmouth, which concentrated on its specialty of submarine building.

An example of the wartime role of a large naval shipyard is furnished by the Norfolk yard, which, from 1940 to 1945, repaired, converted or overhauled worked on 6,850 naval vessels totalling more than 27,000,000 tons, of that number, 2,238 were taken into dry dock. In the same period, the Norfolk yard built 101 new ships, ranging from large amphibious craft (LST's) to a battleship and three carriers. The value of work performed during the war years amounted to more than \$1,000,000,000, including \$372,000,000 for repairs, \$561,000,000 for new construction and \$214,000,000 worth of diesel engines, ship's equipment and other items manufactured in the yard.

Advance Bases—In 1940 the United States navy had no properly equipped advance base other than Pearl Harbor. During the next five years, the bureau of yards and docks constructed more than 400 advance bases in the Atlantic and Pacific ocean areas. The largest of these were built at Guam, Leyte, Samar, Manus, Okinawa, Saipan, Trinidad, Argentina peninsula (Newfoundland), Espiritu Santo, Timor, Bermuda, Subic bay (Philippines), Noumea (New Caledonia), Eniwetok, Ulithi, Peleliu, New Guinea and Milne bay (New Guinea). Considerably more than half of these first had to be taken from the enemy and cleared of debris before construction could begin.

The first advance bases were set up to provide aerial protection for lines of communication to the southwest Pacific. Later ones were developed as staging bases at which convoys of transport and cargo ships were serviced and the combat fleet could be resupplied with oil and ammunition, provisions and repair. As the fleet pushed farther into the western Pacific, it became necessary to establish main repair bases at which even the largest ships could be docked and repaired, thus eliminating long, time-consuming trips to the United States.

The first large advance base in the Pacific was at Espiritu Santo, New Hebrides, the next was a main repair base at Manus in the Admiralty Islands. The base at Guam was capable of supporting a third of the Pacific fleet, a similar base was established at Leyte, Samar and a third such base was being built on Okinawa when the war ended.

Facilities at these bases duplicated installations at continental navy yards, including hospital and personnel facilities, piers, roads, shops and all utilities. Since it was impracticable to attempt the construction of large dry docks under wartime conditions, the navy developed floating dry docks, which were built in the United States and towed into the Pacific in sections. Some idea of the logistics involved can be gained from the fact that at Guam alone replenishment stocks of ammunition, food and other consumable supplies on V J day would have filled a train 120 mi long, at that base alone, aviation gasoline was used at the rate of 1,000,000 gal daily.

In planning advance bases, a system of tailor-made bases was evolved, greatly simplifying procurement of material and equipment.

Civilian labour was utilized, until the beginning of World War II, on construction projects in Hawaii, Alaska, various Pacific islands, the Canal Zone and the Caribbean area and on the 99 year lease bases acquired from Great Britain in 1940. After the war began, however, it was not practicable to use civilian workers in overseas bases or combat zones. The navy then established the navy construction battalions, popularly known as Seabees. By July 1945 the Seabees numbered 247,000 officers and men, 83% of whom were serving overseas.

Floating Docks—An outstanding feature of the US advance bases was the floating dock. Floating docks had been in use for many years, the prototype of navy mobile docks was patented in 1876. Several sectional docks were built of wood about 1850, but there is little information available on their use. Two steel docks were built for the navy in 1899 and 1902 at Sparrows Point, Md. The first, of 18,000 tons' lifting capacity, was towed to Algiers, La., and in 1940 to Pearl Harbor. The second, the famous Dewey dry dock of 16,000 tons' lifting capacity, was towed to the Philippines via the Suez canal in 1905-1906. The Pearl Harbor dock was damaged on Dec 7, 1941, during the Japanese raid, but was repaired and continued in service. The Dewey dock was scuttled in 1942 to prevent its use by the Japanese.

Prior to World War II the navy designed and built two auxiliary repair docks of revolutionary design. These were one piece docks, ship shaped in form with moulded closed bows and faired sterns closed by bottom hinged flap gates operated by hydraulic rams. Each carried its own diesel electric plant, repair shops and crew quarters. They were the first dry docks sufficiently self-sustaining to accompany a fleet into distant waters. These docks had a capacity of about 3,000 tons, during the war more than 30 of them were built for advance base use.

Sectional floating docks were built in two sizes, one with ten sections and a lifting capacity of 100,000 tons, and a smaller model of seven sections with a capacity of 56,000 tons. Another type of floating dock was built of concrete, with a 2,800-ton capacity, 12 of these were built. About 30 small 1,000 ton steel docks were also constructed. In all, the navy built 150 floating docks of all types, with a total lifting capacity of 444,000 tons, which docked more than 7,500 ships from 1942 to 1945.

(See also Docks)
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DOCTOR (Lat for "teacher"), the title conferred by the highest university degree. Originally there were only two degrees, those of bachelor and master, and the title "doctor" was given to certain masters as a merely honorary appellation. At Bologna it seems to have been conferred in the faculty of law as early as the 12th century. Pans conferred the degree in the faculty of divinity, according to Antony Wood, some time after 1150. In England it was introduced in the 13th century, and both in England and on the continent it was long confined to the faculties of law and divinity. It was not until the 14th century that the doctor's degree began to be conferred in medicine. The tendency since has been to extend it to all faculties in French and English univer-

sities, while in Germany, in the faculty of arts, it has replaced the old title of *magister*.

Doctors of the church are certain saints whose doctrinal writings have obtained, by the universal consent of the church or by papal decree, a special authority. In the case of the great schoolmen a characteristic qualification was added to the title doctor, e.g., *angelicus* (Aquinas), *melchiorius* (Bernard). The doctors of the church are: for the east, SS Athanasius, Gregory of Nazianzus, Basil the Great, John Chrysostom, for the west, SS Hilary, Ambrose, Jerome, Augustine, Gregory the Great, Anselm, Bernard, Bonaventura and Thomas Aquinas. To these St Alphonso dei Liguori was added by Pope Pius IX.

DOCTORS' COMMONS When, in 1511, Richard Bode well founded the Association of Doctors of Laws and of the Advocates of the Church of Christ at Canterbury, he and his colleagues were establishing for practitioners of canon and civil law a body somewhat similar to the Inns of Court, whose members practised in common law and equity. This society became known as Doctors' Commons. It was a self governing teaching body whose members held degrees either of doctor of civil law at Oxford or doctor of laws at Cambridge and were finally admitted as advocates by the dean of the arches. Members of the governing body called fellows, were elected from the advocates by existing fellows. The members practised in the ecclesiastical courts, in the court of admiralty—which together included the courts whose place is now taken by the probate, divorce and admiralty division of the high court—and in arbitrations involving questions of international law.

In 1565 the master and fellows of Trinity hall took from the dean and chapter of St Paul's a lease in Paternoster row on behalf of the society. This remained the society's headquarters until its incorporation as the College of Doctors of Law Exercent in the Ecclesiastical and Admiralty Courts in 1768, and thereafter until its dissolution in 1858. This event was provided for in the Court of Probate act, 1857, and the Matrimonial Causes act of the same year, these measures were the forerunners of the institution of a single supreme court of judicature, inheriting the jurisdiction of the courts of civil law as well as those of common law and equity, and with a single bar practising before it.

See Sir W S Holdsworth, *A History of English Law* (London, 1903-5).

DOCTRINAIRES, the name given to the leaders of the moderate and constitutional royalists in France after the second restoration of Louis XVIII in 1815. In 1816 the *Nam jaune refuge*, a French paper published at Brussels by Bonapartists and liberal exiles, began to speak of Royer Collard as the "doctinaire". The "doctrinaires" was a popular name for a religious order founded in 1593 by Cesar de Bus. The nickname for Royer Collard was well chosen, for he made it his business to preach a doctrine and an orthodoxy. The rapid extension of the name to his colleagues proves that it had more than a personal application. The Duc de Richelieu and De Serre had been royalist *émigrés*, Royer Collard himself, Lainé and Maugué de Biran had sat in the revolutionary assemblies, Pasquier, Beugnot, De Barante, Cuvier, Mounier, Guizot and Decazes had been imperial officials, but they were closely united by political principle, and all were noted for the dialectical rigidity of their arguments. Their ideal was a king who frankly accepted the results of the Revolution and who governed in a liberal spirit, with the advice of a chamber elected by a very limited constituency. Their views were set forth by Guizot in 1816 in his treatise *Du Gouvernement représentatif et de l'état actuel de la France*. The history of the Doctrinaires as a separate political party began in 1816 and ended in 1830. In 1816 they obtained the co-operation of Louis XVIII, who had been frightened by the violence of the reactionary majority in the chamber of 1815. In 1830 they were destroyed by Charles X when he took the reactionary prince de Polignac as his minister and entered on the conflict with liberalism which ended in his overthrow. During the revolution of 1830 the Doctrinaires became absorbed in the Orléanists (*See France History*). The word "doctinaire" has become naturalized in English as applied, in a slightly contemptuous sense, to a theorist, as distinguished from a practical man.

DOCUMENT, strictly, in law, that which can serve as evidence or proof, and is written or printed, or has an inscription or any significance that can be "read", thus a picture, authenticated photograph, seal or the like would furnish 'documentary evidence.' More generally the word is used for written or printed papers that provide information or evidence on a subject (*See* DIPLOMATIC and EVIDENCE).

DODDER, the popular name of the nonchlorophyll bearing rootless, leafless, twining, parasitic plants forming the genus *Cuscuta* formerly regarded as representing a distinct family *Cuscutaceae* but now included in the *Convolvulaceae*. The genus contains nearly 100 species and is widely distributed in the temperate and warmer parts of the earth. The slender threadlike stem is white, yellow or red in colour, bears no leaves, and in the seedling stage attaches itself by suckers to the stem or leaves of

the eastern states and adjacent Canada, the glomerate dodder (*C. parodora*), which forms dense ropes of flowers on tall herbs in the central states, and the marsh dodder (*C. salina*), abundant in salt marshes of the Pacific coast, forming golden patches on various saline herbs.

DODDS, ALFRED AMEDEE (1842-1922), French general, was born at St Louis, Senegal, Feb 6, 1842, of Anglo-French origin. He was educated at Carcassonne and at St. Cyr, and in 1864 joined the marine infantry as a sub lieutenant. He served as a company commander in the Franco German War, was taken prisoner at Sedan but escaped, and took part in the campaigns of the Loire and of the east. In 1872 he was sent to west Africa, and except when on active service in Cochinchina (1878) and Tongking (1883), he remained on duty in Senegal for the next 20 years, taking a prominent part in the operations which brought the countries of the upper Senegal and Upper Niger under French rule. He led the expeditions against the Boal and Kayor (1889), the Serres (1890) and the Futa (1891), and from 1888 to 1891 was colonel commanding the troops in Senegal. At the close of 1891 he returned to France to command the 8th marine infantry at Toulon. In April 1892 Dodds was selected to command the expeditionary force in Dahomey, he occupied Abomey, the hostile capital, in November, and in a second campaign (1894) he completed the subjugation of the country. He was then appointed inspector general of the marine infantry, and after a tour of the French colonies was given the command of the XX (Colonial) army corps, becoming inspector general of colonial troops. From 1904 to 1914 he was a member of the Conseil Supérieur de Guerre. He died in Paris on July 18, 1922.

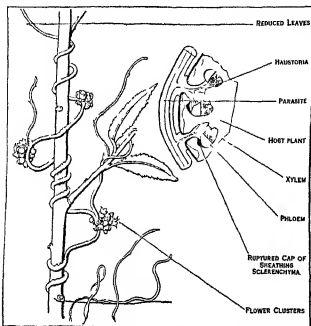
DODECAHEDRON *see* SOLIDS, GEOMETRIC

DODECANESE, Greek inhabited islands in the Aegean sea, known also as Southern Sporades and Aegean Islands. Although "Dodecanese" signifies in Greek "twelve islands," 13 are regularly included in the group, viz, Astypalaea (Astropalia), Calymnos, Karpathos, Cassos, Castellorizo, Chalki, Cos, Leios, Nisyros, Patmos, Rhodes, Symi, Telos (Rhodope). Some authors add the islet of Lapos. Prior to 1912 Rhodes and Cos were not considered part of the group. Nikaia (Icaria) was included, however, until 1912, when it became part of the Greek state.

In antiquity these islands, especially Rhodes (*g v*), were known as centres of Greek culture. Among distinguished Dodecanesians there were Cleobulus, one of the Seven Sages of Greece, Apelles, the famous painter, Hippocrates, father of medicine, Erinna, the first Greek poetess, Antus, the comic poet, Xenophon, the noted physician of Cos, who was the first Dodecanesian to visit England. The Rhodian school of sculpture occupies a prominent place in Greek art. Especially well known works of this school are the statue of Laocoon, now in the Vatican, and the Colossus of Rhodes, which was counted among the seven wonders of the ancient world. Rhodian maritime law played a significant part in later codifications.

The Dodecanese, together with their mother country Greece, have come successively under the domination of various alien rulers (Roman, Saracen, Venetian, Genoese, Algerian, Arab and the Knights of St John of Jerusalem). In 1522 the islands were occupied by the Turks, but were guaranteed the privileges of complete autonomy in local administration in return for payment of a fixed annual tax. These privileges, despite occasional infringements, continued until 1912. In that year Italy, at war with Turkey, occupied the Dodecanese. The islanders aided the Italians, believing in the promises of General Ameglio and Admiral Presbitero, who formally assured them that autonomy would follow the abolition of Turkish rule. Indeed, an insular assembly met at Patmos, declaring the Dodecanese the "Autonomous State of the Aegean" and proclaiming the wish of the islanders to be united with Greece. Now Italy's real intentions became manifest. No recognition was given to this declaration and severe penalties were imposed upon some of the delegates. Although in the Treaty of Lausanne (Oct 5, 1912) Italy undertook to withdraw her army from the islands, the occupying forces remained, upon one pretext and another.

The great powers, especially England, recognized the strategic



BY COURTESY OF MESSRS. GUSTAV FISCHER, FROM STRASBOURG, LEHRBUCH DER BOTANIK.

DODDER (*CUSCUTA EUROPAEA*). A PARASITIC PLANT ON A WILLOW TWIG. In the small figure is seen a transverse section of the host plant, showing the contact of the dodder with the tissues of the host, which it finally destroys.

some other plant round which it twines and from which it derives its nourishment. It bears clusters of small flowers with a four- or five-toothed calyx, a cup-shaped corolla with four or five stamens inserted on its tube, and sometimes a ring of scales below the stamens, the two culled ovaries becoming when ripe a capsule, splitting by a ring just above the base. The seeds are angular and contain a threadlike spirally coiled embryo which bears no cotyledons. On coming in contact with the living stem of a susceptible plant around which it twines, the seedling dodder throws out suckers which penetrate the host, its tissues establishing organic union. By this means water is drawn from the wood or xylem and nutriment from the phloem of the host. The dodder then soon ceases to have any connection with the ground. As it grows, it throws out fresh suckers, establishing itself very firmly on the host plant. After making a few turns round one shoot the dodder finds its way to another, and thus it continues twining and branching till it resembles "fine, closely-tangled, wet catgut." The injury done to flax clover, hop and bean crops by species of dodder is often very great. *C. europaea*, the greater dodder (*see fig*) is parasitic on hops, vetches, sugar beet, potato and several wild hosts in Europe, but is rare in America, also willow, *C. epithymum*, on flax, hemp and some other hosts, *C. epithymum*, on various species of clover, alfalfa and other legumes. *C. tralalis*, the clover dodder, is probably a subspecies of the last mentioned. In the United States and Canada about 20 species occur, a few of which have been naturalized from the old world. Among the native species are the love-vine (*C. growia*), common on herbs and low shrubs in

importance of the Dodecanese in the eastern Mediterranean. In 1913 Sir Edward Grey declared that "as long as one of the Great Powers remains in occupation of these islands the situation will remain abnormal," and that their fate interested all the great powers.

Nevertheless when the Allies wished to induce Italy to join them in World War I, they concluded with that country the Secret Treaty of London (1915), among other things promising her "full possession" of the Dodecanese. In 1917 the United States joined the Allies with the understanding that secret treaties should not be recognized. On July 29, 1919, an agreement was reached between Eleutherios Venizelos and the Italian Foreign Minister Tommaso Tittoni, whereby Italy promised to cede the Dodecanese to Greece with the exception of Rhodes, which was to have "broad local autonomy." By an additional secret accord Italy bound herself to permit the inhabitants of Rhodes to decide their own fate in the event that Great Britain should announce her willingness to cede Cyprus to Greece, although not until five years should have elapsed. On July 22, 1920, Count Sforza, Tittoni's successor, denounced this agreement. On Aug. 10, 1920, at Sévres, under pressure from the Allies, Italy concluded a new accord with Greece, similar to the previous agreement, but specifying 15 years, instead of 5, until a plebiscite might be held in Rhodes.

The Dodecanese, however, were still *de jure* a Turkish possession. In order to permit Italy to transfer the islands to Greece according to the above agreement, an article (#122) was included in the Treaty of Sévres, by which Turkey "renounced in favour of Italy all rights and titles" upon the Dodecanese. This treaty and the new Graeco-Italian accord were signed simultaneously. In 1922, Italy denounced the latter. Great Britain immediately protested this unilateral denunciation.

In 1923 the Treaty of Lausanne superseded the Treaty of Sévres. Article 15 of the former is identical with article 122 of the Sévres Treaty just described. It is this article which Italy construes as giving her full sovereignty over the Dodecanese. The opposing view is based upon article 16 of the Treaty of Lausanne, which provides that "the fate of the islands is settled or to be settled by the parties interested," and upon a written reservation made by Greece at Lausanne (Jan. 21, 1923), concerning the "determination of the future lot" of the Dodecanese.

Italian authorities have applied the term "possession" to the Dodecanese inasmuch as their literacy and general cultural level have made it impossible to regard them as a colony, and since the inhabitants are obviously not Italian and thus could not be classified as a province. Their administration has been assigned to the ministry of foreign affairs.

During the occupation by Italy the Dodecanese suffered grievously from the Italian policy of "assimilation." The majority of the local Greek schools were closed, and those remaining open were compelled to conduct most of their instruction in the Italian language. Freedom of speech and of the press were abolished, and Greek newspapers banned. Heavy taxation, espionage and imprisonment without cause were the order of the day. Pressure was brought to bear upon the Greek orthodox and native churches were closed. The Roman Catholic archbishopric which existed in Rhodes prior to the Turkish occupation was re-established, and Roman missions and Uniat churches opened. These measures occasioned large scale emigration to Greece, Egypt, the United States, Australia and other countries. The population of the islands, which in 1912 was 143,080 (133,761 Greeks, 6,874 Turks and 2,445 Jews) had diminished to 121,480 by 1951.

The soil of the Dodecanese is relatively infertile except in Rhodes and Cos. All the islands are mountainous. Fruits are grown in small quantity, also tobacco, olives and wheat. Fishing, sailing and sponge diving constitute the principal occupations of the inhabitants. From the financial point of view the islands were not an asset to Italy, which was obliged to contribute 8,000,000 lire annually in addition to extraordinary credits in order to compensate for the economic deficit.

During World War II the Italians and the Germans made extensive use of naval and air bases in the Dodecanese.

With the unconditional surrender of Italy (Sept. 8, 1943), representatives of the Dodecanesian people convened in New York City (Oct. 23, 1943) and formally declared their union with the people of Greece. During the autumn of 1943 some of the islands were actually liberated, but the Germans were able to reoccupy them. Early in 1945 some of the Dodecanese were again freed, and by unanimous proclamation the inhabitants reaffirmed their decision to be united with Greece, and requested the Greek government to send representatives to administer the islands.

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For the Italian point of view see L. Vilhri, *The Expansion of Italy* (London, 1930), A. Giannini, *L'Ultima Fase della Questione Orientale 1913-1932* (Rome, 1939).

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DODGE CITY, a city of southwestern Kansas, U.S.A., on the Arkansas river, at an altitude of 2,478 ft., the county seat of Ford county. It is on federal highways 50S and 154, and is served by the Rock Island and the Santa Fe railways. The population in 1950 was 11,262, in 1940 it was 8,487. It has railroad shops, farm implement plants, a dressed poultry plant and creameries and is the supply centre for a large agricultural and stock-raising area. The meridian separating central from mountain time passes through the city. Dodge City was settled about 1872 and incorporated in 1875. It was a famous frontier town on the old Santa Fe trail, the rendezvous of picturesque characters, the centre of important freighting lines and headquarters of the cattle business. At the peak, in 1884, herds aggregating 8,000,000 head of cattle passed through from Texas, in charge of 3,000 men. There were immense herds of buffalo in this region. Hunting parties often killed 250 in a day, and the first trains often had to wait hours while a herd crossed the track. The first winter after the Santa Fe came through, 200,000 buffalo hides were shipped from Dodge City. At some stations in the vicinity shipments of buffalo bones in 1875 averaged a carload a day. On the river 5 mi E. of the city is old Ft. Dodge, an important frontier garrison, now the state home for disabled volunteer soldiers.

DODGSON, CHARLES LUTWIDGE ("Lewis Carroll") (1832-1898), English mathematician and author, son of the Rev. Charles Dodgson, vicar of Daresbury, Cheshire, was born in that village. The literary life of "Lewis Carroll" became familiar to a wide circle of readers, but the private life of Charles Lutwidge Dodgson was retired and practically uneventful. After four years at Rugby, Dodgson matriculated at Christ Church, Oxford, in May 1850. He took a first class in the final mathematical school in 1854, and the following year was appointed mathematical lecturer at Christ Church, a post he continued to fill till 1881. His earliest publications, beginning with *A Sylabus of Plane Algebraical Geometry* (1860), and *The Formulae of Plane Trigonometry* (1861), were exclusively mathematical, but late in the year 1865 he published, under the pseudonym of "Lewis Carroll," *Alice's Adventures in Wonderland*, which has become an English classic. It was an open secret that the original of "Alice" was a daughter of Dean Liddell. Alice was followed (in the "Lewis Carroll" series) by *Phantasmagoria* (1869), *Through the Looking-Glass* (1872), *The Hunting of the Snark* (1876), *Rhyme and Reason* (1883), *A Tangled Tale* (1885), and *Sylvie and Bruno* (in two parts, 1889 and 1893). He wrote skits on Oxford subjects from time to time. *The Dynamics of a Particle* was written on the occasion of the contest between William Gladstone and Gathorne Hardy (afterward earl of Cranbrook), and *The New Bulfinch* in ridicule of the election put up at Christ

Church for the bells that were removed from the cathedral tower While 'Lewis Carroll' was delighting children of all ages, C. L. Dodgson periodically published mathematical works—*An Elementary Treatise on Determinants* (1867), *Euclid, Book I*, *Prolegomena* (1874), *Euclid and his Modern Rivals* (1879), the work on which his reputation as a mathematician largely rests, and *Curious Mathematical* (1888). Though the fact of his authorship of the 'Alice' books was well known, he ungraciously denied when occasion called for such a pronouncement that Mr Dodgson neither claimed nor acknowledged any connection with the books not published under his name. His memory is appropriately kept green by a cat in the Children's Hospital, Great Ormond Street, London, which was endowed perpetually by a public subscription. The cat of Alice in Wonderland was sold by Dean Iddell's daughter in April 1908 for £15.400.

See S. D. Cullingwood *Life and Letters of Lewis Carroll* (1898), F. B. Lingen *Victoria Through the Looking Glass: The Life of Lewis Carroll* (1945).

DODO, the name for large birds formerly inhabiting the islands of Mauritius and Réunion, but now extinct, and which, with the solitaire (*q.v.*), constituted the family Raphidae in the order Columbiformes. The Dutch explorers called them *walgvogels*, or noxious birds since no cooking made them palatable. H. L. Strickland and A. G. Melville's *The Dodo and Its Kindred* (London, 1848) and G. R. von Frauenfeld's *Neu aufgefunden 10-bildung des Dodo's* (Wien, 1868) list known records. They survived until 1681. Specimen parts were found by G. Clark in a mud pool in 1865, on Mauritius, and others by Th. Sauer in 1889 in the same swamp. Skeletons were prepared and restorations made for Mauritius and European museums.



FROM WILLIAM SCOTLAND: THE ILLUSTRATION OF THE DODO (*RAPHUS CUCULLATUS*). Native to Mauritius the Dodo was exterminated about 1681. It was nearly the size of a swan and flightless, living in the island forests.

The huge blackish bill of the dodo terminated in a large, horny hook, the cheeks were partly bare, the stout, short legs yellow. The plumage was dark ash coloured, with whitish breast and tail, yellowish white wings (incapable of flight). The short tail formed a curly tuft. The bird of Mauritius was *Raphus cucullatus*, while on the nearby island of Réunion was a related species, *R. solitarius*. The dodo inhabited forests and laid one large white egg on a mass of grass. Man and the hogs and other animals he imported effected its extermination.

(G. T. S.)
DODONA, in Epirus, the seat of the most ancient and venerable of all Hellenic sanctuaries. Its ruins are at Dramos, near Tsacharova. Though the Greeks of the south looked on the inhabitants of Epirus as barbarians nevertheless for Dodona they maintained a certain reverence. Its temple was dedicated to Zeus, and connected with it was an oracle which would seem to date from early times, for the method of gathering responses was by listening to the rustling of an old oak tree, perhaps a remnant of very ancient tree worship. Sometimes, however, ruggies were taken from doves in the branches, the murmur of a fountain, or the clanging of brazen caldrons hung round the tree or tripod. Croesus proposed to this oracle his well known question, Lycian der sought from it sanction for his ambitious, Athens frequently appealed to its authority. But the most frequent votaries were the Aeanians and Actolians with the Boeotians, who claimed a special connection with the district.

Dodona is spoken of in the *Iliad* as the abode of Selvi who sleep on the ground and wash not their feet, and the *Odysses* has an imaginary vision of Odysseus to the oracle. A Hesiodic fragment describes Dodona as Heliopia as a district full of cornfields, of herds and flocks and of shepherds, where is built on an extremity (τῆς ἑξωτερικῆς) Dodona, where Zeus dwells in the stem of an oak (ἄκρῳ). The priestesses were called doves (πτερυγίδες) and Herodotus tells a story which he learned at Egypt in Thebes that the oracle of Dodona was founded by an Egyptian priestess

who was carried away by the Phoenicians but says that the local legend substitutes a black dove, in which he tries to find a rational meaning. In historical times it was worshipped together with Zeus, a consort named Dione (see further ZEUS ORACLE, DIONE).

The ruins, a theatre, town walls and other buildings were identified by Wordsworth in 1832, and excavated by Constantin Cavapanos after 1875. The topographical and architectural results are disappointing either the site always retained its simplicity, or else its buildings have been very completely destroyed.

South of the hill on which are the town walls east of the theatre, and towards the eastern end of a plateau about 200 yd long and 50 yd wide are the remains of the temple of Zeus, pronaos cella and opisthodomus about 130 ft by 80 ft over all. Some lower drums of internal columns of the cella still rest on their foundations. No trace of external colonnade was found. It had been converted into a church. In and around it were found statues and decorative bronzes, many bearing dedications to Zeus Naurus and Dione, many small tablets of lead which contained questions put to the oracle.

Below the terrace was a precinct, flanked with porticoes over 200 yd in length and breadth, of irregular shape. One of the buildings on the south western side contained a pedestal or altar, and is described by Carapanos as a temple of Aphrodite. In front of the porticoes are rows of pedestals, which once bore statues and other dedications. At the southern corner is a gate, flanked with two towers, between which are placed two coarse limestone drums. If these belong to the original gateway, it must have been of a very rough character.

The smaller antiquities are now in the National Museum in Athens. Among the dedications are weapons dedicated by King Pyrrhus from the spoils of the Romans.

The temple of Dodona was destroyed by the Aetolians in 219 B.C., but the oracle survived to the times of Pausanias and the emperor Julian.

See C. Wordsworth, *Greece* (1839), p. 247, Constantin Carapanos, *Dodone et ses ruines* (Paris, 1878). For the oracle inscriptions, see E. S. Roberts in *Journal of Hellenic Studies*, vol. 1, p. 218.

DODS, MARCUS (1834–1909), Scottish divine and biblical scholar, was born at Belford, Northumberland, on April 11, 1834. He studied at Edinburgh and was licensed in 1858. In 1864 he became minister of Renfield Free Church, Glasgow, where he worked for 25 years and in 1889 was appointed professor of New Testament exegesis in New College, Edinburgh, of which he became principal on the death of Dr. Rainy in 1907. He died in Edinburgh on April 26, 1909. His views on inspiration brought on him a charge of unorthodoxy which was preferred against him by the General Assembly in 1890, a year after his election to the professorship, the charge was soon dropped by a large majority, and in 1891 he received the honorary degree of D.D. from Edinburgh university. He edited Lange's *Life of Christ* in English (Edinburgh, 1864, 6 vols.), Augustine's works (1872–76), and, with Dr. Alexander Whyte, Clark's "Handbooks for Bible Classes" series. In the Expositor's Bible series he edited Genesis and I Corinthians, and he was also a contributor to the ninth edition of the *Encyclopaedia Britannica* and Hastings' *Dictionary of the Bible*.

Among other important works are *The Epistle to the Seven Churches* (1865), *Israel's Iron Age* (1874), *Mohammed, Buddha and Christ* (1877), *Handbook on Haggai, Zechariah and Malachi* (1879), *The Gospel according to St. John* (1897), in the Expositor's Greek Testament, *The Bible, its Origin and Nature* (1904). See his *Early Letters* (1910) and *Later Letters* (1911).

DODSLEY, ROBERT (1703–1764), English bookseller and miscellaneous writer, was born near Mansfield, Nottinghamshire, where his father was master of the free school. He is said to have been apprenticed to a stocking weaver in Mansfield, from whom he ran away, taking service as a footman. In 1729 Doddsley published his first work, *Servitude, a Poem* written by a Footman, with a preface and postscript ascribed to Daniel Defoe, and a collection of short poems, *A Muse in Livery, or the Footman's Miscellany*, was published by subscription in 1732. Doddsley's patrons comprising many persons of high rank. This was followed by a satirical farce called *The Toyshop* (Covent Garden, 1735).

With the help of his friends—Pope lent him £100—Doddsley set up as a publisher at the "Tully's Head" in Pall Mall in 1735. One of his first publications was Dr Johnson's *London*, for which he gave 10 guineas in 1738. He published many of Johnson's works, and he suggested and helped to finance the *English Dictionary*. Pope also made over to Doddsley his interest in his letters. In 1738 the publication of Paul Whitehead's *Manners*, voted scandalous by the lords, led to a short imprisonment. Doddsley also founded several literary periodicals: *The Museum* (1746-67, 3 vols.), *The Preceptor* containing a general course of education (1748, 2 vols.), with an introduction by Dr Johnson, *The World* (1753-56, 4 vols.), and *The Annual Register*, founded in 1758 with Edmund Burke as editor. Doddsley is, however, best known as the editor of two collections: *Select Collection of Old Plays* (12 vols., 1744, 2nd edition with notes by Isaac Reed, 12 vols., 1780, 4th edition, by W. C. Hazlitt, 1874-76, 15 vols.), and *A Collection of Poems by Several Hands* (1748, 3 vols.), which passed through many editions. In 1737 his *King and the Miller of Mansfield*, a "dramatic tale" of King Henry II, was produced at Drury Lane, the sequel, *Sir John Cockle at Court*, a farce, appeared in 1738. In 1745 he published a collection of his dramatic works, and some poems which had been issued separately, in one volume under the modest title of *Trifles*, and this was followed by other poems and plays. His tragedy of *Cleone* (1758) had a long run at Covent Garden, 2,000 copies being sold on the day of publication and it passed through four editions within the year. In 1759 Doddsley retired, leaving the conduct of the business to his brother James (1724-97), with whom he had been many years in partnership. He died at Durham while on a visit to his friend, the Rev. Joseph Spence.

Doddsley's poems are reprinted with a memoir in A. Chalmers's *Works of English Poets*, vol. xv (1810). See also Charles Knight, *Shadows of the Old Bookshelves* (1865) pp. 189-216, E. Solly, in *The Bibliographer*, v (1884) pp. 57-61, Austin Dobson, "At Tully's Head" in *Eighteenth Century Vignettes* (2nd series, 1894), R. Straus, *Robert Doddsley, Poet, Publisher and Playwright* (1910).

DODSWORTH, ROGER (1585-1654), English antiquary, was born near Oswaldkirk, Yorkshire, the son of Matthew Doddsworth, registrar of York cathedral. He collected a vast store of materials for a history of Yorkshire, a *Monasticon Anglicanum*, and an English baronage. The second of these was published with considerable additions by Sir William Dugdale (2 vols., 1655 and 1661). The mss were left to Thomas, third Lord Fairfax, who by his will bequeathed them (160 volumes in all) to the Bodleian library at Oxford. Portions have been printed by the Yorkshire Archaeological society (*Doddsworth's Yorkshire Notes*, 1884) and the Chetham society (copies of Lancashire post mortem inquisitions, 1875-1876).

DODWELL, HENRY (1641-1711), scholar, theologian and controversial writer, was born at Dublin. He became a fellow of Trinity college, Dublin, but having conscientious objections to taking orders he relinquished his fellowship in 1666. In 1688 he was elected Camden professor of history at Oxford, but in 1691 was deprived of his professorship for refusing to take the oath of allegiance to William and Mary. He retired to Shottesbrooke to study chronology and ecclesiastical polity.

His chief works on classical chronology are *A Discourse concerning Sanchoniathon's Phoenician History* (1681), *Annales Thucydides et Xenophones* (1707), *Chronologia Graeco-Romana pro hypothese Dion Halicarnassensis* (1692), *Annales Vellorum, Quintilianei, Statuini* (1698), and a larger treatise entitled *De veteribus Graecorum Romanorumque Cyclicis* (1701).

DOG Although the word "dog" is believed to have been originally applied to a particular English breed, it is now used in a general sense to connote all the domesticated varieties of the zoological genus *Canis*, of which the wolf (*Canis lupus*) and the northern jackal (*Canis aureus*) of Europe and Asia are familiar wild species. The accepted zoological name is *Canis familiaris*.

Origin and Antiquity—The time that prehistoric man first domesticated a wild canine to serve as his hunting aid or cave guardian is unknown. The aboriginal peoples of Switzerland and Ireland used dogs for hunting and undoubtedly ate dog flesh long before they learned to till the soil. Cave drawings of the palaeolithic era include hunting scenes in which the rough form of a

canine appears alongside the huntsmen. One of these drawings is estimated to be 50,000 yrs. old.

The question which naturally arises relative to such old drawings is whether the canines pictured can rightfully be called dogs. They undoubtedly were wild animals, probably wolves, which were taken into the cave-men's abode as cubs and nourished by bones and entrails of the animals eaten by the family. The domesticated canine probably learned that it was easier to procure food by accompanying the huntsman than by chasing and killing its own prey, thus becoming a hunting assistant and probably a guardian of its master.

The most commonly accepted theory of canine development is that the wolf was the main progenitor, with subsequent crossings with other wild canines. It is unlikely that the jackal was a contributor to the strain in view of the fact that the jackal's dental structure is different from that of the dog, whereas the teeth of the wolf are identical in every detail with those of the dog.

From the investigations of caves, middens and lake dwellings, it is known that Europeans of the new stone age possessed a wolf-like breed of dogs, and a similar breed has been traced through the successive ages of bronze and iron. But accurate information of the external form of domesticated dogs prior to historic times is not available. From the oldest records supplied by Chaldean and Egyptian monuments, it is manifest that several distinct varieties had been developed 4,000-5,000 years ago. Slender dogs of the greyhound type, and a short-legged breed of a terrier type are depicted in Egypt, and the Assyrians of about 600 B.C. had mastiff-like hounds.

The early Greeks and Romans had dogs and mentioned them often in their literature. The Romans' canine classifications were similar to our modern groups. Both made distinctions between those which hunted by scent and those which hunted by sight, just as we divide hounds from hunting breeds. The Romans also had *Canes vulgares* (housedogs) and *Canes pastorales* (sheep dogs) which compare to modern working dogs.

MODERN BREEDS OF DOGS

There are five main classes of dogs in addition to a miscellaneous sixth group. This division is based on the uses of the dogs—sporting dogs for hunting by air scent, hounds for hunting primarily by ground scent, terriers which hunt by going to earth, working dogs to serve as guards, guides and herders, toy dogs to serve as companions, and the miscellaneous or nonsporting group of dogs for a great variety of uses. This general classification applies to modern dogs all over the world. In 1945 there were 113 breeds in these 6 groups recognized in the United States.

The Sporting Group—(Wire haired pointing griffon, pointer, German short haired pointer, Chesapeake Bay retriever, curly coated retriever, flat-coated retriever, golden retriever, Labrador retriever, English setter, Gordon setter, Irish setter, American water spaniel, Brittany spaniel, clumber spaniel, cocker spaniel, cocker spaniel [English type], English springer spaniel, field spaniel, Irish water spaniel, Sussex spaniel, Welsh springer spaniel and Weimaraner).

The dogs in this group serve as hunters' assistants, mainly as finders and retrievers of small fur-bearing and fowl. The spaniels are the largest class of hunting breeds. The Irish were among the first users of spaniels, and the name indicates that they probably procured their original stock from Spain. The water spaniel was first printed in the Irish laws of 17 A.D. in a statement that water spaniels had been given as tribute to the king. Three hundred years later, during the period when Wales was overrun by the Irish spaniels are mentioned in Welsh statutes.

English literature of the 14th century mentions "spanyells," and they were used in falconry during the 16th century, probably to retrieve game killed or injured by the falcons. From the reign of Henry VIII there are records of payments made to "Robin the King's spaniel keeper."

The spaniel family is divided into those breeds which hunt and retrieve those which retrieve only and toy spaniels which do not hunt (see *Toy Dogs*, below). Most of the sporting spaniels, in-

cluding the cocker, springer and dumber range the hunting ground just ahead of the gunner. Their task is to range back and forth over terrain selected by the hunter, but always close enough to the gunner that the charge from his shotgun can kill the game which the dogs flush. Thus the spinnel may be close as 20 yds to the hunter, rarely more than 75 yds away. The reason that spaniels must hunt close is that they give no warning upon finding game—as do the pointing dogs, but immediately rout the game from cover. A well trained spinnel of this type hunts until he finds game flushes the game then immediately sits. For such a dog to chase the bird into a serious hunting fault. If the game is killed the spinnel is ordered to find the dead bird or animal and return it to the gunner. Hunting spinnels of this type are trained to flush both furred and feathered game. They also can be trained to retrieve waterfowl from a hunting blind, the springer spaniel being especially adaptable for this work.

The Irish water spinnel despite its name, is usually dressed with the terrier, rather than the spinnel. It competes with the Labrador, Chesapeake Bay and other retrievers in use.

A second group of gun dogs include the pointers and setters, which hunt up and flush birds by pointing. Unlike the spinnels, which hunt close to the gunner, the pointing breeds range far ahead of the hunter as often out of sight. When they scent game they do not immediately flush the birds into the air, but stand motionless within a few feet of the game, their sensitive noses pointing toward the single bird or covey. They remain in this position until the hunter flushes and shoots the birds. A well trained pointing dog will hold such a shot for a minute to two hours stand stunchy, while the game is hot and wait for the hunter's command to find and retrieve the killed game.

Pointing dogs are of comparatively recent origin, their development paralleling the development of sporting firearms. Wing shooting came into popularity during the first decade of the 18th century, and from that period the rise of the "bird dogs" was marked. The dogs of the pointing group include the German short-haired pointer, the pointer, English setter, Irish setter, Gordon setter and Weimaraner.

Most of the pointing breeds were developed in the British Isles. The first of record were those used in England about 1650 for pointing hares. The English setter probably was developed from crosses of the Spanish pointer, the large water spaniel and the springer spaniel, and there is evidence that a distinct breed of the English setter type was used as early as 1582. It was not until about 1825, however, that the breed came into real prominence through the English sportsman, Edward Laverack, whose breeding practices standardized the appearance of the English setter.

The Gordon setter often is called the black and tan setter because of its coat colours. The breed never has approached the English or Irish setter or the pointer in popularity.

The mythogav red Irish setter, as distinguished from an earlier red and white breed, first appeared in Ireland early in the 19th century. In addition to being one of the most handsome of all breeds, the Irish setter is a capable field dog.

The retriever breeds are hunting specialists. Their job in the field is that of finding game which has been killed or wounded by the hunter and returning that game to their masters. During the hunting of upland game, retrievers often are worked with spaniels. The spaniels quarter the ground and "spring" the game while the retrievers are kept at the hunter's side. When game is downed the retrievers are sent out to do their specialized job.

The most common use of retrievers is in the hunting of waterfowl. In this type of sport the retrievers remain in the shooting blind until birds are killed, when they are ordered after the downed game. They retrieve equally well on land or water, being strong swimmers. The most popular retriever breeds are the Labrador, Chesapeake Bay and golden retriever, and the Irish water spaniel. Other breeds used in this hunting work are the curly-coated and flat-coated retrievers.

The Hound Group—(Afghan hound, basenji, basset hound, beagle, bloodhound, borzoi, dachshund, Scottish deerhound, Amer-

ican foxhound, English foxhound, greyhound, harrier, Norwegian elkhound, otterhound, saluki, whippet and Irish wolfhound.)

Most of the dogs of this group were developed for sporting uses, primarily to trail game by ground scents. The exceptions to this rule are the Irish wolfhound, borzoi and Scottish deerhound, all of which hunt large game primarily by sight.

The typical breeds of the hound group are powerfully built dogs with strong legs, long heads and muzzles, pendulous ears and pendulous upper lips or "flews." There was at least one hound type, called the St. Hubert, in France before the Conquest, and there are good reasons for the belief that English breeds of the present day are traceable to the importation of these dogs by King William I. From them were derived the talbot and the old English staghound, both now extinct, and the bloodhound which still survives. The bloodhound, which exhibits the hound characteristics of the head in the most exaggerated form, has the keenest scent of all dogs but is heavily built and lacking in speed. For these reasons the bloodhound has been weaned away from its original use as a sporting dog and now is used as a police aid in the trailing of criminals and lost persons.

There seem to have been other breeds in England in the middle ages known as the southern and northern hounds and in addition there was a large hound used for trailing deer and smaller hounds, principally harriers and beagles, used for hares. Harriers and beagles are miniature foxhounds in appearance, the beagle being the smallest of the true hounds.

The English country gentlemen of the middle ages were the prime developers of hound breeds, and the development of the breeds paralleled the hunting fancies of the times. Stag hunting and hare hunting were popular long before fox hunting became the vogue, thus harriers and beagles, which were followed on foot, are older breeds than the foxhound. The latter breed probably was developed by crossing one of the old English hounds of the bloodhound type with the greyhound to give speed in the pursuit of the fox in open country.

In the United States, the two most popular hounds are the beagle and the dachshund. Basically they are hunting dogs, and the beagle's popularity is due to its ownership by thousands of rural sportsmen for the hunting of rabbits. Single beagles commonly are used for this type of hunting, but they may be hunted in braces or in packs.

Short-legged and long bodied hounds of the dachshund type were recorded in carvings in Egyptian monuments of the 15th century B.C., and there is evidence that Englishmen, as well as Germans and Italians, had a similar breed used in hunting during the 15th and 16th centuries, but it was in Germany that the breed was standardized in its modern conformation. The dachshund's popularity in the United States springs from the fact that it is a small, intelligent and friendly house pet. The breed is only occasionally used for hunting. Another of the hound breeds, the greyhound, is distinguished as one of the oldest of all established dog types.

The Working Group—(Alaskan Malamute, Belgian sheep dog, Bernese Mountain dog, Bouvier de Flandre, boxer, briard, bull mastiff, collie [rough], collie [smooth], Doberman pinscher, Eskimo, German shepherd, great Dane, Great Pyrenees, komondor, Kuvasz, mastiff, Newfoundland, old English sheep dog, puli, Rottweiler, Samoyede, schnauzer [giant], Shetland sheep dog, Siberian husky, St. Bernard, Welsh corgi [Cardigan] and Welsh corgi [Pembroke].)

There is no doubt that the dogs of the working group have the greatest utilitarian value of all the modern canine classifications. Except in rare cases they are not used in sporting capacities. Instead, they work as police aids, draught animals, herders of livestock and guides for the blind.

In the police group are the boxer, Doberman pinscher, Rottweiler, German shepherd, great Dane and giant schnauzer, all of which are commonly trained to serve as sentry aids and guard dogs. In addition, the Airedale and standard schnauzer from the terrier group are similarly trained, and the bloodhound from the hound group serves often as a police aid for trailing duty. Thus all of these breeds may be considered "police dogs," a term often

mistakenly used to denote the German shepherd

Other breeds in the working division were developed as farmers' aids. This group includes the collie, puli, old English sheep dog, Shetland sheep dog, Belgian sheep dog, German shepherd and the coon, all of which are herders. The Norwegian elkhound, from the hound group, also is used for herding duties. Almost every nation has its dog breed used for herding purposes. Thus we have the collie from Scotland, the puli from Hungary, the corgi from Wales and other imported breeds. The dog most commonly used on U.S. farms for herding work is an unrecognized breed unofficially called the American shepherd, English shepherd or border collie. It is a collie type, but has a shorter muzzle and smaller body, and usually is black and white in colour.

Sure-footed draught animals also are included in the utilitarian group of working dogs. Arctic explorations would have been impossible but for the Eskimo and Alaskan malamutes which pulled long sleds filled with necessary foods and supplies. Draught dogs also are commonly used in Belgium and the Netherlands.

A further subclassification of working dogs are the "rescue breeds"—the St. Bernard and Newfoundland. The former breed accompanies the monks of the Hospice of St. Bernard, Switzerland, to find helpless persons overcome during storms. The Newfoundland, a strong swimmer, is used to carry life lines to stricken vessels and to aid in the rescue of shipwreck survivors.

The activities of other working breeds, including guide dogs for the blind and modern war dogs, are included in later paragraphs.

The Terrier Group—(Airedale terrier, Bedlington terrier, border terrier, bull terrier [white], bull terrier [coloured], Cairn terrier, Dandie Dinmont terrier, fox terrier [smooth haired], fox terrier [wire-haired], Irish terrier, Kerry blue terrier, Lakeland terrier, Lhasa terrier, Manchester terrier, Norwich terrier, schnauzer [miniature], schnauzer [standard], Scottish terrier, Sealyham terrier, Skye terrier, Staffordshire terrier, Welsh terrier, West Highland white terrier).

The terriers hunt by digging into the earth to root furred animals such as badgers, woodchucks, otters and many others. In some cases their duty is merely to force the furbearers from their dens in order that the huntsman can complete the capture. In other cases the terrier's job is to find and destroy the furbearers, either on the surface or underground. The word terrier is from the Latin *terra*, earth.

The terrier group includes breeds which differ so profoundly from each other that the extreme types have hardly a character in common. The terriers are linked with the mastiff group through the bull terrier, which originally was produced by crossing the bulldog with the white English terrier, a breed now extinct. With the hound group the terriers are connected through the Airedale, which resulted from a cross between the otterhound and a terrier of the Aire valley in England. Apart from their size, the original Airedales did not differ greatly from rough-coated Welsh or Irish terriers.

England, Ireland and Scotland produced most of the terrier breeds. Among the breeds developed in England were the afore-mentioned Airedale, Bedlington, bull terrier, fox terrier, Manchester and Staffordshire. Scottish breeders developed the popular Scottish terrier in addition to the Cairn, Skye, and West Highland white. Ireland's contributions to the terrier family include the Irish terrier and the distinctive Kerry blue terrier, whose coat ranges from light steel blue to very dark blue. The Sealyham and the Welsh terriers came from Wales. The standard and miniature schnauzers were developed in Germany, and the Lhasa terrier is of Tibetan origin.

The Toy Group—(Affenpinscher, Chihuahua, English toy spaniel, Brussels griffon, Italian greyhound, Japanese spaniel, Maltese, Mexican hairless, Papillon, Pekingese, miniature pinner, Pomeranian, pug, toy Manchester terrier, toy poodle, Yorkshire terrier).

All of the dogs in the first four groups, *see*, the sporting dogs, hounds, working dogs and terriers, originally were bred for a specific purpose—to hunt, trail, root vermin, serve as protectors of livestock or humans or fill some other need. In most cases, how-

ever, the dogs kept in modern homes are kept primarily as pets, secondarily for the utilitarian purpose they can fulfill. Thousands of setters never are taken into the hunting field, thousands of sheep dogs never are used for herding stock, and only a comparatively few of the breeds developed as police aids are used for that work. These breeds are capable of such work if trained for it, but the modern dog serves mankind mainly as a companion and pet.

The dogs of the toy group make little claim to any value except as ideal house pets. Like most breeds, they develop a protective instinct which causes them to warn members of their masters' families upon the approach of a stranger, but aside from the performance of that valuable service they earn their keep by providing friendly companionship.

All of the dogs of the toy group are small, ranging from Chihuahua, which may weigh as little as 1 lb., to pugs which may range up to 18 lb. Most of the toy breeds are miniature counterparts of larger breeds. The English toy spaniels and Japanese spaniels, for example, are similar in conformation and physiognomy to the hunting spaniels. The Italian greyhound is a dwarfed specimen of the larger gazehound of the ancients. The Pomeranian is the smallest representative of the northern group, which includes the chowchow, Siberian husky, Eskimo, Norwegian elkhound, keeshond and schipperke. The toy Manchester terrier is the toy counterpart of the standard Manchester terrier.

It should not be assumed that toy breeds are new breeds. The Chinese are known to have kept "lion dogs" almost identical to the modern Pekingese as early as 2000 B.C. "Lap dogs" were popular during Caesar's reign. The forest laws written by Canute in the early years of the 11th century contained the provision that any dogs kept within 100 m. of any of the king's forests must have their knee joints cut to prevent them from chasing game. An exception was made in the case of small dogs which could pass through a dog gauge, an oval ring 7 in. wide and 5 in. high.

Neither must it be assumed that all toy dogs are useless except as companions. As mentioned above, most dogs of the toy group develop a protective instinct after being in a home for a few months, thereafter serving effectively as sentries to warn of the approach of strangers. In many cases this instinct becomes so completely developed that toy dogs will attack intruders.

The Nonsporting Group—(Boston terrier, bulldog, chowchow, Dalmatian, French bulldog, keeshond, poodle, schipperke).

In this miscellaneous sixth class of dogs are some of the most interesting of all canine types. Three of the eight breeds are of the bulldog family. These are the bulldog, Boston terrier and French bulldog. The distinguishing features of this family are the muscular neck and the strong jaws and teeth. The English-type bulldog was the first of the three modern bul dogs. This massive breed was mentioned in a book published in England in 1500, and probably was used at least two centuries before that in the sport of bullbaiting. In this activity, an English forerunner of bullfighting, a dog with strong jaws was needed to seize the bull by the nose and hold the animal close to the floor of the arena. Thus cruel sport was outlawed, but the massive and courageous bulldog was retained. The French bulldog is a comparatively new breed, having been developed by the French from small bulldog stock imported from England. The Boston terrier is one of the few breeds developed in the United States, crossbred by Robert C. Hooper, of Boston, in the mid 19th century.

The chowchow probably is the oldest of the breeds in the nonsporting group. A ban relief dated to the Han dynasty of about 150 B.C. pictures a chow in a hunting capacity. The modern chow is popular in England and the United States as a companion and guard dog.

Wild Dogs—Besides the wolves and jackals there are a number of other undomesticated dogs.

The Australian dingo (*g v*) is about the size and build of a small German shepherd and is generally of a tawny colour, sometimes with the tail tip and feet white. It is believed to have been brought to Australia by the aboriginal peoples thousands of years ago. It hunts singly or (rarely) in packs and is destructive to

livestock. Dingos are easily domesticated and are used by the Australian natives to lead them in hunting kangaroos and other game. The dingo will readily cross with domesticated dogs.

The Asiatic wild dog or dhole (*q.v.*) is of the same general colour as the dingo but with its tail tip black, and it is slightly smaller in size. This animal is found from southern Siberia south through eastern Asia to Sumatra and Java. It hunts in packs and is very destructive to game.

The African hunting dog (*q.v.*) or *Lycan pictus* inhabits the plains of Africa. Its peculiar colour pattern reminding one of a tortoise shell (it is a mixture of patches of yellow, black and white, no two individuals being identical). The large, rounded upstanding ears are also a characteristic of this animal. These dogs hunt in packs preying chiefly upon the many species of antelope which abound in Africa.

THE DOG'S SENSES

In most respects the dog's senses are considerably keener than man's. In hearing tests conducted by W. A. Engelmann, a German scientist, a German shepherd responded from a distance of 26 yds to a command which could not be heard by a man 64 yds away. The so-called "silent whistles" used by many trainers of hunting dogs demonstrate the great range of a dog's hearing powers. A man standing only a few feet away cannot hear the sound which emanates from these instruments, yet a dog will respond to the same sound from a distance of more than 75 yds. The reason for this is that the sound range of the human ear is restricted, whereas the dog can hear extremely high pitched tones from a considerable distance. These same tones are above the auditory range of the human ear.

The dog's nose is so sensitive that we are unable to conceive the great range of odours which canines detect. A piece of wood touched only by the tip of a master's finger can be selected by a trained dog from 20 other identical pieces. Bloodhounds have been known to follow perfectly the trail of a stranger 48 hrs after the path was traversed. There is no known method of measuring this sensitivity of the dog's olfactory powers, but it is among his strongest and most often utilized senses.

The dog's sight, on the other hand, is considerably weaker than man's, forcing the dog to use his keen senses of smell and hearing to make identifications. In one scientific test it was found that dogs could not distinguish between a 2 in. delta triangle and a 2 in. inverted triangle at a distance of 20 in. On the other hand, dogs have great sensitivity to movements, however slight. This ability to detect very slight motions explains the ability of stage dogs to solve problems in arithmetic. Such trained dogs bark the answers to addition and multiplication problems by following movements of the trainer's hand or jaw which cannot be detected by the human eye.

In another respect dogs' sight is inferior, in that they are colour blind. Their world is one of white, black, and shades of gray, and most tests indicate that their ability to differentiate between gray shades is inferior to that of man.

Guide Dogs for the Blind.—One of the most concentrated efforts to turn dogs to the use of man has been the training of thousands of guide dogs for the blind. The Germans led this movement by training several thousand dogs to guide soldiers who returned sightless from World War I. Nearly all other countries which participated in that war started similar training programs. In the United States the Seane Eye foundation, Morristown, N. J., became the leading school for training guide dogs, several others were established in the middle west and western states.

The German shepherd is the breed most often used for this work about 90% of all US guide dogs being of this breed. Other breeds sometimes used are the boxer, Doberman pinscher and Labrador retriever. Bitches are preferred for guide service, but temperament is the guiding factor in selecting individual canines for the work.

Guide dogs wear a leather harness to which is attached a leather covered metal hoop which extends to the master's palm. The blind person holds this hoop lightly as the dog walks close to his legs, and is guided according to the pressure exerted by the

dog's movements as transmitted through the harness. The dogs guide their masters at about the same speed as that of the normal walker. They proceed largely without commands except for "right," "left," "forward" and "halt." They guide their masters around all holes and barriers and stop before going down or up a curb stone. After making such a stop the dog waits until the master determines the height of the curb and orders "forward." In addition to serving as a guide animal, the dogs perform such other services as picking up articles which the master may have dropped unintentionally. Such services are rendered without command.

A question commonly asked about guide dogs relates to their ability to follow red, green and yellow traffic signals. Inasmuch as dogs are colour blind, they obviously cannot interpret such signals. In fact, trained dogs do not watch traffic signals. They are trained to watch the flow of traffic and to guide their masters across streets when traffic permits safe movement.

The training of guide dogs is complicated for many reasons. These canines must be taught to judge, for example, the speed of approaching vehicles to determine if there is time to cross the street before the vehicle reaches the blind person's path. Similarly, they must be trained to judge heights to determine if the blind person can pass under a barrier or must walk around it.

Institutions which train guide dogs believe, with good reason, that the work of these canines provides psychological as well as economic benefits. Not only do the dogs give their masters almost complete independence of human aid, but in many cases have changed their masters' entire temperament and approach to life.

Dogs in World War II.—All of the major powers engaged in World War II used trained dogs in numerous capacities. The United States army organized a K-9 corps as a branch of the quartermaster department for the sole purpose of training dogs for war use. It is known that Germany had 40,000-50,000 trained dogs available for service at the start of the war and later gave Japan 10,000 of these. Russia and England also adopted dogs for military purposes.

US military dogs were put to use by all branches of the service—army, navy, marines and coast guard. The breeds wanted and approved by the armed forces for war dog training, as of 1943, were as follows: Airedale terriers, Alaskan malamutes, Belgian sheep dogs, Bouviers de Flandre, boxers, briards, bull mastiffs, Chesapeake Bay retrievers, collies (both rough and smooth), curly coated retrievers, Dalmatians, Doberman pinschers, English springer spaniels, Eskimos, flat coated retrievers, German shepherds, German short-haired pointers, giant schnauzers, Great Pyrenees, Irish water spaniels, Labrador retrievers, Newfoundlanders, Norwegian elkhounds, pointers, Rottweilers, Samoyeds, Siberian huskies, St. Bernards, standard poodles, wire-haired pointing griffons, and crossbreed dogs of any of the above breeds.

The major use of dogs trained for the military is that of aiding sentries. The canines are taught to accompany guard soldiers, either inside supply depots or outside military buildings or encampments. Under such conditions the dog is expected to range away from its handler, using its nose to find and rout any intruders. Other uses for which war dogs are trained are as messengers, detectors of machine gun nests, pack dogs, sledge dogs and first aid assistants.

FEEDING THE DOG

The basis of canine health is a proper diet. A well fed dog has the resistance to throw off minor diseases and resist major ailments. Similarly, a well fed dog is most likely to be active and alert, with clear eyes and a healthy skin and coat. Conversely, a poor diet may be the forerunner of many troubles, including diseases of the heart, intestines, lungs and skin.

In their natural state dogs are carnivorous animals. Wild canines live almost entirely on the flesh, skins and bones of animals which they catch. It therefore follows that meat is the prime requisite in the dog's diet, although the variations in the mode of existence between wild dogs and modern house pets

naturally requires that there be variations in their diet.

Wild dogs, for example, require more food and a higher ratio of protein foods than do domesticated house pets, for the obvious reason that a wild dog utilizes considerable energy for chasing and killing the game which he eats, whereas the pet kept in a home gets his meals without effort.

The meat which forms the backbone of the dog's diet may be supplied in one of several forms. It may be fresh meat, commercially-packed dog meat or dehydrated meat in biscuit form. Many large kennels which keep dogs in almost perfect condition for exhibition in shows feed almost no fresh meat, but depend upon commercially-manufactured biscuit foods which contain dehydrated meat in addition to bone meal, corn and wheat products, soybean meal, dried milk, yeast, bran, cheese meal, fish meal, molasses and cod liver oil. Pet owners who keep only one dog in the house can economically follow the example set by the large kennels by feeding biscuit foods in conjunction with table scraps, milk and other beneficial dog foods. These prepared cereal foods may be fed dry, but are more palatable if softened with milk, hot water or broth.

Since the dog is primarily a carnivorous animal, vegetables must be considered as a subsidiary food in his diet. Vegetables may be fed to dogs in small portions and mixed with other foods. In almost every case they should be cooked and mashed, since the dog cannot digest vegetable chunks. Among the vegetables which, in small quantities, are beneficial to the dog are spinach, carrots, asparagus, beans, tomatoes and potatoes. Milk can be given to dogs of any age and is particularly beneficial to puppies just past the weaning stage. Among the foods which should be avoided are pork, uncooked fish and fowl.

A common query relates to the quantity of food to be given to a dog and the number of meals each day. Most veterinarians recommend that a puppy from 6 to 10 weeks old be given 4 meals a day at 4 hr. intervals. Between the ages of 10 weeks and 6 months the dog can be fed 3 times a day at 5 hr. intervals. After 6 months most dogs thrive on a light meal in the morning and a major meal in the evening.

There is no fast rule on the amount of food a dog should be given each day. Roughly, toy breeds require about $\frac{1}{2}$ lb. of food per day, breeds weighing 10-20 lbs. require about 1 lb. of food, dogs weighing 20-50 lbs., about $1\frac{1}{2}$ lbs. of food, and those weighing more than 50 lbs. may consume 2-4 lbs. of food per day. This schedule varies greatly, however, according to the temperament of the individual dogs. A very active terrier weighing only 20 lbs. for example, may eat as much as a 50 lb. dog that has a placid temperament. The best rule is to watch the dog's actions to determine the amount of food he can assimilate. The owner should feed no more than the dog eats readily at each meal and naturally change or reduce the diet if the dog becomes overweight or underweight.

DOG AILMENTS

Distemper—Sometimes called "canine plague" because of its widespread occurrence and virulence, distemper is one of the most serious of all the diseases of dogs. The virus causing distemper is air borne, and can affect dogs of any age, although it is most serious in puppies under a year of age because these young dogs often do not have the strength to combat the disease.

The most common symptoms of distemper are discharges from the nose and eyes, an offensive odour of the skin, caused by slight skin eruptions, sneezing and coughing, loss of appetite and a general indication of waning strength.

Distemper is more easily prevented than cured. A series of three inoculations, given to puppies over three months of age by a veterinarian, provides dogs with almost complete protection.

Rabies—Rabies is an infectious disease affecting many warm-blooded animals, including man, in which case it is termed hydrophobia. It is more common in dogs than in any other animal because of their roving nature, but it can affect and be transmitted by rodents, cattle, horses, cats, monkeys and other animals. The usual method of transmission of the rabies virus is through the bite of an infected animal, in which case the rabies bodies in the

saliva of the infected animal are injected into the nervous system of the animal attacked. In rare cases the disease can be transmitted without biting taking place. This occurs if saliva from an infected animal enters the nervous system of another animal through a skin abrasion.

There are two types of true rabies in dogs. The first is dumb rabies, so called because the lower jaw of a dog thus affected becomes paralyzed, preventing barking and biting. The second type is violent rabies, the symptoms including extreme nervousness and biting of other animals without reason.

Veterinarians and scientists disagree as to the value of preventive rabies inoculations. Many U.S. states require annual anti-rabies inoculations. England has almost eliminated rabies by a strict quarantine law which bans dogs from the country until after six months of observation. The most certain method of protecting a family dog against rabies is to keep it under strict control, either on its home property or otherwise on leash, since the only manner by which it can contract the disease is through the bite of an infected animal.

There is no cure for rabies or hydrophobia, but it can be prevented by the Pasteur treatment, provided this treatment is started while the disease is in the incubative stage.

Internal Parasites—Several types of worms may be internally harboured by dogs. They can be inherited, but more commonly the worm *livera* is taken into the dog's organs through its food. The most common internal parasites are roundworms, tapeworms, hookworms, whipworm and heartworm. The latter type is most common in the southern United States and usually is fatal.

Worms sometimes can be detected in the dog's bowel excretions, but a microscopic examination usually is necessary to determine the type of worms present. External indications of the presence of worms include excessive appetite, or almost complete lack of appetite, laziness, loss of weight, eye excretions and vomiting. These same symptoms also are present in other dog ailments, however, and therefore are not positive guides. The aforementioned microscopic examination of the dog's stool is the only definite proof of worm presence. Treatment for worms varies according to the types present, and should not be undertaken in the home without veterinary recommendations.

INDIVIDUAL BREEDS

Sporting Breeds—*Griffon (Wire Haired Pointing)*—A medium-sized dog developed in the last quarter of the 19th century. Primarily a pointing breed.

Pointer—One of the leading sporting breeds, and the first type of dog developed to stand game as we understand the term to day. Originally used in England to point hares. The pointer probably was developed from foxhound, greyhound, bloodhound and spaniel blood. Common colours are white and black, white and liver, white and orange and white and lemon.

Pointer (German Short Haired)—A versatile breed developed in Germany about 1895 for pointing upland game and coursing furberies and large game.

Retriever (Chesapeake Bay)—Hunters' retriever used for finding and delivering upland game and waterfowl. Developed in America.

Retriever (Curly-Coated)—First breed developed exclusively for retrieving game in the hunting field. First exhibited publicly in England in 1859.

Retriever (Flat Coated)—Similar to the curly-coated retriever and developed at about the same time for the same uses.

Retriever (Golden)—Developed in England about 1870 from the Russian tracker breed, with bloodhound crosses.

Retriever (Labrador)—An all black, short-haired retrieving breed developed in England from stock imported from Newfoundland.

Setter (English)—One of the most popular game pointing breeds in the British Isles and the United States. Developed in England in the 15th century for pointing upland game birds.

Setter (Gordon)—Similar to the English setter and Irish setter, but black and tan in colour. Developed in Scotland, and

takes its name from the Duke of Gordon, a Scotch breeder of the late 18th century.

Setter (Irish)—A red or chestnut coated pointing breed developed in Ireland early in the 18th century.

Spaniel (American Water)—Smaller than the Irish water spaniel, and used both for flushing and retrieving game.

Spaniel (Brittany)—Developed in France, this is the only member of the spaniel family which points game.

Spaniel (Cumber)—A large and deliberate sporting dog, the Cumber was developed in England from spaniel and bissethound bloodlines.

Spaniel (Cocker)—In the 1940s the most popular breed in America being kept primarily as a house pet and hunting dog. Originally developed in England for hunting woodcock, hence its name. Specimens of this breed weigh 15-24 lbs and may be either solid coloured or tri-coloured.

Spaniel (Cocker-English Type)—Similar to the American-type cocker spaniel in conformation, colour and temperament, but slightly larger in size.

Springer (English Springer)—One of the most popular of the sporting dogs, of general usage, the springer flushes and retrieves upland game and also retrieves in water. Dogs of this breed weigh 42-50 lbs and have the typical spaniel head and body conformation.

Spaniel (Fulld)—Dark coated hunting spaniel developed in England, weighs 35-50 lbs.

Spaniel (Irish Water)—Developed in Ireland in the first half of the 19th century. Tallest of the spaniels, the breed is used primarily as a retriever on land and water.

Spaniel (Sussex)—A determined and valuable hunter of upland game, the Sussex works more slowly and deliberately in the field than does the cocker or springer. Weighs 35-45 lbs.

Spaniel (Welsh Springer)—A red and white spaniel developed in Wales and used primarily in the British Isles for upland game. **Blairmount**—A German breed similar in appearance to the short haired pointer. An all round hunting breed, but most commonly used for pointing upland game.

Hound Breeds—**African Hound**—One of the oldest of all breeds, there being evidence that it was kept in Egypt 5,000 to 6,000 yrs ago. Later bred in northern Afghanistan, the breed hunts by sight.

Basset Hound—Developed in France, the basset weighs 25-40 lbs and is used in the United States for trailing foxes, rabbits, pheasants and raccoons.

Beagle—One of the five most popular breeds in America, the beagle is primarily a rabbit hunter and companion dog. Became popular during the Elizabethan period for hunting hares. May be hunted singly, in braces or in packs.

Bloodhound—One of the oldest of the scent hunting hounds, having been known in Italy as early as the 3rd century. The breed name is derived from the fact that it was one of the first of the 'blooded' or purebred hounds, and its main modern use is that of trailing criminals or lost persons.

Borzo—Used as coursing hounds since the 13th century, the borzo also is called the Russian wolfhound. Large, angular canines, the borzo stand from 26-31 in at the shoulder and weigh 55-105 lbs.

Dachshund—One of the most popular of the hounds, the dachshund has the temperament, size and intelligence to qualify it as an ideal house pet. Developed in Germany to enter badger dens, hence its long body and short, powerful legs. The short haired variety is most common, but there also are long haired and wire-haired types.

Deerhound (Scottish)—As its name implies, this breed was used most extensively in Scotland and England for coursing deer. Completely established as a distinct breed in the 16th century.

Foxhound (American)—A variation of the English foxhound, and well established in the United States in colonial days. George Washington was one of the first U.S. enthusiasts of the breed.

Foxhound (English)—Somewhat larger than the American foxhound, and hunted in packs for trailing the fox. The most common colour combination for both the American and English fox-

hound is black, white and tan.

Greyhound—One of the oldest established breeds, having been established in Egypt between 4000 and 3500 B.C. and later favoured by the Greeks. Used for tracking all types of game, but most commonly used in hunting hares.

Harrier—One of the early hounds used in pack hunting, the harrier probably was introduced into England by the Normans. Similar to but smaller than the foxhound.

Norwegian Elkhound—Another of the ancient hound breeds, having been used by the Vikings as early as 4000 B.C. Has a thick, grey coat, and stands 18-20 in tall at the shoulder.

Otterhound—Hounds were used for killing otter in England as early as A.D. 1,000, and this breed was established for this type of hunting as early as A.D. 1300. A large, rough coated dog weighing up to 65 lbs.

Saluki—Perhaps the oldest known breed of domesticated dog, excavations of the Sumerian empire of 7000 to 6000 B.C. show canines of the saluki type. Similar to the greyhound in conformation, but with silky feathering on the ears and tail.

Whippet—The fastest of all the small, domesticated animals, the whippet is similar to but smaller than the greyhound, weighing up to 28 lbs.

Wolfhound (Irish)—The tallest of all dogs, having a greyhound conformation. The Irish wolfhound was kept by Celts as early as 273 B.C.

Working Breeds—**Alaskan Malamute**—One of the oldest of the Arctic sled dogs. A heavy coated, compact dog weighing 85 lbs.

Belgian Sheep Dog—There are six varieties of Belgian sheep dogs, the Groenendael, a long coated black type, being the most popular. This variety weighs 50-55 lbs and is used mainly for herding.

Bernese Mountain Dog—One of the four varieties of Swiss mountain dogs, used mainly as a draught animal. Stands 21-27½ in high at the shoulder.

Bouvier de Flandre—A Belgian breed used as police and army aids. Usually fawn or black in colour, and stands 22½-27½ in at the shoulder.

Boxer—Related to other breeds of the bulldog type, having some terrier blood. The boxer is smooth coated, of medium size and handsome conformation. Excellent as a police aid and home protector.

Briard—A French breed known as early as the 13th century. A dark coloured dog standing 22-27 in at the shoulder. Used primarily as a sheep herder, guard dog and police aid.

Bull Mastiff—A massive short haired breed developed in England in the latter half of the 19th century by crossbreeding the mastiff and the bulldog.

Collie—The smooth coated collie and the more common rough coated collie are recognized as separate breeds. Both developed in Scotland in the 13th century, the former for driving sheep and the latter for guarding sheep.

Doberman Pinscher—A medium-sized guard dog and companion developed by Louis Dobermann, a German breeder, around 1890. Usually black and rust or rust in colour, short-haired and weighing 60-75 lbs.

Ekmo—One of the northern breeds, famed as a sledge dog. Has long hair and weighs 50-85 lbs.

German Shepherd—A leading working breed, having been used in herding, guard work, battlefield rescue missions, guiding the blind and police assistance. Has long hair, of almost all colours, and stands 22-26 in at the shoulder.

Great Dane—One of the largest of the modern breeds, having been developed in Germany to hunt boars. Probably has Irish wolfhound and old English mastiff blood. May be brindle, fawn, blue, black or black and white. Females measure more than 28 in at the shoulder, males 30 in.

Great Pyrenees—A large dog, usually white, most commonly used as a watch dog, companion and pack dog. Known in Europe more than 3,000 yrs ago and became a favourite of French royalty in the 17th century.

Komondor—One of the three breeds of Hungarian working



PHOTOGRAPHS (1 3 & 8) CHICAGO TRIBUNE
(2) CAROLA GREGOR FROM HONKHEIMER (4) HERRINGER FROM HONKHEIMER (5) RALPH MORAY (6) W. SUGITZKY PIX. HANES AND OWNERS OF DOGS (7) CHAMPION LADIE OF INGLEHURST OWNED BY C. C. HANDEE (3) CHAMPION KING'S MESSENGER OWNED BY HANLEY F. HART (5) STAN LEE SCOPER OWNED BY MRS. ANTHONY A. BLISS (6) BROWNIE PRINCESS OWNED BY G. B. GIL PLANT (7) CHAMPION MASTER JUMBO OWNED BY CHARLES WILLIAM MILLER (8) SOLON S. CLEAR OWNED BY MRS. W. R. BOLTON

SPORTING DOGS AND WORKING DOGS

- 1 Gordon setter (sporting)
- 2 Irish setter (sporting)
- 3 Old English sheepdog (working)
- 4 Doberman pinscher (sporting)
- 5 Chesapeake Bay retriever (sporting)
- 6 Pointer (sporting)
- 7 Newfoundland (working)
- 8 Samoyede (working)
- 9 Tibetan mastiff (working)



PHOTOGRAPHS (1-7) 8) CHINATO TRIBUNE (2) 4) 6) YLLA FROM RAPHO GUILLUMETTE (3) 8) W. LI 5) 9) PIX AND AND A 6) OF 6) 8) LI 1) 1) 7) MA AT HAND BY RAYMOND BIERA 9) (7) CRIEDEL OWNED BY MRS. E. Y. ALLEN (8) CHAMPION MUGELM TOSCHE OWNED BY MARGARET A. AND HAZEL BENISH

TERRIERS

- 1 Miniature schnauzer puppy
- 2 Smooth fox terrier
- 3 Smooth fox terrier
- 4 Irish terrier

- 5 Bull terrier
- 6 Welsh terrier puppy
- 7 Cairn terrier
- 8 Airedale terrier

dogs kept mainly by shepherd of that country for protecting the flocks. An all white breed, with long hair, standing at least 23½ in at the shoulder.

Kuvass—Developed in Hungary in the 15th century from for bears brought from Tibet the Kuvass was used for hunting big game, for guard duties and for herding purposes. All specimens are pure white, long-haired and stand 25-27 in. at the shoulder.

Mastiff—A giant, short haired dog, with heavy head and short muzzle, which has been used in England for more than 2,000 yrs as a watch dog. A representative of the mastiff family known in Egypt as early as 3000 B.C.

Newfoundland—Originated in Newfoundland from forer brought there by fishermen from Europe. A large, strong, active dog, black in colour and weighing 110-150 lbs. Landseer Newfoundland may be almost any colour, but usually are white with black or bronze markings.

Old English Sheep Dog—Developed in England early in the 19th century for driving cattle and sheep. Usually white with markings of grey, grizzle or blue, with long hair over entire body, including the head.

Puli—The third of the Hungarian working breeds, the puli is an alert, medium sized dog used primarily for herding sheep. Has a long coat, usually black, grey or white in colour.

Rottweiler—A large, mastiff-type working dog developed by German breeders from stock known to the Romans. Primarily a guard dog and cattle driver, the Rottweiler is black with tan markings and stands 21½-27 in. at the shoulder.

Samoyede—An Arctic sledge dog, white in colour and weighing 36-55 lbs.

Schnauzer (Giant)—See Schnauzer under Terrier Breeds, below.

Shetland Sheep Dog—A miniature collie in appearance, this breed was developed in the Shetland Islands. Stands 12-15 in. at the shoulder, and is usually sable, black or blue with markings of white and tan.

Siberian Husky—A sled dog developed in Siberia and commonly used in Alaska. Usually grey with white and black markings and weighing 40-65 lbs.

St Bernard—This breed has been kept by monks at the Hospice of St Bernard in the Swiss Alps since the latter part of the 17th century. It is massive, stands 25½-27½ in. at the shoulder, and has red or brindle markings.

Welsh Corgi (Cardigan Type)—This breed was introduced to Wales by the Celts at about 1200 B.C. It is similar to the dachshund in conformation, but has a medium length coat and erect ears. Used for driving cattle.

Welsh Corgi (Pembroke)—Similar to the Cardigan type corgi in conformation, but having a short tail. Introduced into Wales by Flemish immigrants in A.D. 1107.

Terrier Breeds—**Airedale Terrier**—Developed by cross breeding the now extinct old English terrier with the otterhound. One of the largest of the terriers, black and tan in colour and weighing 38-45 lbs.

Bedlington Terrier—Developed about 1825 in Bedlington, Northumberland, England. Distinctive because of its sheep like appearance, it weighs 22-24 lbs and has a thick coat of light blue, liver or sandy hue.

Border Terrier—An active, game terrier weighing 11½-15½ lbs, with a head akin to that of an otter.

Bull Terrier—Developed early in the 19th century by cross breeding of the white English terrier, bulldog and Spanish pointer. There are two varieties—one all white and the other any colour other than white or coloured with white markings. The weight of the standard varieties is 25-60 lbs.

Cairn Terrier—One of the Scottish breeds, developed for routing otter, foxes and other furbearers. Females weigh 13 lbs, males 14 lbs, and may be any colour except white.

Dandie Dimont Terrier—A native of the borderlands between England and Scotland, first recorded as a distinct breed about 1700. Mustard or pepper in colour, dogs of this breed weigh 14-24 lbs.

Fox Terrier—One of the best known of the terriers being

popular in the United States, Britain and most of the nations of continental Europe. Developed by the English for routing vermin, the fox terrier may have either a smooth- or wire haired coat. White is the predominating colour, with dark markings. The fox terrier weighs 16-18 lbs.

Irish Terrier—An all red terrier, with a wire haired coat, this breed was developed in Ireland. Similar to the fox terrier in conformation, but somewhat larger, weighing 25-27 lbs.

Kerry Blue Terrier—Ireland's national dog having been developed in County Kerry before 1834. A distinctive breed, having a light or dark blue coat and weighing 32-38 lbs.

Lakeland Terrier—Similar to the Irish terrier in conformation but weighing only 16-17 lbs. Developed in the lake districts of England for routing fox and other dogs of this breed may be black and tan, grizzle and tan or blue and tan in colour.

Lhasa Terrier—Developed in Tibet more than 800 years ago, the Lhasa terrier has a long, straight coat, usually of golden hue.

Manchester Terrier—The standard Manchester terrier weighs 14-22 lbs, whereas the toy Manchester weighs 7-12 lbs. Both are black and tan in colour, short haired with somewhat roached backs. Developed in the Manchester district of England.

Norwich Terrier—A small, short-legged, wiry-coated dog used for routing foxes, the Norwich usually weighs about 11 lbs and is red, black and tan or grizzled in colour.

Schnauzer—There are three size varieties of this breed, the grint standing 21½-25½ in. at the shoulder, the standard type measuring 17-20 in. at the withers, and the miniature type 11½-13½ in. at the shoulder. All are similar in conformation, with hard, wiry coats, rectangular heads and short tails.

Scottish Terrier—One of the earliest of the terriers indigenous to Scotland, this popular breed usually is black in colour, but may be wheaten, grey or grizzled. An active, short legged breed weighing 18-20 lbs and used for routing foxes, rodents and other furbearers.

Sealyham Terrier—A white terrier having conformation and size similar to that of the more common Scottish terrier. Developed in Wales between 1850 and 1890.

Skye Terrier—A short legged and long bodied Scotch breed, being about 9 in high at the shoulder, about 40 in long and weighing 16-18 lbs. The breed's coat is about 5½ in long and is blue, grey or fawn in colour.

Staffordshire Terrier—Similar to and related to the white bull terrier, but dark in colour, the Staffordshire weighs 35-50 lbs and was developed from bulldog and terrier blood.

Welsh Terrier—A squarely built black and tan terrier standing 15 in high at the shoulder and weighing about 20 lbs, this breed was developed in Wales for hunting the otter, fox and badger.

West Highland White Terrier—Of the Scottish family of terriers, this breed is all white and weighs 13-19 lbs. It has the conformation of most of the Scottish terrier breeds, with short legs and a short, cobby body.

Toy Breeds—**Affenpinscher**—A rare breed in America, somewhat similar to the more common Brussels griffon in appearance, the affenpinscher has a red or grey wiry coat, a distinctive "beard" and never exceeds 10½ in in height.

Chihuahua—The smallest of all breeds, weighing only 1-6 lbs, the Chihuahua is a native of Mexico. This breed should not be confused with the Mexican hairless, since it may be either short-haired or long haired.

English Toy Spaniel—A breed weighing 9-12 lbs, the English toy spaniel has a long silky coat and a head formation somewhat like that of the Pekingese. There are several varieties of this breed, including the Prince Charles, King Charles, Ruby and Blenheim, the main variations being in colour.

Griffon (Brussels)—Developed prior to the 17th century from the affenpinscher, the now extinct Belgian street dog, the Chinese pug and the Ruby spaniel, the Brussels griffon has a wiry, reddish brown coat and weighs 7-12 lbs.

Italian Greyhound—A small, short haired breed of typical greyhound conformation, the Italian greyhound has existed in its present form for more than 2,000 yrs. The average dog of this

breed weighs about 8 lbs

Japanese Spaniel—This breed is similar to the English toy spaniel in appearance, but is always black and white or red and white in colour. This spaniel has a head somewhat similar to that of the Pekinese, its coat may be profuse or short and its average weight is about 7 lbs

Maltese—This breed, somewhat like the Skye terrier in conformation and type of coat, was developed on the island of Malta more than 2,800 yrs ago. Its coat is white and long, and it weighs 2-7 lbs

Mexican Hairless—A rare breed, probably having descended from the hairless dogs of China. These dogs were established in Mexico by the Aztecs. Not to be confused with the Chihuahua, which is a distinct breed

Papillon—A member of the toy spaniel group of dogs which probably was developed in Spain but attained its greatest popularity in France during the reign of Louis XIV. A small breed, predominantly white with patches of other colours

Pekinese—One of the most popular of the toy breeds the Pekinese originated in China before the 8th century. It has a pug type head, including a very short flat nose. The profuse Pekinese coat may be any colour, and specimens of the breed weigh under 14 lbs

Pinscher (Miniature)—Similar to the more common Doberman pinscher in conformation and coat, but weighing only 6 to 10 lbs this breed was developed in Germany

Pomeranian—One of the northern breeds, being related to the chowchow, Alaskan malamute and Norwegian elkhound, the Pomeranian was developed in Pomerania, Germany. Ideal specimens of the breed are compact short-coupled, weigh about 7 lbs and have profuse coats and plume tails of varying colours

Pug—A short faced dog which probably originated in China, the pug is a squat, cobby breed which weighs 14-18 lbs and has a short coat which is silver or apricot fawn in colour

Toy Manchester Terrier—See Manchester Terrier under Terrier Breeds, above

Toy Poodle—See Poodle under Non Sporting Breeds, below
Yorkshire Terrier—Probably a descendant of the Skye terrier, having been developed in the Lancashire and Yorkshire areas of England, this small terrier type has a long straight coat which often touches the ground and usually is dark blue mingled with fawn or bronze

Nonsporting Breeds—**Boston Terrier**—One of the few breeds developed in America, the Boston terrier became one of the most popular of U.S. dogs. It was developed in Boston in the middle of the 19th century by crossbreeding the English bulldog and the white English terrier. The breed is compactly built, with a square skull, bulldog-type face, brindle and white or black and white in colour, short coat and a weight of about 12-25 lbs

Bulldog—An English breed originally used in baiting and fighting bulls. Like other members of the bulldog family, this breed has a short, broad face with protruding lower jaw, a deep-set nose, massive neck and body and rather short, strong legs. Females of this breed weigh around 40 lbs, males 10 lbs more

Chowchow—One of the oldest dog breeds, the chow was standardized in China as early as 150 B.C. It has a large, massive head, flat skull, short nose, deep-set eyes and erect ears. Its coat is abundant, outstanding and may be any solid colour

Dalmatian—A medium sized, short-haired dog, white spotted with black or liver, this breed gets its name from Dalmatia, on the eastern shore of the coast of Venice. The Dalmatian weighs 35-50 lbs

French Bulldog—This breed probably was developed of miniature bulldog stock sent to France from England. Specimens are similar to the more common English bulldog in conformation but are smaller, weighing less than 28 lbs, and have erect ears

Keshond—One of the northern breeds, related to the Samoyede chowchow, and Pomeranian the keshond is considered the national dog of Holland. It has a short, compact body, small erect ears, fox-like head and a dense grey coat. The breed height is 17-18 in at the shoulder

Poodle—Although the poodle probably was originated by the

Germans, it attained its greatest popularity in France and some times is called the "French poodle". The standard poodle stands more than 15 in at the shoulder, the miniature poodle less than 15 in, and the toy poodle never exceeds 12 lbs. All three types may be any solid colour

Schipperke—A native of the Flenish provinces of Belgium, the schipperke is all black, tailless and weighs up to 18 lbs. It has a small foxlike head and is alert and active

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DOG-BANE (*Apocynum androsaemifolium*), N. American plant of the dog bane family (Apocynaceae), called also spreading dog bane, honey bloom, wild



BY COURTESY OF WILD FLOWER PRESERVATION SOCIETY

NORTH AMERICAN DOG BANE AN HERBACEOUS PLANT VALUED FOR THE TONIC PROPERTIES OF ITS ROOT

specific and American fly trap native to fields and thickets from Quebec to British Columbia and southward to Georgia, Missouri, Arizona and California. It is a rather slender, herbaceous perennial, 1 ft to 4 ft high, with widely branching stems, opposite oval, slightly pointed leaves, numerous, small, bell shaped pink flowers, with darker stripes in base, borne in clusters at the ends of the branches. When in blossom from late June to August it is a beautiful wild flower. (See *APOCYNACEAE*)

DOG DAYS, hot summer days, when Sirius, the dog-star, rises in conjunction with the sun

DOGE, the title of the chief magistrate in the extinct republics of Venice and Genoa. For the character of the office at Venice see the articles *COMMUNE Medaevae*, BUCENTAURO. In Genoa the institution of the doge dates from 1339. At first he was elected without restriction and by popular suffrage, holding office for life, but after the reform effected by Andrea Doria (1512) the term of his office was reduced to two years. At the same time plebeians were declared ineligible, and the appointment of the doge was entrusted to the members of the great and the little councils, who employed for this purpose a machinery almost as complex as that of the later Venetians

See B. Cacciari, *Il Doge di Venezia* (1864), E. Muscati, *Storia della promissione duale* (Padua, 1888), and H. F. Brown, *Venice a Historical Sketch* (1893)

DOG-FISH, a name applied to several species of the smaller sharks, perhaps because of the habit these fishes have of pursuing or hunting their prey in packs. The European small spotted dog fish or rough hound (*Scylium canicula*) and the large spotted or nurse hound (*Scylium catulus*) keep near the sea bottom, feeding chiefly on the smaller fishes and crustacea. They differ from the majority of sharks in being viviparous. The eggs are enclosed in semi-transparent horny cases, often called "mermaids' purses" and these have tentacle-like prolongations from each of the four corners, by means of which they are moored to seaweeds or other fixed objects, until the young dog fish is ready to make its exit

The larger of these species attains a length of 4 to 5 ft, the smaller rarely more than 30 in. The picked dog fish (*Squalus acanthias*) is abundant in the temperate seas of both hemispheres, and on both sides of the Atlantic. It attains a length of 4 ft, but the usual length is 2 to 3 ft, the female, as in most sharks, being larger than the male. The body is round and tapering, and the mouth is placed ventrally some distance from the end of the snout. There are two dorsal fins, each armed anteriorly with a sharp spine. This species is viviparous, the female producing five to nine young at a birth, the young when born are 9 to 10 in long and similar to the parents, except in size. The picked dog fish is gregarious, and is abundant at all seasons everywhere on the British coasts. They, even more than other dog-fish, are the special enemies of the fisherman, injuring his nets, removing the hooks from his lines, and spoiling his fish. They are eaten, both

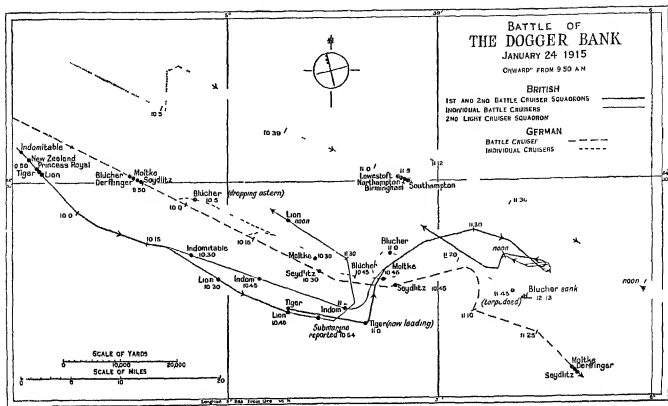


CHART OF STEAMING TRACKS OF BRITISH AND GERMAN BATTLE CRUISERS IN ACTION

Admiral Beatty with the 1st and 2nd battle cruiser squadrons surprised Admiral Hipper commanding the German 1st scouting group near the Dogger Bank in the North Sea on Jan 24 1915. A running fight ensued the German squadron making for port under full steam as soon as they sighted Beatty's ships. The *Blocher* was finally sunk by two torpedoes from the *Arethusa* and the *Seydlitz* was seriously damaged. The approach of the German High Sea Fleet enabled Hipper to escape without further loss. German casualties were 954 killed 90 wounded, and 189 taken prisoners; the British 15 killed and 32 wounded.

fresh and salted, on the west coast of England, and are sold regularly in the French markets. The bowfin, an unrelated American fresh water fish is also called "dog fish" (See SELACHIANS, BOWFIN, FISHES).

DOGGER BANK, an extensive shoal in the North Sea, about 60 m E of the coast of Northumberland, England. The depth of water, in some parts only 6 fathoms, is generally from 10 to 20 fathoms. It is well known as a fishing ground. The origin of the name is obscure, but the middle Dutch *dogger* signifies a trawling vessel, and was formerly applied to two masted vessels employed in the North Sea fisheries, and also to their crews (*doggermen*) and the fish taken (*dogger-fish*). Off the south end of the bank an engagement took place between English and Dutch fishes in 1781: Here on Oct 21, 1904, during the Russo Japanese War, some British trawlers were fired on by the Russian Baltic fleet. An acute crisis between Britain and Russia followed. The affair was settled by an international commission which reported on Feb 25, 1905. Compensation was paid by the Russian government.

BATTLE OF THE DOGGER BANK

This naval action was fought during the World War on Jan. 24, 1915, near the Dogger Bank in the North Sea between British and German battle cruisers and light forces.

Reports from America at this time had led the Germans to think that a plan for blocking their harbours was afoot and Rear-Admiral Hipper was despatched at nightfall on Jan 23 to reconnoitre off the Dogger Bank. His force consisted of four battle-cruisers of the 1st scouting group, "Seydlitz" (flag), "Derfflinger", "Moltke" and "Blücher", with four light cruisers and 19 destroyers. Before the ships left the Jade, their strength and intentions were betrayed by their own wireless and Vice-Admiral Beatty left the North Sea coast on the 23rd on the 23rd. With him were the five battle-cruisers of the 1st and 2nd Cruiser Squadrons, the "Lion" (flag), "Tiger", "Princess Royal", "New Zealand" and "Indomitable", and the four light cruisers of the 1st Light Cruiser Squadron under Commodore W. E. Good-

enough in the "Southampton." He was to proceed to a rendezvous in lat 55deg 12min north, long 3deg 12min east, 180m from Heligoland, where he was to meet Commodore Tyrwhitt with three light cruisers and 30 destroyers of the Harwich force. The 3rd Battle Squadron, of seven "King Edwards," left Rosyth and Admiral Jellicoe put to sea from Scapa with the battle-fleet at 9 p.m. In heavy guns Beatty's force was decidedly superior, mounting 24 13.5-in and 16 12-in against Hipper's 8 12-in, 20 11-in and 16 8.2-in.

The Fight Begins.—Beatty reached the rendezvous at 7 A.M. It was a crisp winter morning with a calm sea and good visibility. The battle cruisers were in single line ahead with Goodenough light cruisers two miles on the port bow. Course was then altered to south by west at 18 knots. Ten minutes later "Arethusa," Tyrwhitt's flagship, was sighted southeast about seven miles on the port bow. She had hardly been identified when the flash of guns was seen to the south south-east. "Aurora" some 1.5 m. behind Tyrwhitt, had met and engaged the German light cruiser "Kolberg" on the port bow of Hipper's squadron coming from the southeast. Each received a couple of hits and "Kolberg" retired at 7.25 A.M.

At the sound of the guns, Beatty ordered the light cruisers to chase to south "Southampton" had barely gone two miles when she sighted "Aurora" on her starboard bow and, a few minutes later, German battle-cruisers on the port bow to the south east. Dense clouds of smoke were pouring from their funnels and they were evidently raising steam for full speed. It was then 7.50 a.m. Beatty's appearance had come on Hipper as a surprise and, turning to the southeast, the latter ran for home.

Pursuit of the Germans—At 8 30 A.M. Beatty's position was at 54deg 50min north, long 3deg 40min east, and the two had settled down to a long rush towards Heligoland, 140m away. The British battle cruisers were in single line ahead on a south-east by south course, working up to full speed. Hipper was 11m sharp on "Lion's" port bow, in full flight on a south south east course. In speed Beatty's squadron had a decided superiority. It was

able to maintain a seagoing speed of 26 knots, while Hipper was limited at first to 23 or 24. At 8 52, when the range of "Blücher" had come down to 22,000 yd., "Lion" opened fire and at 9 05 hoisted the signal to engage. The German battle cruisers were then forming on a line of bearing to port. At 9 09 Hipper opened fire as "Lion" scored her first hit on "Blücher."

The action ran on to the southeast with the range gradually decreasing, but it was not till 9 26 that the Germans scored their first hit on "Lion," sending an 11 in shell through her waterline. At 9 43 a 13 5 in shell crashed through the quarter deck of "Seydlitz," penetrated the after turret and, exploding inside, set fire to the charges in the working chamber. The flames went roaring through the turret, passed through a small door into the adjoining one, set fire to the charges there and, wrapping both turrets in a sheet of flame, slew as one every man inside. "Blücher" was having trouble with her engine at this time and about 10 A.M. drew out of the line, labouring heavily.

At 10 22 Beatty, to bring the rest of his line into action, ordered the battle cruisers to form on a line of bearing north-north-west and to proceed at utmost speed. "Lion" had eased to 24 knots to let the ships in the rear come up and, as the enemy had turned slightly away, the range was increasing. At 10 30 a salvo fell on "Blücher," a shell penetrated the central ammunition passage set fire to the magazines and sent a flash of flame through the fore turrets. The main steam pipe was damaged; her speed came down to 17 knots and she gradually dropped behind, enveloped in smoke.

The Action Broken Off—The remainder of the enemy were, clearly, bent on escape and to this end, concentrated their fire chiefly on the leading British ship, the "Lion," which between 10 35 and 10 50 was repeatedly hit with heavy shell, with the result that she started to drop astern, while the other battle cruisers raced past her. At 11 A.M. the flagship received such heavy injuries that she was thrown definitely out of the fight. Beatty, however, still retained control. Just before this the periscope of an enemy submarine was reported on the starboard bow, and at 10 54 he had made a signal to alter course 8 points (90°) to port to a course north by east. This was the mutual cause of the action being broken off. The usual submarine warning was not made by the "Lion," thereby mystifying the other ships and Rear-Admiral Sir A. G. H. W. Moore, the second in command, as to the reason for the manoeuvre, and making it doubly difficult for the signals intended to convey Beatty's subsequent wishes to be interpreted. These, made at 11 02, were an endeavour by the latter to get the squadron to turn back again three points to the north-east, followed by a signal "Attack the enemy's rear." The form in which the signals were displayed, however, was such that they were understood to mean that the ships were to attack the enemy bearing north-east, which was the "Blücher." This ship was by now disabled and rapidly drifting astern of her companions.

Beatty made a final effort to turn the squadron back on to the course of pursuit by signalling "Keep closer to the enemy," but this was misunderstood. The British battle cruisers, however, continued to pursue the enemy, and at 11 15 the signal was given to "Discontinue firing." The British battle cruisers, however, continued to pursue the enemy, and at 11 15 the signal was given to "Discontinue firing." The British battle cruisers, however, continued to pursue the enemy, and at 11 15 the signal was given to "Discontinue firing."

Beatty by this time had transferred his flag to the destroyer "Attack" and was racing after his squadron. He reached "Princess Royal" at 12 30 and hoisted his flag, but pursuit was then hopeless and a warning had been received of the approach of the High Sea Fleet. He therefore gave up all idea of renewing the action. Hipper made for home and got in touch with the High Sea Fleet about 2 30 P.M. "Blücher" had been lost, "Seydlitz" seriously damaged and "Derfflinger" hit. On the British side "Lion" had been put out of action and "Tiger" damaged.

Admiral Jellicoe with the battle-fleet met Beatty at 4 30 P.M.

"Lion" was taken in tow by "Indomitable" and, screened by light cruisers and destroyers, reached Rosyth safely the next morning. On the British side the result was regarded as disappointing, but it must be remembered that, with the exception of "Blücher," the enemy's speed was not seriously diminished when the action was broken off.

The forces engaged were as follows

BRITISH

1st Battle Cruiser Squadron

"Lion" (flag), Vice-Admiral Sir David Beatty, Captain Alfred Chatfield, 28 knots
"Princess Royal," Captain Osmond de B. Brock, 28 knots
"Tiger," Captain Henry B. Pelly, 30 knots
Armament of each ship 8 13 5 in., 16 4 in. ("Tiger" 16 6 in.)

2nd Battle Cruiser Squadron

"New Zealand" (flag), Rear-Admiral Sir Archibald Moore, Captain Lionel Halsey, 25 knots
"Indomitable," Captain Francis W. Kennedy, 25 knots
Armament of each ship 8 12 in., 16 4 in.

1st Light Cruiser Squadron

Southampton, Commodore W. T. Goodenough (commander), E. A. Rushon
"Birmingham," Captain Arthur A. Duff
"Nottingham," Captain Charles B. Miller
"Lowestoft," Captain Theobald W. Kennedy
Armament of each ship 9 6 in., "Southampton" 8 6 in., 25 5 knots

Harwich Flotillas

"Arethusa," Commodore Reginald Tyrwhitt
10th Flotilla "Meteor" (Commodore Hon. Herbert Mordaunt), "Miranda," "Mline," "Mentor," "Mastiff," "Mines," "Mortar," speed 34 knots
3rd Flotilla "Undaunted" (Captain Francis St. John), "Lookout," "Lysander," "Landrail," "Laurel," "Tribune," "Laertes," "Lucifer," "Lawford," "Lydia," "Louis," "Le gion," "Lark," speed 29 knots
1st Flotilla "Aurora" (Captain Wilmot S. Nicholson), "Acheron," "Attack," "Hydra," "Ariel," "Forester," "Defender," "Druid," "Hornet," "Tigress," "Sandfly," "Jackal," "Goshawk," "Phoenix," "Lapwing," speed 27 knots

GERMAN

1st Scouting Group (battle cruisers)

"Seydlitz," Rear-Admiral Hipper, 10 11 in., 12 5 9 in., 26 5 knots
"Derfflinger," 8 12 in., 12 5 9 in., 26 5 knots
"Moltke," 10 11 in., 12 5 9 in., 25 knots
"Blücher," 12 8 2 in., 8 5 9 in., 24 knots

2nd Scouting Group (light cruisers)

"Graudenz," "Stralsund," "Kolberg," "Rostock"

Casualties—"Blücher," which sank, received about 40 hits and 2 torpedoes, had 792 of her crew killed, 45 wounded and 189 taken prisoner. "Seydlitz" sustained 3 hits, had 159 killed and 33 wounded. "Derfflinger" was only hit once, and "Kolberg" twice, the latter having 3 killed and 2 wounded.

On the British side "Lion" was put out of action with 12 hits, 1 killed and 20 wounded. "Tiger" received 7 hits, having 10 killed and 11 wounded. "Aurora" received 2 hits and "Meteor" sustained 1 hit, with 4 killed and 1 wounded. The British fired 1,154 rounds of heavy gun ammunition, of which 708 were armour-piercing shell, 77 common, 365 high explosive and 4 shrapnel. The Germans fired 976 rounds from their heavy guns.

BIBLIOGRAPHY—Sir J. S. Corbett, *History of the Great War: Naval Operations*, vol. 2 (1921), A. B. Fison, *Young, With the Battle Cruisers* (1921), see also the German official publication, *Krieg zur See Nordsee*, vol. 3.

DOGETT or DOGGET, THOMAS (d. 1721), English actor, was born in Dublin, and made his first appearance in London in 1691 as Nincompoin in *D'Urfey's Love for Money*. He followed Betterton in Lincoln's Inn Fields, creating the part of

Ben, especially written for him, in Congreve's *Love for Love*, with which the theatre opened (1695), and next year played Young Hobbs in his own *The Country Wake*. He was associated with Cibber and others in the management of the Haymarket and Drury Lane, and he continued to play comedy parts at the former until his retirement in 1713. In 1715 he founded the prize of "Doggett's Coat and Badge," "in commemoration of his Majesty King George's happy Accession to the British Throne." The prize was a red coat with a large silver badge on the arm, bearing the white horse of Hanover, and the race had to be rowed annually on Aug. 1 on the Thames, by six young watermen who were not to have exceeded the time of their apprenticeship by twelve months. The names of the winners have only been preserved since 1791. The race is still rowed each year, but under modified conditions. The date of his death is variously given as Sept. and Oct. 1721.

See *Thomas Doggett, Deceased* (1908).

DOG LICENCES. The great growth of dog keeping is revealed by the record of the dog licence duties, which show that the dog populations have become enormous. In Great Britain dogs over six months old must have a licence which costs 7s 6d a year. Dogs used as guides by blind persons, sheep and cattle dogs, and hounds under 12 months old which have not hunted, are exempt. In 1936, 2,932,612 dog licences were taken out, but it is probable that there are about four million dogs in Great Britain. The penalty for non compliance with the law is a fine up to £5. The licences are issued at post offices, and their revenue goes to the local authorities in whose areas the receiving post office is situated. The law requires also that dog collars should be engraved with their owners' names and addresses, but it is not strictly enforced. In Great Britain there is no way of telling if a particular dog is licensed or not.

In the Irish Free State dogs must be licensed when one month old and in Northern Ireland when six months old, in each case the licence costs 5s.

In the British overseas Dominions dog licensing is general. In Canada each province by statute empowers its municipalities to impose a dog tax. Thus in Ontario the licence costs \$3 for a dog and \$4 for a bitch, a higher duty being imposed when more than one animal is kept. In Australia licences vary little, in Victoria all dogs are taxed at 5s a year, in South Australia a dog is licensed at 5s, a bitch at 7s 6d. All dogs must wear a collar or tag unless kept for hunting or coursing. In South Africa the tax is high, being 12s 6d in Natal and 10s in the Transvaal, where there is a £5 tax on all dogs with a greyhound strain that can be used for hunting.

In Germany all dogs are taxed, the amounts varying in the different districts, being usually small in villages and high in the big towns, and the law is strictly enforced. In Berlin the dog tax is £3 in English money. Sheep dogs on German farms go free of tax. A metal disc bearing the number of the licence must be attached to each dog's collar.

In the United States licences are issued variously by a State, county or municipality. Enforcement of the ordinances requiring registration of dogs is usually within the police powers conferred upon local corporations, but some States, such as Pennsylvania and Connecticut, have general laws on the subject. Registration of dogs above the age of six months, except those in kennels, for which there are special regulations, is usually required annually. A stated fee is paid to the city, county or State officer for the licence, the applicant receiving a tag which must be attached to the animal's collar as evidence of such registration. In case the tag is lost, a duplicate may be obtained, but failure to register a dog, under most ordinances, authorizes the officers to kill it.

DOGMA, DOGMATIC THEOLOGY. Theology, like political economy, has no technical terminology, but seeks to use the language of ordinary life in a specialized sense. Colloquially, to assert dogmatically is contrasted with speaking tentatively. But also, dogmatism is contrasted with proof. "I'm not arguing with you, I'm telling you"—he who so speaks is, reasonably or unreasonably, dogmatic. The claim of accuracy akin to that of science and of authoritativeness akin to that of law, are the two poles of

the universe of dogma. In the New Testament the word means decree, although the Greek fathers early misunderstood it. The older philosophical use, for the leading and inviolate principles of any system, is best illustrated by the *Ipe diast* of the Pythagoreans, whatever their master had said was final. German theologians have sought to define the word for their own purpose by drawing a line round those doctrines which deserve to be called dogmas and by separating them from the region of open questions. According to W. Herrmann (opening p. of *Dogmatik in Die Kultur der Gegenwart*), "We must not mainly understand by a 'Dogma' a definition upon Church authority. Such a definition is only the last stage in a long process, which has all along been actuated by the thought of a *revealed doctrine*. And that conception is the main element in 'Dogma'." In contrast with this F. I. Coefs (*Leitfaden zum Studium der Dogmengeschichte*, ed. 4, p. 9) holds that "Dogma is those affirmations of religious faith whose acknowledgment a Church expressly requires from its members or at least from its teachers." Harnack in his great *History of Dogma* prefers a more historical definition. Dogma is (1) a creation of Greek thought on the soil of the gospel and (2) kindred mediaeval findings, but (3) it is transformed or disappears in Protestantism through deepening religious insight, in Socinianism and the Enlightenment through the dominance of rationalism, in the post Tridentine church through more sweeping exercise of authority. Each of these definitions has its merits. Something is to be said also for the view that, in the modern Church of Rome, we have dogmatism superlatively developed—partly just because that Church forbids one to draw a hard and fast line separating dogmas from pious opinions, or formulated dogmas from unformulated, all the Church's teaching being infallibly and dogmatically true. The choice of a definition can only be made by balancing advantages against disadvantages.

As to dogmatic theology, all that need be said is that it is the most widely accepted name for the systematic statement of Christian doctrines—and not merely of dogmas, if dogmas are to be separated off from the floating mass of theories.

When the Church inherited the Jewish scriptures, it took over an instalment of dogma, and one beset for it by special difficulties too little recognized by theologians—a book holy and divine, and yet not the perfect revelation of God! When, in controversy with Gnosticism, a collection of New Testament writings was added to the "Old Testament," the inheritance grew, and the dogmatic postulate, that all scriptures contain the same teaching, became no easier to vindicate. One cannot deny that Calvinism in the past or that fundamentalism in the present is in a very high degree dogmatic. For each of these, the corpus of scripture is the sum total of dogma, and to the scripture every thought of man is to bow. The Catholic ethos adds other things—an emphasis on sacraments, a gathering up of the contents of the Bible (with unconfessed modifications) into creeds, a franker announcement of church authority. In these features of Catholicism there appears to be a fuller realization of the dogmatic temper than where appeal is made to the Bible alone.

Harnack has good reason for insisting on the fundamental importance of the great Eastern dogmas, Trinity and Incarnation. These expressed the piety of Eastern Catholicism, and they passed into the mediaeval West and even into historic Protestantism as presuppositions—only presuppositions, but as such indispensable. And yet, in their original shaping, the West had played no small part, when curiously hard questions were raised by the East. It has been felicitously observed that "the East thought that everything could be explained, and the West, that nothing needed to be explained." Even at the first General Council (Nicaea, 325) it appears certain that Western minds brushed aside Eastern scruples in imposing the watchword "homoousios"—a term with questionable associations, but a term which not even the slipperiness of the Anans could evade. So again, at Chalcedon (451) and at the First Trullan Council (680), the West threw in the dogmatic watchword round which crystallization ensued. The Councils of Constantinople (381) and Ephesus (431) were more Eastern. The adoption of a non-Biblical phrase at Nicaea, constituted a landmark in the growth of dogma, it is true, since

he Church—the universal Church speaking by its bishops—says so, though the Bible does not! Even at Nicea there was a small obstinate minority. Oliver Wendell Holmes draws the inference that Catholic unanimity means “a majority vote” (followed by excommunication of the few). Similarly, from Nicea onwards, formulated dogma is accompanied by anathemas. We have good reason for including in our definition of dogma this mark—dogma (for all who receive it) is an affirmation which it is sinful to deny, or to challenge, or to ignore. It is a singularly ominous claim.

Another landmark is established for us by the so called Athanasian creed—a (probably later) Western summary and elaboration of Eastern results, with two well marked divisions concerning the Trinity and concerning the Person of Christ. It is “before all things” necessary to be accurate in minute detail regarding these doctrines. Sacraments are not so much as named. Indeed except in the “one baptism for the remission of sins” of the “Nicene-Constantinopolitan” creed, the great early creeds are strangely silent concerning sacraments, although no Catholic mind could ever doubt that it is “he that believeth and is baptized” who shall be saved. In one sense, then, the Athanasian creed marks a climax. It puts the claim of dogma amazingly high. Though it has not forgotten that Christ is “to judge all men according to their own works” orthodoxy is “before all things necessary.”

Yet the mediaeval West goes on to alter the balance of emphasis in several ways. First, it works out the theory of sacraments in fuller detail—numbers them as seven, specifies them one by one, includes in its findings the staggering miracle of transubstantiation. And in all these points the East receives results from the West. Sacraments will not save if an *obex* or hindrance is wilfully interposed (e.g., by deliberate purpose of mortal sin), and the doctrine of reception *in voto*—heaven taking the will for the deed—seems to shake the theory to its foundation. But the emphasis is laid upon the necessity of sacraments, even at the expense of doctrine. For, secondly, implicit faith may suffice lay Christians—may possibly suffice many of the clergy. It is a popular error, though shared by some well educated persons, to speak of implicit “obedience.” *Fides implicita* is the correct phrase. By assenting in general terms to Church teaching, while believing explicitly the minimum creed of Heb. xi. 6, one believes by implication whatever else is *de fide*. We even meet with the position that there is merit before God in believing heretically, if one honestly supposes that one’s heretical view is taught by the Church. All this is a notable counter stroke to the detailed dogmatism of the Athanasian creed. One understands the motives at work, but it is not with God that “we have to do,” still less with conscience, but with—the Church. There is no shadow of excuse in the theory for dissent from Church teaching. Ignorance is encouraged, bad mistakes are excused, but submission is exacted to the uttermost.

The third mediaeval innovation is the Thomist doctrine of mystery. While reason and conscience warrant theistic belief, revelation includes things which reason cannot grasp. Again one comprehends the motive, but again one observes how the significance of the Church is aggrandized by the new doctrine. An enemy might say that doctrines which are “mysterious” in the technical sense are the fossilized remains of what once was living thought. We have a formula, true, but what does the formula contain? No child of the Church dare seek to answer. If the progress of dogmatic definition means the condemnation of views which in the past were innocent, the goal of the dogmatic progress seems to lie altogether beyond the region of knowledge.

Genius in Protestant theology was confined almost entirely to Luther, and even he in later life stifled and hid his. When he proclaims that justification by faith is in itself the *articulus stantis vel cadentis ecclesiae*—“article” is a frequent synonym for dogma—he is seeking to gather up a multitude of *ad-hoc* rational dicta in one thrilling personal experience. So too, when he graduates the books of the New Testament he is clanking to go beyond the letter even of scriptural authority in the strength of his knowledge of the gospel of salvation. In words of his which are written on his monument at Worms and which might be called the undying charter of evangelical Protestantism: *“I ose who truly*

know Christ cannot be caught in the snare of any human authority.” While Luther was incomparably the most daring, all the early reformers hesitated over the great Greek dogmas, but all alike brushed their hesitations aside, and imposed upon the modern time the presuppositions of their fathers. Similarly, the Protestant doctrine of inspiration grew steadily harder. An imperfect but valuable attempt to construe Christianity as a thing of experience was made by Schleiermacher, and the school of Ritschl has even more carefully sought after “Anschluss an Luther.” Historically it is a fair question whether Protestant evangelicalism ought to speak of dogmas at all. This means that doctrine is for it a less thing than Christian life, and that “we know in part.”

The Council of Trent (1545–63) for the first time dogmatically places unwritten tradition side by side with scripture, it also subordinates scripture text and interpretation to the Church’s authority. After the period of general relaxation in the 18th century, movements of reaction everywhere arose. In the Church of Rome Pius IX. (1854) proclaimed *de suo* the Immaculate Conception of the Virgin, and the Council of the Vatican (1869) recognized the Pope’s personal authority as equal to that of any council. In quaint technical language, his formal pronouncements are “irreformable.” Thus dogma makes quite clear that the “development” of which J. H. Newman and others speak is purely one of accretion. Nothing can be cancelled. Nothing can be bettered—it is divinely perfect. Alike in 1854 and in 1870, the *decreta* claim to reiterate a “divinely revealed doctrine” or “dogma.” The Vatican council also makes Thomist apologetic *de fide* (1) Theism is demonstrable. But (2) there are unintelligible mysteries in revealed faith. The former position seems highly complicated. It is now a dogma that dogmatic revelation exists, reason itself proves the being of God, if you hesitate over this, *anathema sit*. The highroad of reason is prescribed to you authoritatively, and the goal is also prescribed. If your reason does not lead you to the goal, *anathema sit*. And if you fail to recognize mysteries above “though not contrary to” reason, *anathema sit*.

When for the first time a closure was introduced into the House of Commons, Lord Salisbury “did not believe the Liberals were sharpening their scimitar in order to cut bread and butter.” The Church of Rome since 1871 has possessed the keenest possible cutting weapon, but has cut with it—nothing. The dogmatic impulse seems to have temporarily exhausted itself in placing the Pope upon his pinnacle.

At the opposite theological extreme from Roman Catholicism, radical Protestantism shows a germ or a vestige of dogma, or at any rate a real parallel to dogma, if it asserts (with G. B. Foster) *the Finality of the Christian Religion*.

It has been proposed by an eminent scientific writer, Dr. Whitehead, that we should speak of the “dogmas” of science, and should recognize that these must from time to time be “changed.” Apparently, the first principles underlying scientific theory are working hypotheses. Such things of course are endlessly modifiable. But a student of theology must hold that it will not tend to clearness of thought if working hypotheses are called “dogmas.”

LITERATURE.—Matthew Arnold’s *Literature and Dogma* (1873) is important for literary usage. J. A. B. Bruce, *Chief End of Revelation* (Classical and early Christian usages, E. Hatch, *Hibbert Lect.* (1882), pp. 119, 120; J. B. Lightfoot on Colossians i. 14 (20), W. Schmidt, *Dogmatik*, vol. I (1895)—many quotations in *extenso*, C. Stange, *Der Dogma und seine Bedeutung in der neueren Dogmengeschichte* (1898)—a pamphlet protesting against what Loofs terms the “generally accepted view” Articles in the (Roman Catholic) *Kirchenlexikon* of Wetzer and Welte, 2d ed. (by Hergenrother and Kaulen), 1883–1901. Arts “Dogmatik” (J. Kostlin), “Dogmengeschichte” (F. Loofs) in Herzog-Hauck’s *Enzyklopädie der Theologie* (vol. IV, 1898), Art “Glaubensartikel” in previous ed. (Herzog-Plitt, vol. V, 1879) by C. F. Kling and L. F. Schoeberlein. Along with Foster, Troeltsch should be studied, English summaries in R. S. Slegue’s *Sufficiency of Christianity* and Ernst Troeltsch, and briefly in a paper on *Troeltsch* by the present writer, *Congregational Quarterly* (April, 1925). J. M. E. McTegart’s *Some Dogmas of Religion* interprets dogmas as “claiming ultimate absolute truth” (See also TISCHBORN) (R. M.).

DOGMATISM is the uncritical acceptance and application of any belief, especially of those ultimate or fundamental beliefs

known as principles. The term has been applied by Kant (*q.v.*) to most preceding systems of philosophy because of their alleged neglect to examine critically the nature and bounds of human knowledge as a preliminary step to their construction.

DOGON (less correctly *HABBE*), a tribe of Sudinese Negroes inhabiting the mountainous country around Bandiagara and Hom borri about 120 mi SW of Timbuktu, where they have maintained a fortified redoubt of paganism for many centuries against the pressure of the great Islamic and other empires which have flourished in the surrounding region during the past millennium. Their organization is theocratic and hierarchical, closely conditioned by a highly integrated complex of philosophical and cosmogonic ideas under sacred priest chiefs (*Hogon*), whose lives are completely governed by ritual. The tribal religion is based largely on the cult of the ancestors, and Dogon wood carvings, representing ancestors, are among the finest specimens of African art, the style being abstract, as is normal in Sudanese sculpture. Masked ritual dances are organized by the men's societies on the occasion of funerals and initiations and at a ceremony in expiation of the original sin of the tribal ancestors, the masks being markedly architectural in character. The dead are buried in holes in the cliff face.

See M. Griaule, *Maquis Dogons* (Paris, 1938), D. Paulme, *Organisation sociale des Dogons* (Paris, 1940). (W. B. Fr.)

DOGRA, an inhabitant of the Duggar tract in the foothills now mostly comprised in the Jammu territory of Kashmir, India. Duggar appears to mean the 'land between two lakes,' as the original home of the Dogra people was situated between the lakes of Siroensar and Mansar. Sanskritized as Drigarh desh, it is unknown to literature. The Duggar is inhabited by a number of castes, including Brahmans, about five classes of Rajputs with numerous septa and the usual undercastes. The Dogra who enlists in the Indian army is or should be a Rajput of some degree from this or the adjacent sub-Himalayan tracts. He is an excellent soldier. The Dogra regiments acquired their high reputation in the first Sikh war.

DOGS, ISLE OF, a district of east London, Eng. on the north bank of the Thames, forming the southern extremity of the metropolitan borough of Poplar (*q.v.*). It is enclosed on three sides by a bend of the Thames formed by Limehouse, Greenwich and Black wall reaches, and includes Millwall (with Millwall dock) on the west and Cubitt Town on the east, the West India docks across its northern end make of it almost an island. Greenwich tunnel (built in 1902) on pedestrians passes under the river there. The whole district is occupied by docks, riverside works and houses for the workers.

The origin of the name is not certain, until the 16th century the area was known as Stepney Marsh, the present name may have originated as a nickname of contempt.

DOG STAR see *SIRIUS*

DOG'S-TOOTH VIOLET, any plant of the genus *Erythronium* of the lily family (Liliaceae) comprising about 15 species, all except one, North American. They are low herbs with unbranched stems which spring from deep corms and bear near the surface of the ground a pair of unequal leaves, often mottled with dark blotches, and large, nodding, lily-like, mostly solitary flowers on slender stalks. The European dog's tooth violet (*E. dentatum*), the only old world species, a delicate spring bloomer, with rose purple flowers, is planted in borders and rockeries. The best known representative in eastern North America is the yellow

ing, projecting triangles, called, from its saw tooth shape, in French, *dent de scie*. Early examples of this decoration are found in Syria and in the Mesopotamian valley, e.g. in the palace front at Rabbath Ammon (built either in the last years of the Sassanid dynasty or in the early part of the Mohammedan rule), where it is used on arch moldings, and in a highly decorative form, in the palace of Machitta of the 8th century. It is found widely during the Romanesque period throughout Europe where it is thought to have been introduced by the Crusaders from the east, and is particularly common in Norman work in France and England, appearing as the chevron (*q.v.*) and zig zag. It often appears in arch moldings as a series of projecting pyramids the sides decorated with foliage. To its supposed resemblance, in this form, to a dog's tooth violet, some people incorrectly attribute the origin of its name.

DOGWOOD, the name applied to shrubs and small trees of the genus *Cornus*, of the family Cornaceae, comprising some 60 species which, except for a single Peruvian species, are found in north temperate regions. They are mostly hardy shrubs, usually with handsome foliage and attractive flowers and fruits. Several are widely cultivated as summer and autumn ornamentals and also for the winter effect of their brightly coloured branches. The common European dogwood, prickwood skewerwood cornel or dogberry (*C. sanguinalis*), is a shrub reaching a height of 8 ft or 9 ft, and is commonly found in hedges, thickets and plantations in Great Britain. Its branches are dark red, the leaves, egg shaped, pointed, about 2 in long by 1½ in broad, turn red in the autumn, the flowers are dull white, borne in terminal clusters. The berries are small, of a black purple colour, bitter and one seeded, and contain a considerable percentage of oil. The white wood is very hard, and, like that of various other dogwoods, is used for making ladder spokes, wheelwork, skewers, forks and other implements.

About 20 species are native to North America, mostly found east of the Rocky mountains, only 6 occurring on the Pacific coast. Of these the most striking are the flowering dogwood (*C. florida*), of the eastern and southern United States, one of the most beautiful of American flowering trees, and its very similar counterpart, the western dogwood (*C. nuttallii*), of the Pacific coast. The wood of the former is used for shuttles. Both are usually small trees 10 ft to 15 ft high, but occasionally 40 ft or more, bearing in early spring a profusion of flower heads each surrounded by four flowering bracts (involucre) 1 in to 3 in long, usually white but varying to rose red, giving the head the appearance of a flower 2 in to 5 in across. The red flowered forms of *C. florida* are extensively propagated for ornament. Other well known North American species are the red osier dogwood or kinnikinnick (*C. stolonifera*), found across the continent, the silky dogwood (*C. amomum*), the pricked dogwood (*C. paniculata*), and the alternate leaved or pagoda dogwood (*C. alternifolia*), natives of the eastern states and adjacent Canada. There are also two low, almost herbaceous, species—the dwarf cornel or bunchberry (*C. canadensis*), found from Newfoundland to Alaska south to Virginia and California, and the northern or Lapland cornel (*C. stueckeana*), native across Canada and northward of the Arctic circle, also in Scotland, northern Europe and Asia. Both bear clusters of brilliant red fruits, those of the latter are eaten by the Eskimos.

The widely planted Cornelian cherry (*C. mas*), a native of Europe and northern Asia, is a handsome shrub with glossy foliage, clusters of yellow flowers, and shining scarlet edible fruits which are made into preserves. The Japanese Kousa (*C. kousa*) native to eastern Asia, with creamy white flowering bracts 3 in across and fruits united in a globular head, is also grown as an ornamental shrub. The Jamaica dogwood, the root bark of which is poisonous, is *Ichthyomethus piscipula*, of the family Leguminosae. (E. S. Hx.)

DOHERTY, CHARLES JOSEPH (1855–1931), Canadian politician, was born at Montreal on May 11, 1855, and educated at McGill university. Called to the Quebec bar in 1877, he became a Q.C. in 1887 and was a puisne judge of the superior court of Quebec from 1891 to 1906. He was first elected to the

house of commons is a Conservative member for the St. Anne's division of Montreal in 1908 and became minister of justice in Sir Robert Borden's government in 1911. In 1912 he held until 1917. He joined the Unionist government in Dec. 1917 and, as acting prime minister and minister of justice, he had the difficult task of administering the Military Service Act. In 1918 he accompanied the prime minister to the peace conference at Paris, and in 1920 was one of the Canadian representatives at the League of Nations. He was appointed to the privy council, London, in the same year.

DOHERTY, HUGH LAWRENCE (1875-1919), English lawn tennis player, was born at Cliphurst, London, on Oct. 5, 1875. He was educated at Westminster school and Trinity College, Cambridge. At Cambridge he and his brother, Reginald F. Doherty (187-1911) made their names as tennis players. They were undoubtedly among the greatest and most trusted players of their day, and their joint work *On Lawn Tennis* (1903) is a classic of the game. The elder brother held the All England singles championship at Wimbledon from 1897-1900 and the younger from 1902-06 when he resigned the title. Playing in doubles the brothers were champions from 1897 to 1905, being only once defeated, by S. H. Smith and F. L. Ruseley in 1902. H. L. Doherty won the U.S. national championship in 1903. He died Aug. 11, 1919.

DOHNANYI, ERNST VON (1877-) Hungarian composer, pianist and conductor, was born at Bratislava (Pressburg) on July 21, 1877. He studied at the Budapest Royal Academy, and was for a short time a pupil of Eugen d'Albert. He attracted notice by his first pianoforte quintet as early as 1895. He was appointed professor of the pianoforte at the Berlin Hochschule (1908) and director of the academy at Budapest in 1910. He became conductor of the Philharmonic orchestra of Budapest, and conducted with notable success in the U.S. The style of his compositions is conservative and individual and carries on the romantic traditions of the 19th century. Among his principal works are *Der Schläfer der Pierrette* (ballet pantomime), *Tante Simona* (comic opera, 1912), *Der Turm des Wozzowski* (opera, 1922), also orchestral and chamber music and songs, all of a high order and giving him a place among the first composers of his day.

As a pianist Dohnányi also took high rank.

DOHRN, ANTON (1840-1909), German zoologist, was born on Dec. 29, 1840, at Stettin, the son of Karl Dohrn, coleopterist, and editor of *Monatsschrift für Entomologie* (16 vol., 1846-66). After studying at Jena, under Ernst Haeckel, he devoted himself to the investigation of marine animals, and in 1870 founded the famous zoological station at Naples. He died on Sept. 26, 1909, at Munich. His publications are *Untersuchungen über Bau u. Entwicklung der Arthropoden* (1870), *Der Ursprung der Wirbelthiere* (1875), and *Studien zur Urgeschichte des Wirbelthierkörpers* (1882).

See *Science* new series, vol. 34 (Nov. 20, 1917).

DOIRAN, BATTLE OF, 1917. This abortive offensive by the British on the Doiran sector on April 24, 1917, and the subsequent attempts are described under SALONIKA CAMPAIGNS. The British forces were there launched against the most formidable positions with the idea of easing the way, by attracting enemy reserves, for a decisive Allied stroke elsewhere—an attack which was suspended before it began.

DOL, a town of northwestern France, in the department of Ille-et-Vilaine, 36 mi. N. of Rennes on the Ouest-Etat railway. Pop. (1946), 4,008. The town was unsuccessfully besieged by William the Conqueror, taken by Henry II in 1164 and by Guy de Thouars in 1204. In 1793 the Vendéens there defeated the republican forces who had taken refuge within its walls. The bishopric was suppressed in 1790. Dol is situated to the southwest of the rich agricultural district known as the marsh of Dol, where market gardening is especially flourishing. Picturesque houses of the 14th and 15th centuries still stand with projecting upper stories. The gray granite cathedral, mainly 13th century, dedicated to St. Samson, is interesting for the English character of its design, for its stained glass windows of the 13th century

and for the finely sculptured tomb of Bishop Thomas James (d. 1504). About 1½ mi. from the town is the *piere du Champ Dolent*, a menhir about 30 ft. in height, not far off stands the great granite rock of Mont Dol, more than 200 ft. in height, surmounted by the statue and chapel of Notre Dame de l'Espérance. Dol has trade in grain, vegetables and fruit, and there are salt marshes. Tanning and leather currying are carried on.

DOLABELLA, PUBLIUS CORNELIUS, Roman general and son-in-law of Cicero, was born about 70 B.C. In the civil wars he at first took the side of Pompey, but afterward went over to Caesar and was present at Pharsalus. To escape the demands of his creditors he introduced (as tribune) a bill proposing that all debts should be cancelled. This was resisted by his colleagues and led to disturbances in Rome. Caesar, on his return from Alexandria, seeing the expediency of removing Dolabella from Rome, took him as one of his generals in the expedition to Africa and Spain. On Caesar's death Dolabella seized the consulship (which had already been conditionally promised him), and, by making friends with Brutus and the other assassins, was confirmed in his office. When, however, M. Antonius offered him the command of the expedition against the Parthians and the province of Syria he changed sides at once. His journey to the province was marked by plundering, extortion and the murder of G. Trebonius, proconsul of Asia, who refused to allow him to enter Smyrna. He was thereupon declared a public enemy and superseded by G. Cassius (one of the murderers of Caesar), who attacked him in Laodicea. On the capture of the place, Dolabella ordered one of his soldiers to kill him (43). Throughout his life he was a profligate and a spendthrift.

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DOLCE, LODOVICO (1508-1568), prolific but mediocre Italian writer, was a native of Venice. He wrote on many subjects, but is remembered chiefly for his *Marianna*, a tragedy from the life of Herod, and for five comedies, *Il Ragazzo* (1541), *Il Capitano* (1545), *Il Martirio* (1545), *La Fabbrica* (1549) and *Il Ruffiano* (1551).

See A. Salza, *Delle commedie di Ludovico Dolce* (1899), Irene Sanesi, *La Commedia*, vol. 1, 251 ff. (Milan, 1911).

DOLCI, CARLO or CARLINO (1616-1686), Italian painter, was born in Florence on May 25, 1616, and died there on Jan. 17, 1686. He was a disciple of Jacopo Vignali, and when only 11 years of age he attempted a whole figure of St. John and a head of the infant Christ. His portrait of his mother displayed a new and delicate style which brought him extensive employment at Florence and in other parts of Italy.

Carlo Dolci holds somewhat the same rank in the Florentine school as Sassoferrato does in the Roman school. Without the possession of much genius, invention or elevation of type, both these artists produced highly wrought pictures, extremely attractive to some tastes. Many of his pictures represent the patient suffering of Christ, or the sorrows of the Mater Dolorosa. Dolci was, in fact, from early youth, exceedingly pious, it is said that during Passion week every year he painted a half-figure of the Saviour. Among his best works are the "St. Sebastian", the "Four Evangelists", at Florence, "Christ Breaking the Bread", in the marquis of Exeter's collection at Burleigh, the "St. Cecilia" in Dresden, an "Adoration of the Magi", and especially "St. Andrew praying before his Crucifixion", in Florence, his most important composition, painted in 1646. There are examples also in the National gallery and Dulwich gallery, London, and at Rome, Vienna, Munich, Berlin and Leningrad.

DOLDRUMS, an area or belt of calms or very light winds in certain equatorial regions, especially over the oceans. In the days of sailing vessels these areas were avoided, if possible, by manners lest they find themselves becalmed for days or weeks, feeling uncomfortably warm in the still, humid air, losing time and consuming provisions and water. Hence, to be "in the doldrums" means to be "in the dumps."

(H. R. B.)

DOLE, SANFORD BALLARD (1844-1926), jurist and statesman of the Hawaiian Islands, was born in Honolulu on April 23, 1844, the son of American missionaries. After studying law in Boston he returned to Hawaii to become one of its leading lawyers, a member of the legislature from 1884 to 1887, and a leader in the reform movement which secured the constitution of 1887. Also in 1887 he was appointed an associate justice of the supreme court, which office he held until the monarchy was overthrown in 1893 by a revolution of which Dole was himself a leader. In 1894 he was elected by the constitutional convention as the first president of the Republic of Hawaii. With firmness and wisdom he guided the republic through a difficult period, suppressing revolutions and stabilizing the governmental machinery. When President Cleveland demanded the restoration of Queen Liliuokalani to the throne Dole refused to yield, claiming that Cleveland was without authority to act. In 1898 he went to Washington in the interests of annexation, and when that event took place in 1900 Dole was appointed by President McKinley as the first territorial governor. In 1903 he became United States district judge of Hawaii and in 1909 was reappointed to a second term. At its expiration in 1915 he retired to private life in Honolulu, where he died on June 9, 1926.

DOLE, a town of eastern France, capital of an *arrondissement* in the department of Jura, 29 mi. S.E. of Dijon on the Paris-Lyon railway. Pop. (1946) 18,250. Dole, the ancient *Dola*, was in Roman times the meeting place of several roads, and considerable remains have been found there. In the later middle ages, till 1648, it was the capital of Franche-Comté and seat of a *parlement* and a university, but in 1479 the town was taken and destroyed by Louis XI. It subsequently came into the hands of Maximilian of Austria, and in 1530 was fortified by Charles V. In 1668 and 1674 it was captured by the French and lost its *parlement* and university, both of which were transferred by Louis XIV to Besançon. Dole occupies the slope of a hill overlooking the forest of Chaux, on the right bank of the Doubs, and of the canal from the Rhone to the Rhine which accompanies that river. The steep, narrow streets contain many old houses recalling, in their architecture, the Spanish occupation of the town. The church of Notre Dame is Gothic of the 16th century. The college, once a Jesuit establishment, contains the library and a museum of paintings, and has a chapel of the Renaissance period, the *Hôtel Dieu* and hotel de ville are both 17th century buildings, and the law court occupies an old convent of the Cordeliers. In the courtyard of the hotel de ville stands an old tower dating from the 15th century. The birth of Louis Pasteur (1822) in the town is commemorated by a monument, and there is also a monument to Jules Grevy. Dole is the seat of a subprefect and has tribunals of first instance and of commerce. Metal-founding and the manufacture of pumps, kitchen ranges and other iron goods, chemical products, machinery, blue and blacking, and pastry are among the industries. There is a good trade in agricultural produce and livestock, and in wood, iron, coal and the stone of the vicinity. Much wine is produced in the district.

DOLE, a portion, a distribution of gifts, especially of food and money, given in charity (OE *dol*, cf. mod. "deal"). The distribution of alms to the local poor at funerals was a universal custom in the middle ages. Thus in 1309 Eleanor, duchess of Gloucester, ordered in her will that 15 poor men should carry torches at her funeral, "each having a gown and hood lined with white, breeches of blue cloth, shoes and a shirt, and £20 amongst them." Later, doles usually took the form of bequests of land or money, the interest or rent of which was to be annually employed in charity. Often the distribution took place at the grave of the donor. Lenten doles were also formerly common. A will of 1537 bade a barrel of white herrings and a case of red herrings be given yearly to the poor of Clavering, Essex, to help them tide over the fast. A pilgrim's dole of bread and ale can be claimed by all wayfarers at the Hospital of St. Cross, Winchester. This is said to have been founded by William of Wykeham. Emerson, when visiting Winchester, claimed and received the dole. What were known as "scrambling doles," so called because the meat and bread distributed were thrown among the poor to be scrambled

for, were not uncommon in England. At Wath, near Ripon, a testator in 1810 ordered that 40 penny loaves should be thrown from the church leads at midnight on every Christmas Eve. The best known dole in the United States is the "Leake dole of bread" John Leake, a millionaire, dying in 1792, left £1,000 to Trinity church, New York, the income to be laid out in wheaten loaves and distributed every Sabbath morning after service. (X)

Dole in Unemployment—While, as explained above, a dole is strictly a charitable gift, usually of food, the term came in Great Britain after World War I to be applied loosely to the various kinds of weekly payments to the unemployed.

These payments were first made on a national scale under the out-of-work donation scheme which was instituted immediately after the Armistice in 1918, and inasmuch as the scheme was entirely noncontributory, the term "dole" might be regarded as not inappropriate. The expression "dole" in relation to donation payments obtained currency soon after the scheme began.

The scheme applied not only to unemployed former members of the forces who had served during World War I, but to civilian unemployed workers also. The payments came wholly from the exchequer and amounted to £62,448,000 (£40,723,000 to former members of the forces and £21,725,000 to civilians). The scheme for civilians was in existence for the year Nov. 1918 to Nov. 1919. For former members of the forces it continued until March 1921.

By what may be described as a natural, or at least an easy, transition the term "dole" was afterwards applied to the weekly payments made under the National Unemployment Insurance scheme (see **UNEMPLOYMENT INSURANCE**). This general scheme of insurance against unemployment was, however, on a contributory basis from its inception. The contributing parties were the employer, the employed person, and the exchequer, the share of the contribution borne on national funds being only one fifth of the whole. (The exchequer share was later increased and in the year 1930 amounted to one third of the whole.)

From 1920 to Dec. 1929, over £28,000,000 was contributed by employers and workers and over £10,000,000 by the exchequer.

Unemployment Benefits Subscribed For—The unemployment insurance scheme was launched on what may be called a strictly insurance basis, persons who contributed to it being entitled when unemployed to receive benefit in proportion to their contributions, subject to a maximum period in each year. However, because the scheme came into operation just when the severe industrial depression began, it became necessary to graft on to it a supplementary scheme under which benefit might be drawn by persons who would normally have contributed to the scheme but who, because of the slump, either had not paid a sufficient number of contributions or had exhausted their benefit rights. The term dole was soon commonly applied to this extra or uncovenanted benefit and it almost inevitably became associated with the insurance scheme as a whole, to which, however, as an insurance scheme it is quite inappropriate.

The term was also applied to payments by the Poor law authorities for relief of the able-bodied unemployed—an application which, having regard to the nature of the payments, is more justified than one referring to the unemployment insurance scheme.

Generally, it may be said that after 1919 the term dole was loosely applied to payment made from national or local funds to the unemployed and even to benefits paid from insurance funds to which the recipients themselves contribute heavily. By mid century the term was only occasionally used.

(J F G P, X)

DOLERITE is a term used in England though seldom elsewhere for medium coarse-grained intrusive or hypabyssal rocks of the composition of basalt, and with optically texture. In other words, for rocks which in the United States are called diabase.

The history of the term *dolerite* (*δολερίτης*, deceptive) is long and involved, and is closely tied up with that of diabase (*q.v.*). It was first used by René Just Haüy some time prior to 1819 for a compact rock composed of feldspar and augite. To this definition Karl C. von Leonhard in 1823 added that the texture is that of a basalt whose granularity is megascopically visible. In other words,

fine grained extrusives were called basalt, and the coarser variety dolente. Ten years later, Von I enau inserted between the dense basalt and the coarse grained dolente the term inime site (*varapocis*, in the middle) thus the same except for texture. All these were included by John McCulloch under the old Swedish name trapp. I Sandberg in 1870 separated his basalt from his dolentes by the presence of ilmenite, as in necessary in the latter and magnetite in the former, but Hugo Bucking showed that titanium is present in both.

Simply for a coarse grained basalt the term has been used occasionally in Germany, although Harry Rosenbusch did not use it in his classification, while Friedrich Zirkel used it in the same. Von I enau and in England S. Allport in 1871 determined to drop the word diabase from his classification for he considered the basic, igneous rock—multiphase, aphanitic, diaphane and greenstone—in his nothing, but chloritized rocks, and proposed to group them under the generic name dolente.² The use of the word dolente and the limiting of the term diabase to decomposed rocks came about gradually in England. It was used by J. J. Harris Feil in 1888 but Alford Harker in 1902 still considered diabases as intrusive bodies of hypabyssal pyroclastic rocks. He considered them equivalent in composition to gabbro or basalt, but characterized by their ophtic texture. He also said that some English writers had "inconveniently" employed the name diabase for a more or less decomposed dolente. In 1903, however, Harker substituted "dolente" for "diabase" in his definition, otherwise, word for word, the two are identical. He now said that diabase was in part synonymous with dolente but regarded the word objectionable and dropped it. Arthur Holmes in 1920 said that in general dolente is distinguished from basalt by its coarser grain, the absence of glass, its holocrystalline character and the ophtic texture.

Comparative Usage of the Terms Diabase and Dolente in the United States, Germany and Great Britain

| Country | Intrusive (with ophtic texture) | Extrusive | | | |
|---------------|--|---------------------------------|--------|----------------------------|-------------------------|
| | | Chamo | Fine | Pre Tertiary | Altered |
| United States | Diabase (modern use) | Basalt | Basalt | No age classification used | No special name |
| Germany | Diabase by Zirkel, 1866 | (Dolente*) | Basalt | Diabase (Rosenbusch) | Diabase (general usage) |
| Great Britain | Diabase by Harker, 1902; dolente by Harker, 1903 | Dolente generally, Allport 1874 | Basalt | No age classification used | Diabase (general usage) |

*Not in common use at present.

† Diabase is often used for the altered rocks, primarily because the Palaeozoic rocks are usually so altered.

‡ Presumably dolente would be included also under the term dolente.

From Albert Johannsen in *Journal of Geology*, Univ. of Chicago Press

For a rock of the alkali series, intermediate in composition between a trachyte and a dolente, but containing more labradorite than orthoclase or anorthoclase, and usually carrying a small amount of a felspathoid, H. Rosenbusch proposed the name trachydolente. The term, however, has been used with several meanings, and it is questionable whether it should be retained. BRACHYOPHY—Albert Johannsen, "On the Use of the Terms Diabase and Dolente," *Journal of Geology*, vol. xxv, pp. 270-275 (1917), 4. Descriptive Petrography of the Igneous Rocks, vol. iii, pp. 291-296, 311-318 (1937). Complete references to the literature are given.

(A. J.)

DOLET, ÉTIENNE (1509-1546), French scholar and printer, was born at Orléans. After studying at Paris and Padua, he became secretary in 1530 to the bishop of Limoges, who was French ambassador to the republic of Venice. He then studied law at Toulouse. In 1535 he entered the lists against Erasmus in the famous Ciceronian controversy, by publishing a *Dialogus de instantanea Ciceroniana*; and the following year saw his *Commentarii linguae Latinae*. This work was dedicated to Francis I, who gave him the privilege of printing during ten years any works in Latin, Greek, Italian or French, which were the product of his own pen or had received his supervision, and accordingly, on his release from an imprisonment occasioned by his justifiable homi-

cide of a printer named Compaign he began at Lyons his typographic and editorial labours. He started by publishing a *Cato christianus* as Christian moralist, in which he made profession of his creed. The catholicity of his literary appreciation, in spite of his ultra Ciceronianism, was soon displayed by the works which proceeded from his press—ancient and modern, sacred and secular, from the New Testament in Latin to Rabelais in French. After being three imprisoned for atheism, he was tortured and burnt at Paris on Aug. 3, 1546. On his way to the stake, he is said to have composed the punning pentameter—*Non dolet ipse Dolei, sed pia turba dolet*.

Whether Dolet was a Protestant or an anti-Christian rationalist is debatable. He was condemned by Calvin but many of his books were of a religious character and he repeatedly advocated the reading of the Scriptures in the vulgar tongue.

See A. F. Didot, *Essai sur la typographie* (1852); L. Michel, *Dolet* (1880); R. C. Christie, *Étienne Dolet, le Marin of the Renaissance* (2nd ed. 1889, bibl.); O. Galtier, *Étienne Dolet* (1908), and pt. 3 of J. C. Prevost's *Toujours en Renaissance*, (1913).

DOLGELLY, market town, urban district and the county town of Merionethshire, Wales, on the streams Wnion and Aran, at the north base of Cader Idris, on the G.W. railway. Pop. (1918) 2,461. Area 18 sq. mi. It consists of small squares and narrow streets, with a grammar school (1665), market hall and assize hall. There is a little manufacture of flannel and coarse woollens. An ancient house has associations with Owen Glendower, who established relations with the continent from here in 1404. Hengwrt, a mansion near the ruins of Cymmer abbey, has given its name to a famous collection of Welsh MSS. once housed there, and now in the National Library of Wales, Aberystwyth.

DOLGORUKI, VASIL LUKICH, Count (1672-1739). Russian diplomatist and minister, was one of the first group of young Russians whom Peter the Great sent abroad to be educated. On his return home he entered the diplomatic service, and served on a series of important missions. During the reign of Peter II (1727-30) Dolgoruki was appointed a member of the supreme privy council, and, after procuring the banishment of Menshikov, he took charge of the young emperor, whom he would have forced to marry his niece Catherine but for Peter's sudden death. He then drew up a letter purporting to be the last will of the emperor, appointing Catherine Dolgoruki his successor, but had to abandon the scheme as impracticable. He supported the election of Anne of Courland to the throne on condition that she first signed nine "articles of limitation" which left the supreme power in the hands of the Russian council. Anne, who repudiated the "articles" on the first opportunity, never forgave Dolgoruki. He was banished first to his country seat and then to the Solovetsky monastery. Nine years later the charge of forging the will of Peter II was revived, and he was beheaded at Novgorod on Nov. 8, 1739.

See Robert Nisbet Bain, *The Pupils of Peter the Great* (1895).

DOLHAIN, a town of eastern Belgium, situated on the Vesdre, northeast of Verviers and close to the German frontier. It is quite a modern town, occupying the site of the lower town of the ancient city of Limburg, which was destroyed by Louis XIV in 1675. On a rocky eminence above Dolhain are still to be seen the fine ruins of the old castle of Limburg, the cradle of the ancient family of that name from which sprang the Luxembourg family and several emperors of Germany. At a short distance from Dolhain is the famous dam of the Gileppe, the vast reservoir constructed to supply Verviers with water free from lime for its cloth manufactures.

DOLICHOCEPHALIC, having a relatively long head. In anthropology, it denotes a cephalic index of 75 or less (see ANTHROPOMETRY, CEPHALIC INDEX, CRANIOMETRY). In obstetrics the term is applied to a head which is temporarily elongated, usually by moulding from a long and hard labour. (F. L. A.)

DOLLAR, small burgh, Clackmannanshire, Scotland, 6 mi N.E. of Alloa by the N.E.R. Pop. (1938) 1,428. The well known academy is housed in a fine mass of buildings of the Grecian order (opened c. 1819). Castle Campbell, a stronghold of the Argylls from the late 15th century, is an imposing ruin.

DOLLAR, originally a silver coin current in many European countries, and later any of several silver coins. The Spanish peso,

or piece of eight which circulated in the Spanish American and English colonies, was known as a dollar by the English speaking peoples, although the term does not seem to have been in use among the Spanish speaking peoples. Familiarity during colonial times with this coin resulted in the official designation of the United States monetary unit as the dollar. Other countries, notably Canada, also chose the dollar, but these of course are not synonymous with the U.S. dollar. Monetary arrangements differ from country to country and change within countries with the passage of time. Consequently, dollar has a wide range of meanings.

The word itself is a modified form of a Germanic word "thaler," a shortened form of "Joachimst(h)aler," a 16th century silver coin intended to be the equivalent of the guilder, a gold coin. The Joachimst(h)aler was first struck in 1519 under the direction of the count of Schlick, who had appropriated a rich silver mine discovered in St. Joachimsthal (Joachim's dale), Bohemia. The coin bore an effigy of St. Joachim, hence the name. It was also known as the "Schlickenthaler." Many of these coins were struck and they were current in Germany from the 16th century onward. Thaler as a name for a silver coin became general, with various modifications such as daler, dalar, dhalder, taller, etc. Only in 1873 was "thaler" replaced by "mark" as the name of the German monetary unit.

The United States dollar was defined in the law of April 2, 1792, as either 24.75 gr (troy) of fine gold or 371.25 gr (troy) of fine silver. Provision was made for a one dollar silver coin with a bullion content slightly less than that of the Spanish dollar, or peso, as well as for small denomination silver coins and for \$2.50, \$5.00 and \$10.00 gold coins. Thus, from the outset the United States dollar was not simply a silver coin. Rather, the dollar was the unit of account and was given physical embodiment in both gold and silver coins of various denominations. The silver dollar continued in use, but from 1873, when the United States abandoned bimetalism in favour of the gold standard, it had the status of a token coin, i.e., a coin worth more as money than as metal. In 1853 small denomination coins had become tokens.

In the U.S. monetary system "dollar" is used in several senses. By law it is the name of the unit of account. A dollar also is a legally specified weight of gold from 1934, 15.479 gr (troy), 9 fine. As such it does not circulate. Day to day money payments are made with coins, which are mere tokens, with various types of paper money and with checks drawn against bank deposits. There are roughly five times as many dollars in the form of coins, paper money and balances in people's checking accounts as there are gold dollars in the nation's monetary gold reserve. The gold standard does not require that a country's money be limited to the amount of its gold holdings or even that gold coins be used as a circulating money. However, steps must be taken to keep circulating dollars interchangeable with the quantity of gold defined as constituting a dollar. Unless implemented, defining a country's money as a fixed weight of gold has little significance.

As a unit of account the dollar provides the means by which values are expressed. It is in dollars that prices are quoted, accounts are kept, debts are contracted and calculations of incomes and costs are performed. Similarly, in other countries francs, pesos, pounds sterling, etc., are used as the unit of reckoning. In the sense of unit of account, the dollar is an abstract unit of value, but the magnitude of its value is given dimension by virtue of the existence of a limited quantity of circulating dollars.

Fundamentally the purpose of connecting the dollar to gold is to assure that the buying power of the dollar will remain reasonably constant. Great economic distress results when prices in general rise or fall rapidly, or, in other words, when the value of money decreases or increases. The effects of changing price levels are to alter the distribution of income quite inequitably and also to distort production through creating disparities between costs and returns. The basic difficulty is that all prices do not change uniformly.

In many historical episodes money not effectively linked to gold has depreciated seriously. The United States had such an experience during the Civil War period. Germany in 1923, Hun-

gary in 1945 and China in 1949 provide examples of countries impoverished through inflation. However, some nations, notably Sweden in the 1930s, demonstrated that an irredeemable paper currency may retain stability in its value. Nevertheless, there is a strong sentiment for gold-based currencies. Even if they fluctuate in value, historically they have proved more stable than most paper currencies.

Throughout U.S. history the dollar has been defined in terms of gold (and silver also prior to 1873). Moreover, except during 1861-79 and 1933-34, this definition has been meaningful. Prior to March 6, 1933, free coinage of gold together with redemption of paper money in gold coin accomplished this. Beginning Jan. 31, 1934, government purchase and sale of gold in uncoined form at a fixed price served the same purpose. The practical effect of either of these arrangements is that a dollar of circulating money is kept at the same value as the physical quantity of gold specified as constituting a dollar. Of necessity, if circulating money does not itself consist of full weight gold coins, a limit must be placed on the number of circulating dollars which may be created. Otherwise, equivalence cannot be maintained. A complex system of reserve requirements ultimately based on the nation's stock of gold bars serves to fix an upper limit to the circulating medium. Purchase and sale of gold connects circulating dollars to the gold dollar.

A relatively small number of gold dollar coins were struck, beginning in 1849, but their small size made their circulation impractical. This coin contained 25.8 gr (troy), 9 fine gold, which was the gold dollar's weight from 1837 to 1934. On Jan. 31, 1934, the gold in the dollar was reduced to 15.479 gr (troy), 9 fine. In other words, the official price of an ounce of fine gold was increased from \$30.66 to \$35.00. The action was formally taken by means of a presidential executive order issued under terms of the Gold Reserve Act of 1934. Until June 30, 1943, further reduction (as well as a slight increase) was permissible, but no further change was made. Also during 1933-34, gold coins were removed from circulation, title to all monetary gold passed to the government, coins and paper money became full legal tender and gold certificates were called in. To most people these changes were of no consequence.

Devaluation (reduction of the gold content of the dollar) was motivated by the desire to raise the price level, which had fallen by March 1933 to approximately one half its 1929 level. To the disappointment of those who advocated this step, prices generally did not rise as forecast. Not until early in World War II was the price level restored to the 1929 level, and it continued to climb. At mid century, the U.S. cost of living was roughly twice as high as in 1933.

U.S. experience demonstrated that the gold content of the dollar is not the determining factor governing the purchasing power of the dollar. From 1879 to 1933 prices repeatedly moved upward and downward through a wide range despite constancy in the gold content of the dollar. The rise in prices after 1933 was not simply the resultant of devaluation, but of a host of other factors, many of which outweighed that particular factor.

Many students of money have recommended that the linking of the dollar to gold be retained even if price level stability is not achieved simply and automatically by doing so. They hold that international monetary relationships are more stable when currencies have a gold basis and also that it is desirable to impose an upper limit through gold reserve requirements on the volume of circulating money. They believe, however, that price level stability would be achieved only by skilful central bank management within a broad framework of measures designed to promote economic stability.

Others have recommended elimination of the linking of the dollar to a fixed quantity of gold. Irving Fisher (1867-1947), the leading advocate of dollar stabilization, in 1913 proposed a compensated dollar, whose gold content would be varied inversely with the price level. Later, Fisher advocated credit control measures directed at maintaining stability in a selected index number of prices. His general proposals for dollar stabilization gained many adherents, although on matters of detail there was sub-

stantial controversy. Almost everyone agrees that stability in the dollar's buying power, if realized, would contribute greatly to economic stability.

The Employment act of 1946 did not list stability of the buying power of money as one of the objectives of national economic policy. The Federal reserve has repeatedly stated objections to adoption of this criterion as the specific goal of monetary policy. The prevention of inflation (i.e., continued rapid rises in prices) was nonetheless the major economic problem following World War II.

Index numbers of prices are the means of measuring over-all price movements. The United States bureau of labour statistics issues two widely used indexes, one for wholesale prices and another for prices paid by consumers.

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DOLLFUSS, ENGELBERT (1892-1934), Austrian statesman, born in Tetsing, Lower Austria, in 1892, was educated at the universities of Vienna and Berlin. During the world war he served as an officer in the Austrian army. In October 1921 he became president of the Austrian Federal Railways, in March 1932 minister of Agriculture and Forestry, and in May 1932 was appointed Chancellor. On March 4, 1933, feeling the need of a strong government in face of the growing menace to Austria from German Nazis, he dispensed with further meetings of the *Nationalrat*. He was wounded in an attempt upon his life on Oct. 3, 1933, and on July 25, 1934 he was assassinated by a group of Austrian Nazis who, disguised as members of the regular Austrian army, seized the Chancellery in Vienna.

DOLLINGER, JOHANN JOSEPH IGNAZ VON (1799-1890), German theologian and church historian, was born at Bamberg, Bavaria, on Feb. 28, 1799, and was educated at the Würzburg gymnasium and at Bamberg. On April 5, 1822 he was ordained priest. In 1823 he became professor of ecclesiastical history and canon law in the lyceum at Aschaffenburg, and in 1826 professor of theology at Munich, where he spent the rest of his life. He entered into relations with the well-known French Liberal Catholic, Lamennais, whose views on the reconciliation of the Roman Catholic Church with the principles of modern society had aroused much suspicion in ultramontane circles. In 1832 Lamennais, with his friends Lacordaire and Montalembert, visited Germany, with a view to bringing about a modification of the Roman Catholic attitude to modern problems. In 1838 he published a treatise against mixed marriages, and in his works on *The Reformation* (3 vols. Regensburg, 1846-48) and on *Luther* (1851, Eng. tr., 1853) he is very severe on the Protestant leaders. In 1842 he entered into correspondence with the leaders of the Tractarian movement in England, notably with Pusey, Gladstone and Hope Scott, and two years later was made representative of his university in the second chamber of the Bavarian legislature. In 1847, in consequence of the fall from power of the Abel ministry in Bavaria, with which he had been in close relations, he was removed from his professorship at Munich, but in 1849 was invited to occupy the chair of ecclesiastical history. He was a delegate to the national German assembly at Frankfurt in 1848.

It has been said that his change of relations to the Papacy dated from the Italian war in 1859, but no sufficient reason has been given for this statement. He was unfavourably impressed by the promulgation (1854) of the dogma of the Immaculate Conception of the Blessed Virgin, and he disliked the attitude of the zealots for the restoration of the temporal sovereignty of the pope. In 1863 he invited 100 theologians to discuss at Milnes the question which Lamennais and Lacordaire had already raised in France, namely, the attitude that should be assumed by the Roman Catholic Church towards modern problems and modern science. His strong liberalism and the anti-ultramontane and anti-Jesuit attitude which he displayed at this conference led the pope to suppress it after four days session. On Dec. 8, 1864 Pius IX issued the *Syllabus* (q.v.), in the 13th thesis of which he condemned certain of Dollinger's views. It was in connection with

the problems raised at the conference that Dollinger published his *Past and Present of Catholic Theology* (1863) and his *Universities Past and Present* (Munich, 1867).

We now approach the critical period of Dollinger's life. The headquarters of the opposition to the movement for the declaration of papal infallibility which was now mooted in many quarters was Germany, and its leader was Dollinger. Among the group were his intimate friends Johann Friedrich and J. N. Huber (q.v.), in Bavaria. In the rest of Germany he found many supporters, chiefly professors in the Catholic faculty of theology at Bonn, among whom were the famous canonist von Schulte, Franz Heinrich Reusch, the ecclesiastical historian Joseph Langen, as well as J. H. Reinkens, afterwards bishop of the Old Catholic Church in Germany, Knoodt, and other distinguished scholars, and, in Switzerland, Prof. Edward Herzog, who became Old (or, as it is sometimes called, Christ-) Catholic bishop in Switzerland. Early in 1869 the famous *Letters of Janus*, written by Dollinger in conjunction with Huber and Friedrich (which were at once translated into English, 2nd ed. *Das Popsttum*, 1891), began to appear. The *Letters* pointed out the tendency of the *Syllabus* towards obscurantism and papal despotism, and marshalled the evidence against papal infallibility, a subject which had been placed on the agenda of the Vatican Council fixed for Dec. 8, 1869. During its session the world was kept informed of what was going on in the *Letters of Quirinus*, by Dollinger and Huber, who were supplied with information by Augustin Theiner, the librarian at the Vatican, then in disgrace with the pope for his outspoken Liberalism. The dogma was carried by an overwhelming majority and the dissentient bishops, one by one submitted (see VATICAN COUNCIL). Dollinger, understanding infallibility to apply to all official exercise of the supreme magistracy, including encyclicals, headed a protest by 44 Munich professors, and convened a congress at Nuremberg, which met in Aug. 1870 and issued a declaration adverse to the Vatican decrees. The archbishop of Munich called upon Dollinger to submit. Dollinger answered (Nov. 28, 1871) that the decrees were opposed to Holy Scripture, to the traditions of the Church for the first 1,000 years, to historical evidence, to the decrees of the general councils, and to the existing relations of the Roman Catholic Church to the state in every country in the world. "As a Christian, as a theologian, as an historian, and as a citizen," he added, "I cannot accept this doctrine."

The archbishop replied (April, 1871) by excommunicating Dollinger (see VATICAN COUNCIL and INTOLERABILITY), who was thereupon almost unanimously elected rector magnificus of the university of Munich while Oxford, Edinburgh and Marburg universities conferred upon him the honorary degree of doctor of laws and Vienna that of philosophy. The Bavarian clergy invited Bishop Loos of the Jansenist Church in Holland, which for more than 150 years had existed independent of the Papacy and had adopted the name of "Old Catholic," to hold confirmations in Bavaria. The offer was accepted, and the three Dutch Old Catholic bishops declared themselves ready to consecrate a bishop, if it were desired. The momentous question was discussed at a meeting of the opponents of the Vatican decrees, when Dollinger voted against the proposition, and withdrew from any further steps towards the promotion of the movement. He declined to initiate a schism (see OLD CATHOLICS).

Dollinger's attitude to the new community was not very clearly defined. His addresses on the reunion of the Churches, delivered at the Bonn Conference of 1872, show that he was not hostile to the newly formed communion, in whose interest the conference was held, in 1874 and again in 1875, he presided over the Reunion Conferences held there and attended by leading ecclesiastics from the British Isles and from the Orthodox Church. At the latter of these two conferences, when Dollinger was seventy-six years of age, he delivered a series of addresses in German and English, in which he discussed the state of theology on the continent, the reunion question, and the religious condition of the various countries of Europe in which the Roman Catholic Church held sway, and he succeeded in inducing the Orientals, Anglicans and Old Catholics present to accept a formula of concord, drawn

from the writings of the leading theologians of the Greek Church, on the question of the Procession of the Holy Spirit. During his last years of retirement he wrote, in conjunction with his friend Reusch, *Geschichte der Moralstreitigkeiten in der römisch-katholischen Kirche seit dem sechzehnten Jahrhundert mit Beiträgen zur Geschichte und Charakteristik des Jesuitenordens* (Nordlingen, 1889). Dollinger died in Munich on Jan. 14, 1890, at nearly ninety-one. He declined to receive the sacraments from the parish priest at the cost of submission, but the last offices were performed by his friend Professor Friedrich.

In addition to the works referred to in the foregoing sketch, we may mention *The Eucharist in the First Three Centuries* (Mainz, 1836), a *Church History* (1836, Eng. trans., 1840), *Hippolytus and Callistus* (1854, Eng. trans., 1876), *First Age of Christianity* (1860), *The Church and the Churches* (Munich, 1861), *Lectures on the Reunion of the Churches*, *The Vatican Decrees* *Studies in European History* (tr. M. Warre, 1890), *Miscellaneous Addresses* (tr. M. Warre, 1894), *See L. von Kobell, Conversations of Dr. Dollinger* (tr. by K. Gould, 1892), and *J. Friedrich, Ignas von Dollinger* (Munich, 1899-1901).

DOLLOND, JOHN (1706-1761), FRS (1761), English optician, was the son of a Huguenot refugee, a silk weaver at Spitalfields, London, where he was born on June 10, 1706. He followed his father's trade, but found time to acquire a knowledge of Latin, Greek, mathematics, physics, anatomy and other subjects. In 1752 he abandoned silk-weaving and joined his eldest son, Peter Dollond (1730-1820), who, in 1750 had started in business as a maker of optical instruments. His reputation grew rapidly, and in 1761 he was appointed optician to the king. In 1758 he published an "Account of some experiments concerning the different refrangibility of light" (*Phil. Trans.*, 1758), describing the experiments that led him to the discovery of a means of constructing achromatic lenses by the combination of crown and flint glasses. Following the suggestion of Leonhard Euler and the experiments of Samuel Klingensjerna (1698-1765) Dollond commenced a series of tests on achromatism. Early in 1757 he succeeded in producing refraction without colour by the use of glass and water lenses, and a few months later he obtained the same result by a combination of glasses of different refrangibilities (see TELESCOPE). Dollond also published two papers on apparatus for measuring small angles (*Phil. Trans.*, 1753, 1754). He died in London on Nov. 30, 1761.

DOLLS The doll, the familiar toy puppet of childhood, is one of the oldest of human institutions. Common among both savage and civilized people, its antiquity is attested by Egyptian, Greek and Roman remains, among which small figures of clay, wood, bone and ivory are identified as dolls from being found in children's graves.

Dolls are among the first inventions of children, having been doubtless improvised in the earliest instances from natural objects such as sticks and stones. Aboriginal America and Japan are the chief sources of information. The child's doll occurs among the American Indians as the image of a deity, made of wood, regarded as sacred and entrusted to the child in its religious instruction. Such dolls, carved to represent the masked dancers who personate the gods, are used to-day throughout the Pueblo area of the United States in New Mexico and Arizona, and in a derived form among the Pomo in California. They are also treated with great respect by the Pueblos, their sale being forbidden. The dolls of the Keres Indians of Laguna and Cochiti are not elaborately carved or dressed, being flat or rounded billets, identical in form with the prayer sticks employed as ceremonial offerings. The Navajo who occupy the adjacent territory look with superstitious fear upon the Pueblo doll and use a wooden effigy representing a Hopi doll to work evil upon an enemy. Indian mothers among the Chippewa put feathers in the form of a child in the cradle of a dead infant, carrying this about with them and treating it as though living. The Eskimo and northern Indians make children's dolls of bone, ivory and mammoth teeth, and dress them in fur and hide. Small clothed clay dolls are found in ancient Peruvian graves. The bearded buckskin dolls of the Plains and other Indians appear to have been inspired by white influence.

In Japan a primitive type of child's doll consists of a shaved willow stick with shavings or strings for hair, and paper clothes, an

obvious adaptation of the shaved willow sticks formerly set up on the banks of streams as scarecrows at the annual purification ceremony. An actual scarecrow doll, which was dressed and fed and generally treated as though alive, was given to mothers in old Japan to ward off evil from their children. Women desiring children presented dolls essentially emblems of maternity, at a certain shrine. Apart from these "magical" dolls, Japanese girl children have ordinary dolls as well as ceremonial dolls symbolizing



BY COURTESY OF THE MUSEUM OF THE AMERICAN INDIAN

PRIMITIVE TYPES OF DOLLS OF THE CARAJA INDIANS BRAZIL

the imperial court, which are not played with but exhibited formally at the girls' festival on May 3. Japanese boys have similar toy images of warriors, which are displayed at their festivals on the fifth of March. In Korea little girls make their own dolls and cut a bamboo pipe stem about 5 in. long, in the top of which they put long grass, salted and made fine like hair. They never give these a face but sometimes paste a little white powder in its place. They dress the stick in clothes like those worn by women and sometimes put a pin, made by themselves, in the hair. The children's festival in Korea occurs on April 8, celebrated in Japan as the birthday of Buddha. On this occasion, the Koreans make an image of a woman of paper with a rounded base made of clay so that it stands erect. In Japan the corresponding toy is identified as the Buddhist *Daruma* and is purchased by boys at the festival of a certain temple. One which rises quickly to a vertical position is selected. The face is painted, but instead of eyes, two white paper discs are pasted. This doll is carried home placed on the "god shelf" and a prayer is said. The god is promised eyes if he answers the prayer, and this accomplished, black dots are made with ink on the vacant eye discs. In China this toy is made to represent an actor and described as a drunken man.

Among the Hindus and Mohammedans in India, where infant marriage prevails, elaborately dressed dolls with belongings are among the presents given to a girl at marriage. Their use is general throughout the Mohammedan East in spite of the laws of Islam which forbid the representation of the human figure. The nine-year-old wife of Mohammed, Aischa, brought her dolls when she entered his harem and the Prophet himself is said to have played with them. Mohammedan women in Baghdad are said to see a spirit in every doll that may bring harm to their children. Dolls, therefore, are not given to children as toys, but little girls, following their instincts, make dolls of pillows and blocks of wood. In Persia girls make their dolls of pieces of folded cotton which they clothe and mark with features. Here, too, an image of a doll is, it is said, sometimes placed in a temple at the time of its erection to secure its continued welfare.

Dolls are common in Africa, where certain forms are peculiar to certain regions and their use by children as toys is complicated by magical observances. Their general appearance is similar to the carved wooden fetiches to which they seem genetically related. Among the Fingo of the Orange Free State, a girl is given a doll when she becomes of age, which she keeps until she has a child. Then her mother gives her another doll which she keeps until she has a second child. Analogous to the scarecrow dolls of old Japan, these dolls are considered sacred and not parted with.

As regards Christian Europe there is little direct information, although dolls are known to have existed, as has been previously indicated, from Roman times.

It is known also that in earlier centuries those used as playthings were connected with images of the saints and were associated with the Christmas festival. A structure representing the scene of the Nativity was erected in churches and private houses, where the Christ child was displayed in its cradle with more or less elaborately costumed figures of the Holy Family, the Magi

and their retainers. These reached a point of great elaboration in the 17th and 18th centuries as shown in the collection in the Bavarian National museum in Munich. And this custom still survives in France, Spain, Italy and all other Catholic countries. Toy fairs, are held in the streets and purely secular dolls are sold side by side with toy images representing the Holy Infant, the Virgin Mary, St. Joseph, St. Nicholas and St. Christopher and other saints associated with this season.

In Protestant Europe the doll's house seems to have replaced the crèche, the *berche* and the *macinamento* of France, Germany and Spain and is highly developed, as may be seen in the German National museum in Nuremberg, the South Kensington museum in London and in museums of Holland and Belgium.

As regards manufacture of dolls the Netherlands and the Tyrol have long been leading centres of the industry in Europe, while it may be noted further that dolls intended to illustrate seasonal fashions constitute a branch of the industry which came into existence much earlier than might be generally supposed. During the World War elaborately costumed dolls of the latter type, made very often by women artists as a means of livelihood in the period of distress, and bought by adults for ornamental purposes, if not as playthings, were produced in large numbers and acquired great popularity as gifts and keepsakes among the well to do.

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DOLMAN, originally a long, loose garment left unfastened in front, and with narrow sleeves. It is worn generally by the Turks, and is not unlike a cassock in shape. The name was given to the uniform jacket, worn by Hussars, and slung from the shoulders with the sleeves hanging loose.

DOLMEN, the term used of a certain type of prehistoric monuments, which usually consists of several great stone slabs set edgewise in the earth to support a flat stone which serves as a roof. The structure was designed as a burial chamber and is typical of the Neolithic period in Europe. The word is Celtic in origin but probably is not Breton, the Welsh equivalent of the word is Cromlech. Dolmens, although found in covered form as far East as Japan are mainly confined to Europe and Northern Africa. There are many examples in the British Isles. See BARROW and BORDA, *The Dolmens of Ireland* (1897).

DOLMETSCH, ARNOLD (1858-1940), French musician, was born at Le Mans in 1858. He studied under Vieuxtemps in Brussels and later at the Royal College of Music in London. His keen interest in old music and obsolete instruments took the practical form of research among the manuscripts in the British Museum and other collections on the one hand and of collecting and repairing the instruments themselves on the other. To reconstruct new instruments on the lines of the old was the next step, and to this end he worked from 1902 to 1909 at the Chucker factory in Boston, U.S.A., and from 1911 to 1914 at the Gavaud factory in Paris. In 1914 he returned to London, where he became a familiar figure in the musical world by virtue of his interesting revivals of early English music and his ingenious reconstructions of harpsichords and clavichords. He maintained a workshop at Haslemere in Surrey, where he also organized annual festivals of old chamber music of the 16th, 17th and 18th centuries. On these occasions the fortnightly programmes were carried through with the help of a small orchestra of 15-20 instruments, the repertoire being selected by the composer. These concerts, which were held in the open air, were a great success.

Among Dolmetsch's published works are *Die englische Spielweise der Vielle und Vielle* (1914) and *Die englische Spielweise der Vielle und Vielle* (1914).

DOLOMIEU, DODAT GUY SILVAIN TANCREDE GRATET DE (1750-1801), French mineralogist, was born in 1750. He was admitted in his infancy a member of the Order of Malta. In his nineteenth year he quarrelled with a knight of the

galleys on which he was serving, and in the duel that ensued killed him. He was condemned to death, but in consideration of his youth was pardoned, after nine months' imprisonment. In 1775 he published his *Recherches sur la pesanteur des corps à différentes distances du centre de la terre*, and in 1777 accompanied the *bailli* (afterwards Cardinal L. R. E.) de Rohan to Portugal. In the following years he visited Spain, Sicily, the Pyrenees and Calabria, the scientific results being given in a series of important works. In 1789 and 1790 he studied the Alps, and the mineral *dolomite* (named after him) was described by Dolomieu in 1791. He returned to France in that year, bringing with him rich collections of minerals. On Sept. 14, 1792, his friend, the duc de la Rochefoucauld was assassinated at Forges, and Dolomieu retired with the widow and daughter of the duke to their estate of Roche Guyon. In 1798 he accompanied Bonaparte's expedition to Egypt, but all health compelled his return. On the way home he was captured, and imprisoned at Naples in a pestilential dungeon, where he remained 21 months. Deprived of writing materials, he made a piece of wood his pen, and with the smoke of his lamp for ink he wrote upon the margins of a Bible, the only book he still possessed, his treatise *Sur la philosophie minéralogique et sur l'espèce minérale* (1801). He died at Château-Neuf, Saône-et-Loire, on Nov. 26, 1801.

See Lacaze, "Éloge historique de Dolomieu," in *Mémoires de la classe des sciences de l'Institut national* (1860), Thomson, in *Annals of Philosophy*, vol. xi p. 161 (1808).

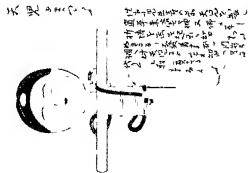
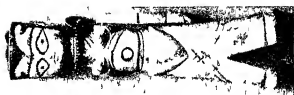
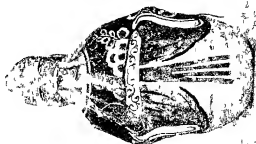
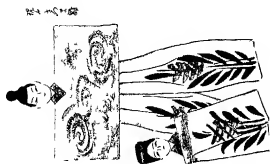
DOLOMITE, a mineral species consisting of calcium and magnesium carbonate, $\text{CaMg}(\text{CO}_3)_2$, and occurring as rhombohedral crystals or large rock-masses. Analyses of most well-crystallized specimens correspond closely with the above formula, the two carbonates being present in equal molecular proportions (CaCO_3 54.35, MgCO_3 45.65%). Normal dolomite is thus not an isomorphous mixture of calcium and magnesium carbonates, but a double salt. In crystalline form it is very similar to calcite, belonging to the same group of rhombohedral carbonates, the primitive rhombohedron, parallel to the faces of which there are perfect cleavages, has interfacial angles of $73^\circ 45'$. A specially characteristic feature is that this rhombohedron is frequently the only form present on the crystals (in calcite it is rare except in combination with other forms), the faces are also usually curved, sometimes to an extraordinary degree, giving rise to saddle shaped crystals. In the degree of symmetry possessed by the crystals there is, however, an important difference between calcite and dolomite, the latter is hemihedral with parallel faces, having only an axis of triad symmetry and a centre of symmetry.

Dolomite is both harder ($H=3.5-4$) and denser ($\text{sp. gr. } 2.85$) than calcite. The two minerals may also be readily distinguished by the fact that dolomite is not acted upon by cold, dilute acids. Crystals of dolomite vary from transparent to translucent, and often exhibit a pearly lustre, especially when the faces are curved, the colour is usually white or yellowish.

The crystallized mineral was first examined chemically by P. Woulfe in 1779, and was named compound spar by R. Kirwan in 1784, other early names are bitter-spar, rhomb-spar and pearl-spar (but these included other rhombohedral carbonates). The name *dolomite* (*dolomie* of N. T. de Saussure, 1792) is in honour of the French geologist, D. G. Dolomieu, this name was originally applied to the rock only, but was later extended to the crystallized mineral, first in the form *dolomite spar*.

In the white crystalline dolomite-rock of the Binnental near Brig in Switzerland beautiful water clear crystals of dolomite are found, and crystallized masses occur embedded in serpentine, talc-schists and other magnesium silicate rocks. The best crystallized specimens are, however, usually found in metalliferous deposits, for example, in the iron mines of Traversella near Ivrea, Piedmont (as large twinned rhombohedra) and Cleator Moor, Cumberland, in the deposits of lead and zinc ores at Alston, Cumberland, Lavey in the Isle of Man and Joplin in Missouri.

DOLOMITES, THE, a mountain district in the South Tyrolean Alps, and a subdivision of the Alps. The mountains are



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ASIATIC AND EGYPTIAN DOLLS

- 1 Wooden Japanese puppet doll mounted on a staff
- 2 Japanese court dolls
- 3 Satsuma standing dolls of Japan made of paper
- 4 Indian dolls, sometimes used as wedding presents to child brides
- 5 Chinese tilting dolls made to represent actors
- 5 Coptic doll of bona seven and one half inches high

between it and later records a gulf that is hard to bridge.

But in the *Dialogus de scaccario* (temp. Hen. II) it is spoken of as a record from the arbitrament of which there was no appeal (from which its popular name of "Domesday" is said to be derived). In the middle ages its evidence was frequently invoked in the law courts, and even now there are certain cases in which appeal is made to its testimony. To the topographer, as to the genealogist, its evidence is of primary importance, for it not only contains the earliest survey of a township or manor but affords in most cases the clue to its subsequent descent. The rearrangement on a feudal basis, of the original returns (as described above) enabled the Conqueror and his officers to see with ease the extent of a baron's possessions, but it also showed how far he had enfeoffed "undertenants," and who those undertenants were. This was of great importance to William, not only for military reasons, but also because of his resolve to make the undertenants (though the "men" of their lords) swear allegiance directly to himself. As Domesday normally records only the Christian name of an undertenant, it is vain to seek for the surnames of families claiming a Norman origin, but much has been done to identify the undertenants, the great bulk of whom bear foreign names.

Domesday Book was originally preserved in the royal treasury at Winchester (the Norman kings' capital), whence it speaks of itself (in one later addition) as *Liber de Wintonia*. When the treasury was removed to Westminster (probably under Henry II) the book went with it. There it remained until the days of Queen Victoria, being preserved from 1696 onward in the chapter house and removed only in special circumstances, as when it was sent to Southampton for photozincographic reproduction. It was eventually placed in the public record office, London, where it can be seen in a glass case in the museum. In 1869 it received a modern binding. The ancient Domesday chest, in which it used to be kept, is also preserved in the building.

The printing of Domesday, in "record type," was begun by the government in 1773, and the book was published in two volumes folio in 1783, in 1811 a volume of indexes was added, and in 1816 a supplementary volume, separately indexed, containing (1) the Exon Domesday (for the southwestern counties), (2) the *Inquisitio Eliensis*, (3) the *Liber Winton* (surveys of Winchester early in the 12th century) and (4) the Bolden Book, a survey of the bishopric of Durham a century later than Domesday. Photographic facsimiles of Domesday Book, for each county separately, were published in 1861-63, also by the government.

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DOMESTIC APPLIANCES. See HOUSEHOLD APPLIANCES.
DOMESTIC OIL HEATING. See OIL HEATING.
DOMESTIC RELATIONS, a term used to express the legal relations subsisting between the various units that compose the family or domestic group.

See CHILDREN PROTECTIVE LAWS, HUSBAND AND WIFE, INFANT, MASTER AND SERVANT.

DOMESTIC SCIENCE. See BUDGET, FAMILY, HOUSEHOLD APPLIANCES, HOUSEKEEPING, etc.

DOMESTIC SERVICE. The extent of employment in household service in different countries depends first upon economic and second upon social structure.

In underdeveloped economies, exceptionally low wages and the absence of alternative employment enable those who have incomes only slightly above the average to employ servants rather than to spend their incomes on consumption or investment. The really wealthy maintain large households of servants, which sometimes count as an index of economic status. As average income per head in a community rises there is a greater demand on the part of the richer members of society for domestic servants, but this tendency is more than offset in countries such as the United States and Australia by the relatively high wages earned by women in industry. Only in countries where income distribution is markedly uneven is there a high proportion (10% or more) of domestic servants. In rich countries with little inequality of income there is a tendency to substitute labour-saving devices in the home for domestic servants, and much of the work formerly required in private households is thus eliminated.

Social structure influences the attitudes toward domestic service in the community. In mediaeval feudal communities men of gentle birth were frequently found among the upper servants of the nobility, and even menial tasks were not considered degrading when they were carried out for the wellborn. A servant might catch the reflected glory of his master. The growth of commerce and industry, the development of a money economy and increased social mobility changed the pattern of social relationships, but it was not until the great economic changes of the 19th century in Europe that a sense of inferiority both toward the employer and toward the outside world became widespread and important among domestic servants. In the 20th century, particularly in periods of full employment, domestic service tended to be regarded as a second-best occupation, to be adopted only under economic pressure when more attractive openings were not available. As private domestic servants declined in numbers there was a growth in the number and size of commercial establishments catering for personal needs, as a result, the personal service sector of the economy continued to grow in highly developed countries.

Domestic service includes many different types and grades of occupation, from the butler (*guy*) in charge of a large household to charwomen employed casually. The history of the different groups has not been written for any country, and it is difficult to generalize about conditions of service. The position of servants has always depended more on human relations than on organization or legal obligations. Six factors influence the position of the domestic servant: (1) the nature of the work to be done, (2) the personality and status of the employer, (3) the size of the household or establishment, (4) the pattern of authority, (5) the payment and conditions of service, and (6) the interference of the law.

The nature of the work to be done varies from highly skilled to completely unskilled jobs. The personality of the employer defies generalization, in the literature of all countries there are stories of employers who have been far more dependent on their servants than their servants have been dependent on them. Status varies from the housewife-employer to the potentate and the size of household varies accordingly. The pattern of authority may be paternalistic, severely hierarchical—as it was in the 18th century—or informal. The whipping of servants was permissible in England until the 17th century and survived longer in eastern Europe and still longer in parts of Asia. In the advanced countries of the 20th century coining and cajolery became common.

Payment and conditions have varied from town to country and from subsistence to money economies. Houses were planned with little attention to servants' quarters, and perquisites varied not only from place to place but from time to time. There was a general upward trend of servants' wages in most countries from the 17th century onward.

The amount of legislation relating to servants is relatively small in all countries. Custom has been more important than legal enactment, and the scattered nature of domestic service has made it difficult for servants to form clubs or combinations to protect their common interest. The inequality between servant and master was less marked in continental Europe than in England in the 19th century.

The shortage of domestic servants in Great Britain and in the United States led to some migration of domestic labour. After World War II a limited number of foreign immigrants was permitted in Great Britain by the Ministry of Labour. In addition the National Institute of Houseworkers was set up in London in 1946 with the object of raising the status of domestic service to that of a skilled trade, successful students are entitled to a diploma, and employers appointing them to posts must agree to offer certain minimum wages and conditions of work. In the United States many universities organized courses on home economics. By the 1950s the position of the domestic servant had already changed much since the end of the 19th century. (A. B. R.)

United States.—In colonial times servants were chiefly Indian and Negro slaves, and transported white convicts and redemptioners. Girls were frequently apprenticed to domestic service until of age or married, and women probably hired out as help before they engaged in any handicraft for pay. The number of women in manufacturing increased rapidly; however, and later many entered clerical and professional pursuits. But in 1870 more than half the gainfully employed females were in domestic service, and even in 1920 this remained one of the principal fields of employment for women.

The relative importance of domestic service as a field of employment for women declined steadily for many years. The trend toward employment in other industries which began during World War I was temporarily reversed during the 1920s and 1930s, but increased greatly during World War II. Regardless of colour or race, women abandoned domestic service to seek employment in stores, factories and offices. The inducements were probably regular and shorter hours in other employments, greater standardization, more congenial companionship and pleasanter surroundings, and also a better social status. Other causes were the high wages and the great demand for women workers outside the home during wartime, practical cessation of immigration between 1915 and 1930, which greatly reduced the number of foreign born women available as servants, increased wages for servants, making them luxuries which only the well-to-do could afford, simplified housekeeping, resulting from the fact that much work formerly done in the home came to be done outside, from increased use of various household appliances and from the increase in apartment homes and the custom of taking meals in *cafés* and restaurants. Servants proved less necessary than formerly, and people did without them. By mid 20th century the occupation of domestic employment had declined from first place to fifth as a field for women, according to the U.S. department of labour's women's bureau. It was estimated that women comprised nine tenths or more of the U.S. domestic workers. In 1950 the number of domestic workers totalled 1,923,000, a decline of 14% compared with the total of 2,240,000 in 1940. In April 1952 domestic workers of whom only 2% were men, numbered 1,786,000. (See also MASTER AND SERVANT, SEDUCTION, SLAVERY.)

See Frieda S. Miller, "Household Employment in the United States," *International Labour Review*, vol. LXV, no. 4 (Oct. 1952).

(A. M. C. X.)

DOMETT, ALFRED (1812–1887), British colonial statesman and poet, was born at Camberwell Grove, Surrey, on May 20, 1811. He became the intimate friend of Robert Browning, of whose poem "Waring" he was the subject. An interesting account of the friendship between the two men appeared in *The Contemporary Review* for Jan. 1905, by W. H. Griffin. (See also Robert Browning and Alfred Domett, ed. by T. G. Kenyon, 1906.) In 1842 Domett emigrated to New Zealand, where he filled many important administrative posts, being colonial secretary for New Munster in 1848, secretary for the colony in 1851 and prime minister in 1862. He returned to England in 1871, was created C.M.G. in 1880 and died on Nov. 3, 1887. Among his volumes of verse, *Ranolf and Amohia*, a *South Sea Day Dream*, is the best known (1872), and *Flotsam and Jetsam* (1877) is dedicated to Browning.

DOMETTE A term applied to a loosely woven fabric of light texture of the plain calico weave and finished with a nap on both sides similar to flannelette (q.v.). It is sometimes woven either

plain or striped as in all cotton fabric, and sometimes with a cotton warp and woollen weft, and employed for various purposes as, for example, a light wadding for use by dressmakers, waistbands for hostry pants, pajamas, shirts and shrouds. One quality of domette contains 36 warp threads per inch, of 32's cotton, and 22 picks per inch, of 10's woollen weft.

DOMFRONT, a town of northwestern France in the *arrondissement* of Alençon, in the *département* of Orne, 43 mi. WNW of Alençon by rail. Pop. (1946) 2,912. The town is situated on a bluff overlooking the Varenne, has a church, Notre-Dame-sur-l'Eau, dating from the 11th century. Domfront is said to have grown up in the 6th century round the oratory of the hermit St. Tront, and played an important part in the wars against the English and the religious wars. In 1574 it was occupied by the Protestant leader Gabriel de Montgomery, who after a stubborn siege was forced to yield it to Jacques Goyon, count of Matignon. In the middle ages it was one of the chief strongholds in Normandy, and there still remain several towers of its ramparts, and ruins of the keep of its castle built in 1011, rebuilt in the 12th century by Henry II, king of England, and dismantled at the end of the 16th century. The town is the seat of a subprefect and has a tribunal of first instance. There are quarries in the vicinity.

DOMICILE, or **DOMICIL**, a residence, in law, the place where a person has his or her principal residence. In French law it is only a step to naturalization. In English law it implies something more than mere residence. A person has either a domicile of origin or a domicile of choice. The former is the place of his parents' home and the latter is the place where he intends to reside. In the United States it is the place where a person exercises his political rights.

Since the beginning of the 19th century most of the leading European states have unified their internal laws, and attachment to a province by domicile having thus become an unnecessary consideration they have adopted political nationality as the criterion of the law to be applied in most of the questions which used to depend on domicile. Thus as between themselves they have greatly simplified the determination of those questions, but a similar elimination of domicile is impossible in what concerns British subjects, because the British empire continues to include a great variety of laws, as those of England, Scotland, the provinces, Quebec, etc. Within the British dominions domicile is the available criterion of the legal character of a British subject. All British courts continue to apply the same criterion to British subjects outside those dominions and to foreigners.

The Roman jurists defined domicile as the place "*ubi iurem ratiuncule ac fortunarum summam constituit, unde rationem si discessurus si nihil vocet, unde cum profectus est, peregrinari videtur, quo si rediit peregrinari iam destitit*". This makes that place the domicile which may be described as the headquarters of the person concerned, but a man's habits of life may point to no place, or may point equally to two places, as his headquarters, and the connection of domicile with law requires that a man shall always have a domicile, and never more than one. The former of these difficulties is met in the manner described by Lord Westbury in *Udhoy v. Udhoy* (L.R., 1 H.L. Sc. 4). "It is," he said, "a settled principle that no man shall be without a domicile, and to secure this end the law attributes to every individual as soon as he is born the domicile of his father, if the child be legitimate, and the domicile of his mother, if the child be illegitimate. This is called the domicile of origin, and is involuntary. It is the creation of the law, not of the party. It may be extinguished by act of law, as for example by sentence of death or exile for life, which destroys the *status civilis* of the criminal, but it cannot be destroyed by the will and act of the party. Domicile of choice is the creation of the party. When a domicile of choice is acquired, the domicile of origin is in abeyance, but is not absolutely extinguished or obliterated. When a domicile of choice is abandoned, the domicile of origin revives, a special intention to revert to it not being necessary. A natural born Englishman may domicile himself in Holland, but if he breaks up his establishment there and quits Holland, declaring that he will never return, it is absurd to suppose that

his Dutch domicil clings to him until he has set up his tabernacle elsewhere." If to this we add that legitimate minors follow the changes of the father's domicil and a married woman follows the domicil of her husband, also that compulsory detention will not create a domicil, the outshines of involuntary domicil will have been sufficiently sketched.

For the establishment of a domicil of choice there must be both *animus* and *factum*, intention and fact. The fact need not be more than arrival in the territory of the new domicil if there be the necessary intention, while any number of years' continuance there will not found a domicil if the necessary intention is absent. As the result of the most recent English and Scottish cases it may be laid down that the necessary intention is incompatible with the contemplation by the person in question of any event on the occurrence of which his residence in the territory in question would cease, and that if he has not formed a fixed and settled purpose of settling in that territory, at least his conduct and declarations must lead to the belief that he would have declared such a purpose if the necessity of making an election between that territory and his former one had arisen. The word territory, meaning a country having a certain legal system, is used advisedly, for neither the intention nor the fact need refer to a locality. It is possible that a Scotsman or a foreigner may have clearly established a domicil of choice in England, although it may be impossible to say whether London, Brighton or a house in the country is his true or principal residence. What is here laid down has been gradually attained. In the older English cases an intention to return to the former domicil was not excluded, if the event on which the return depended was highly uncertain and regarded by the person in question as remote. Afterwards a tendency towards the opposite extreme was manifested by requiring for a domicil of choice the intention to associate oneself with the ideas and habits of the new territory—*Quatenus in illo exere patriam*, not in the political sense, which it was never attempted to connect with change of domicil, but in the social and legal sense. At present it is agreed that the only intention to be considered is that of residence, but that, if the intention to reside in the territory be proved to amount to what has been above stated, a domicil will be acquired from which the legal consequences will follow, even defeating intentions about them so clearly expressed as, for instance, by making a will which by reason of the change of domicil is invalid. The two most important cases are *Douglas v. Douglas* (1871), *L.R.*, 12 Eq. 617, before Vice-Chancellor Wickens, and *Went v. Att. Gen.* (1904), *A.C.* 287, before the House of Lords.

When the circumstances of a person's life point to two territories as domicils, the selection of the one which alone can fill that character often leads to appeals even up to the highest court. The residence of a man's wife and family as contrasted with his place of business, his exercise of political or municipal functions, and any conduct which tends to connect his children with a given country, as by their education, or the start given them in life, as well as other indications, are often cited as important, but none of them is in itself decisive. The situation must be considered as a whole. When the question is between the domicil of origin and an alleged one of choice, its solution is rendered a little easier than it is when the question is between two alleged domicils of choice, the burden of proof lying on the party which contends that the domicil of origin has been abandoned.

In the state of the law which has been described it will not be found surprising that an act of parliament, 24 and 25 Vict. c. 121, recites that by the operation of the law of domicil the expectation and belief of British subjects dying abroad with regard to the distribution of their property are often defeated, and enacts that when a convention to that effect has been made with any foreign country, no British subject dying in such country shall be deemed to have acquired a domicil therein, unless he has been resident in such country for one year previous to death and has made a declaration in writing of his intention to become domiciled, and that British subjects so dying without having so resided and made such declaration shall be deemed for all purposes of testate or intestate succession as to movables to retain the domicil they possessed at the time of going to reside in such

foreign country. Similar exemptions are conferred on the subjects of the foreign State dying in Great Britain or Ireland. But the act does not apply to foreigners who have obtained letters of naturalization in any part of the British dominions. It has not been availed of, and is indeed an anachronism, ignoring as it does the fact that domicil has no longer a world wide importance, owing to the substitution for it of political nationality as a test of private law in so many important countries. The United States of America is not one of those countries, but there the importance of domicil suffers from the habit of referring questions of capacity to the law of the place of contract instead of to any personal law. (J. W.)

DOMINANT, in music, the fifth degree of the diatonic scale, e.g., G in the key of C, A in that of D, and so on, so called from its exceptional influence and importance in relation to the tonic, or key note, and the harmony in general.

Dominant was used by Mendel to describe a biological character which manifests itself, as opposed to a recessive character, which remains latent (see MENDELISM).

DOMINIC, SAINT (1170-1221), founder of the Dominican Order of Preaching Friars, was born in 1170 at Calaroga in Old Castile. He spent ten or twelve years in study, chiefly theological, at Palencia, and then, about 1195, he was ordained and became a canon in the cathedral chapter of Osma, his native diocese. The bishop induced his canons to follow the Rule of St. Augustine and thus make themselves Augustinian Canons (*q.v.*), and so Dominic became a canon regular and soon the prior or provost of the cathedral community. The years from 1195 to 1203 have been filled up with fabulous stories of missions to the Moors, but Dominic stayed at Osma, preaching much in the cathedral, until 1203, when he accompanied the bishop on an embassy in behalf of the king of Castile to "The Marches." This has commonly been taken as Denmark, but more probably it was the French or Italian Marches. When the embassy was over, the bishop and Dominic repaired to Rome, and Innocent III. charged them to preach among the Albigensian heretics in Languedoc, upon which work Dominic was engaged for ten years (1205-15).

The Albigenses (*q.v.*) have received much sympathy, as being a kind of pre-Reformation Protestants, but it is now recognized that their tenets were an extreme form of Manichaeism. They believed in the existence of two gods, a good (whose son was Christ) and an evil (whose son was Satan), matter is the creation of the evil principle, and therefore essentially evil, and the greatest of all sins is sexual intercourse, even in marriage, sinful also is the possession of material goods, the eating of flesh and many other things. So great was the abhorrence of matter that some even thought it an act of religion to commit suicide by voluntary starvation, or to starve children to death (see article "Neumanichaer" by Otto Zockler in ed. 3 of Herzog's *Realencyklopädie für protestantische Theologie* [1903], or in *Life of St. Francis* by Paul Sabatier). Such tenets were destructive not only of Catholicism but of Christianity of any kind and of civil society itself, and for this reason so unecclesiastical a person as the emperor Frederick II. tried to suppress the kindred sect in Italy. In 1208, after the murder of a papal legate, Innocent III. called on the Christian princes to suppress the Albigensian heresy by force of arms, and for seven years southern France was devastated by one of the most bloodthirsty wars in history, the Albigenses being slaughtered by thousands and their property confiscated wholesale.

In the opinion of Grutzmacher, one of the most recent Protestant writers on him, St. Dominic, though keeping on good terms with Simon de Montfort, the leader, and praying for the success of the crusaders' arms during the battle of Muret, "took no part in the crusade, but endeavoured to carry on his spiritual activity on the same lines as before. The oldest trustworthy sources know nothing of his having exercised the office of Inquisitor during the Albigensian war." This verdict of a fair-minded and highly competent Protestant church historian on the most controverted point of Dominic's career is of great value. His method was to travel over the country on foot and barefooted, in extreme poverty, simplicity and austerity, preaching and instructing in high-

vays and villages and towns, and in the castles of the nobility, 'interventing and discussing with the heretics. He used often to organize formal disputations with Albigenian leaders, lasting a number of days. Many times plots were laid against his life. Though in his ten years of preaching a large number of converts were made, it has to be said that the results were not such as had been hoped for, and after it all, and after the crusade, the population still remained at heart Albigenian. A sense of failure appears in Dominic's last sermon in Languedoc. "For many years I have exhorted you in vain with gentleness, preaching, praying and weeping. But according to the proverb of my country 'where blessing can accomplish nothing blows my avail'. We shall rouse against you princes and prelates, who, alas, will arm nations and kingdoms against this land. And thus blows will avail where blessings and gentleness have been powerless." The threat that seems to be conveyed in these words, of trying to promote a new crusade, was never carried out, the remaining years of Dominic's life were wholly given up to the founding of his order.

The Order of Dominicans grew out of the little band of volunteers that had joined Dominic in his mission among the Albigenes. He had become possessed with the idea of addressing wider circles and of forming an order whose vocation should be to preach and minister throughout the whole world. By 1214 the nucleus of such an institute was formed round Dominic and was known as the "Holy Preaching." In 1215 the bishop of Toulouse, Dominic's great friend, established them in a church and house of the city and Dominic went to Rome to obtain the permission of Innocent III to found his order of preachers (see DOMINICANS). By two bulls of Dec. 22, 1216, Honorius III solemnly confirmed the Dominican order. Dominic spent the last years of his life journeying backwards and forwards between Toulouse and Rome, where his abode was at the basilica of Santa Sabina on the Aventine, given to him by the pope, and then in extended journeys all over Italy, and to Paris and into Spain, establishing friaries and organizing the order wherever he went. It propagated and spread with extraordinary rapidity, so that by Dominic's death in 1221, only five or six years after the first practical steps towards the execution of the idea, there were over 500 friars and 60 friaries, divided into 8 provinces embracing the whole of western Europe. Thus Dominic was at his death able to contemplate his great creation solidly established, and well launched on its career to preach to the whole world.

It appears that at the end of his life Dominic had the idea of going himself to preach to the heathen Kuman Tatars on the Dnieper and the Volga. But this was not to be, he was worn out by the incessant toils and fatigues and austerities of his laborious life, and he died at his monastery at Bologna, on Aug. 6, 1221. He was canonized in 1234 by Gregory IX, who, as Cardinal Ugolino, had been the great friend and supporter both of Dominic and of Francis of Assisi.

As St. Dominic's character and work do not receive the same general recognition as do St. Francis of Assisi's, it will be worth while to quote from the appreciation by Prof. Grutzmacher of Heidelberg:—"It is certain that Dominic was a noble personality of genuine and true piety. Only by the preaching of pure doctrine would he overcome heretics. He was by nature soft-hearted, so that he often shed tears through warm sympathy. In the purity of his intention and the earnestness with which he strove to carry out his ideal, he was not inferior to Francis."

The chief sources for St. Dominic's life are the account by Jordan of Saxony, his successor as master general of the order, and the evidence of the witnesses at the Process of Canonization,—all in the Hollandists' *Acta Sanctorum*, Aug. 4. Modern biographies: Jean Gouraud, in the series *Les Saints* (Eng. trans. by Katharine de Mattos, 1901); B. Jarrett, O.P., *The Life of St. Dominic* (1924); H. P. Lott, O.P., *St. Dominic* (1924); H. C. Sheeben, *Der Heilige Dominikus* (1927); P. Mandoulet, O.P., *Saint Dominique, Précurseur, l'homme et l'œuvre* (1937), 2 vols. (Eng. trans. 1944). The two latter works contain further bibliography. See also the article "Dominicus" in ed. of Weter and Wette, *Kirchenlexikon*, and Grutzmacher's article, "Dominikus" in ed. of Herzog, *Realencyklopädie für Protestantische Theologie*. (C. C. B. X.)

DOMINICA, an island of the British West Indies, governed

as a colony of the Windward Islands group. It lies in 15° 30' N and 61° 20' W, between the French islands of Martinique and Guadeloupe, at a distance of about 25 mi. from each, is 29 mi. long, has a maximum breadth of 16 mi. and an area of 304 sq. mi. A range of lofty forest clad mountains traverses the island from north to south, broken in the centre by a narrow plain drained by the rivers Layou and Pagoua, flowing west and east respectively. The highest point is Morne Diablotin (5,314 ft.), in the north. Signs of volcanic activity include solfataras, subterranean vapours and hot springs, while in the south the so-called Boiling Lake lies on the mountain side, 2,300 ft. above the sea, its banks are steep and its depth unknown. Its waters are often forced 3 ft. above the normal level by the pressure of the escaping gases, and the fumes are occasionally poisonous. The island is of extraordinary beauty and botanically remarkable for its great number of peculiar species. The hills produce valuable timber, while coffee, limes, oranges, and rubber trees, spices and many tropical fruits grow luxuriantly in the rich lowlands. There are some thirty streams of considerable size, besides numerous mountain torrents. The fisheries are productive, and honey and wax are furnished by wild bees, originally introduced from Europe. The temperature varies from 78° to 86° F. in the hot season from August to October, and from 72° to 84° in the cooler months, the rainfall varies in different parts from 50 to 160 in. per annum, but the porous soil soon absorbs the rain, and keeps the atmosphere clear and invigorating.

The manufactures include sugar, lime juice and essential oils, the exports are cocoa, coconuts, limes and lime products, oranges and bananas. The inhabitants in 1941 numbered 53,203. The majority are Negroes, the whites are of French and British descent. There are also a few Caribs, the remnant of the aboriginal population. A French *patois* is the language of the peasantry, but English is generally understood. The capital, Roseau (9,000), is a fortified town and a port, Portsmouth, the only other town, possesses the better harbour in Prince Rupert's Bay on the north-west. In religion Roman Catholics predominate, and a bishop resides at Roseau, but there is no established church. Education is free and compulsory.

History—Dominica was thus named by Columbus in 1493, in commemoration of the date, Sunday (*Dies Dominica*) Nov. 3. The first European settlers (1632) were French. In 1660 a treaty appears to have been made between the French, British and the natives, assigning St. Vincent and Dominica to the Caribs, and in 1748 it was once more agreed that Dominica should be left in the undisturbed possession of the natives. Nevertheless the French settlers increased, and the island came under the rule of a French governor. It was captured by the British and recaptured by the French frequently in the wars from 1761 onwards, and in 1805 the French general, La Grange, at the head of 4,000 troops, took Roseau and pillaged the island. The French were, however, unable to make good their hold, and Dominica has since remained undisturbed in British possession.

At first administered as part of the Leeward Islands colony, in 1771 Dominica was made a separate colony. It was rejoined administratively to the Leeward Islands in 1832, and it retained this status until 1940, when it was transferred to the Windward Islands group, once again as a separate colony. The constitution introduced in 1936 provided for an unofficial elected majority in the legislative council.

DOMINICAL LETTERS or SUNDAY LETTERS, letters employed in the construction of the calendar to mark the Sundays throughout the year. The first seven letters of the alphabet are taken to mark the first seven days of the year, the following sets of seven following on according to this marking. As the year consists of 52 weeks and one day the dominical letters go backward one day every year, the same order of letters recurring every 28 years, making the solar circle. See also CALENDAR.

DOMINICAN REPUBLIC

see SANTO DOMINGO

DOMINICANS, otherwise called Friars Preachers, and in England Black Friars, from the black mantle worn over a white habit an order of friars founded by St. Dominic (q.v.). Their first house was in Toulouse, where the bishop established them at the church of St. Romain, 1215. Dominic at once went to Rome

to obtain permission to found an order of preachers whose sphere of activity should be the whole world but Innocent III said they must adopt one of the existing rules. Dominic returned to Toulouse and it was resolved to take the Rule of St Augustine. Dominic himself having been an Augustinian canon at Osma (*see* AUGUSTINIAN CANONS). Dominic went again to Rome, and in 1216 obtained from Honorius III two bulls of confirmation which transformed the diocesan congregation of Toulouse into a religious



After an altar piece by Traini in Santa Caterina at Pisa. Holding a bible in his hand and four of his own works on his knee St. Thomas is the recipient of rays of wisdom from Christ (above) four apostles, Moses and St. Paul Aristotle (at his right) and Plato (at his left). At his feet, between groups of faithful lies the prostrate Averroës, with a ray of refutation piercing his Commentary.

order with a universal mission to preach. Early in 1218 an encyclical bull was issued to the bishops of the whole Catholic world recommending to them the "Order of Friars Preachers," followed in 1221 by another ordering them to give to the friars faculties to preach and hear confessions in their dioceses. By this date the friars had penetrated into some parts of Italy, France, Spain, Poland and Bohemia, and some were on their way to England.

The order took definite shape at the two general chapters held at Bologna in 1220 and 1221. The manner of life was very austere—midnight office, perpetual abstinence from meat, frequent disciplines prolonged fasts and silence. At St. Dominic's suggestion and under his strong pressure, but without consideration of position, the general chapter decided that the poverty prescribed in the order should be so strictly individual as to preclude communal meals and corporate housing. The friars, so that the order should have no possessions, except the means of building and churches, no property, no fixed income, but should live on charity and by begging. This doubtless in imitation of the Franciscans the Dominicans became a mendicant order.

The extraordinarily rapid propagation of the institute suffered no diminution through the founder's death in 1221, for his four immediate successors in the general rule were men of conspicuous ability and high character. In a few years the Dominicans penetrated into Denmark, Sweden, Russia, Prussia and Poland, preaching and missionizing in the still pagan districts of these countries, and soon they made their way to Greece and Palestine and thence to central Asia. From the 14th century until the middle of the 17th the Dominicans had numerous missions in Persia, India and China, and in the northern parts of Africa. They followed the Spanish and Portuguese explorers and conquerors to both East and West, converting, protecting and civilizing the aborigines. Many suffered in martyrdom.

Another conspicuous field of work of the Dominicans lay in the universities. It had been St. Dominic's policy to aim at founding houses first of all in the great university towns—at Paris, Bologna, Palencia, Oxford. This policy was adhered to, and the Dominicans soon became a power in the universities, occupying chairs in those just named and in Padua, Cologne, Vienna, Prague and Salamanca. The scholastic doctors Albert the Great and Thomas Aquinas were the leaders in this side of Dominican activity, and the order's influence on the course of medieval theological development was exercised mainly by these doctors and by the Dominican school of theology, which to this day has maintained the principles and methods elaborated by St. Thomas.

The Dominican name is in a special way associated with the foundation and propagation of the rosary. Through the centuries many Dominicans served the church as inquisitors. The vicissitudes of the order have been much like those of other orders—periods of relaxation being followed by periods of revival and reform, but there were not any reforms of the same historical importance as in most other orders, the policy having been to keep all such movements strictly within the organization of the order. In 1425 Martin V relaxed for some houses the law of corporate poverty, allowing them to hold property, and to have fixed sources of income, and 50 years later Sixtus IV extended this mitigation to the entire order, which thereby ceased to be mendicant. This change caused no troubles, as among the Franciscans, for it was felt that it did not touch the fundamental Dominican ideal.

The Friars Preachers came to England and were established at Oxford in 1222, and by the end of the century 50 friars were in existence in England, usually in the towns, and several in Ireland and Scotland. In London they were first on the site of Lincoln's Inn, but in 1275 migrated to that now occupied by Pumping house Square, their name, "Blackfriars," surviving as that of the adjacent district. The only nunnery was at Dartford. In Mary's reign some of the scattered friars were brought together and established in Smithfield, and the remnant of the nuns were restored to Dartford. In 1550 these houses were suppressed and the nuns and friars expatriated, and for a hundred years there was no English Dominican community. In 1668 Friar Thomas Howard (afterwards Cardinal) succeeded in establishing at Bornhem near Antwerp a house for the English friars. From that time there has always been an organized body of English Dominicans, again and again reduced almost to extinction but ever surviving, it now has half a dozen thriving friaries. The Irish province also survived the days of persecution and possesses a dozen friaries. In 1840 Lacordaire restored the French province. Missionary work still holds a prominent place in Dominican life, there are missions in Anam, Tongking and China, and in Mesopotamia, Mosul and Kurdistan. They have also a remarkable school for Biblical studies and research at Jerusalem, and the theological faculty in the Roman Catholic university at Fribourg in Switzerland is in their hands. There have been four Dominican popes: Innocent V (d. 1276), Benedict XI (d. 1304), Pius V (d. 1572), Benedict XIII (d. 1730).

The friars form the "first order," the nuns, or Dominicans, the "second order." Their rule resembled that of the friars, except that the nuns were strictly enclosed and purely contemplative. The "third order" is divided into two branches: the sisters of the conventual third order and secular tertiary. The sisters have a community life under the three vows and are

devoted chiefly to educational, hospital and missionary work. They are not cloistered and take only simple vows. Secular tertiaries are lay people of both sexes who, while living a normal life in the world, are pledged to aim at Christian perfection by the observance of rules and practices which are in accordance with the spirit of the Dominican order.

See the *Catholic Encyclopedia*, art "Preachers" P. Mandonnet, *St Dominic and His Work* (1944), A. Walz, *Compendium Historiae Ordinis Praedicatorum* (Rome, 1930), B. Jarrett, *The English Dominicans* (London, 1921).

DOMINIONS OFFICE see GOVERNMENT DEPARTMENTS

DOMINIS, MARCO ANTONIO DE (1566–1624), Italian theologian, was born on the island of Arbe, off the Dalmatian coast. He was educated by the Jesuits, and became professor of mathematics at Padua, and professor of rhetoric and philosophy at Brescia. In 1596 he was appointed to the bishopric of Segna (Zengg) in Dalmatia, and in 1600 was raised to the archbishopric of Spalato and primacy of Dalmatia and Croatia. His attempts at reform brought him into conflict with his suffragans, and he also became involved in the quarrel between the papacy and Venice. He resigned his see in Sept. 1616, and wrote at Venice his *Comitum profectio*, criticizing the papacy. In the same year he crossed to England, and being regarded as a convert to Anglicanism, was appointed master of the Savoy (1618) and dean of Windsor (1619), he subsequently presented himself to the living of West Isley, Berkshire. His published attacks on the papacy include the *Papalis Romanus*, issued anonymously (London, 1617, Frankfurt, 1618), the *Scroli del naufragio Cristiano* (London [?] 1618), and a *Sermon preached in Italian*, etc. before the king. But his principal work was the *Da republica ecclesiastica*, of which the first part—after revision by Anglican theologians—was published under royal patronage in London (1617), in which he ably set forth his theory of the church. In 1619 Dominis published without the author's consent Paolo Sarpi's *Historia del Concilio Tridentino*, the ms. of which he had brought with him from Venice.

Three years later the ex-archbishop was back again in Rome, doing penance for his heresies. He may have been enticed back by the elevation of his kinsman Alessandro Ludovisi, to the papal throne at Gregory XV (1621), but if so, he had barely time to publish at Rome (1623) his *Sui reditus ex Angliam con silium*, a repudiation of his antipapal work, when Gregory died (July 1623). The proceedings of the Inquisition against the archbishop were revived, but before they were concluded, Dominis died in prison, on Sept. 8, 1624. Judgment was pronounced over his corpse, which was publicly burnt in the Campo di Fiore. By a strange irony of fate the publication of his *Reditus consilium* was subsequently forbidden in Venice because of its uncompromising advocacy of the supremacy of the pope over the temporal powers.

See Herzer Hauck, *Realencyklopadie*, where a full bibliography is given; G. Goodman, *The Court of James I*, ed. Brewer (London, 1839); H. Newland, *Life and Contemporaneous Church History of Antonio de Dominis* (Oxford, 1859).

DOMINOES, a game played with rectangular blocks of wood or other material, each identified by the number of dots on its face. Such a block is usually $1\frac{1}{2}$ to 2 in. in length, its width being about half its length and its thickness about one-eighth its length. The blocks are usually called *bones*, *dominoes* or *pieces*, but are sometimes called *men*, *stones* or even *cards*.

The face of each piece is divided by a line or ridge, into two square *ends*, and is marked similarly to a pair of dice side by side except that some ends are blank. The usual set comprises 28 pieces, respectively marked 6 6 ("Double six," etc.) 6 5, 6 4, 6 3, 6 2, 6 1, 6 0, 5 5, 5 4, 5 3, 5 2, 5 1, 5 0, 4 4, 4 3, 4 2, 4 1, 4 0, 3 3, 3 2, 3 1, 3 0, 2 2, 2 1, 2 0, 1 1, 1 0, 0 0. Any group of pieces having a common end comprise a *suit*. Of two bones the one bearing the greater number of dots is *heavier*, the other *lighter*. Some sets run up to 99 and others as high as 1, 12.

Dominoes in China are as ancient, or almost, as playing cards (*see CARDS PLAYING*). They were apparently designed to represent all the possible throws with two dice, for Chinese dominoes

(which they call "dotted cards") have no blank faces. It does not necessarily follow however, that European dominoes were derived from the Chinese. In Europe dominoes are relatively new, there being no record of them before the middle of the 18th century in Italy and France. Apparently they were introduced into England by French prisoners toward the end of the 18th century. The name may have been derived from pieces made of

ebony with ivory faces and resembling the black cloth called a domino.

The Inuit Eskimos gamble wildly at their dominoes games, sometimes staking and losing their wives in play. Their game, in which they use as many as 148 pieces was derived from the European game.

The principle in nearly all modern dominoes games is the matching of one end to another, identically or reciprocally numbered. The principal varieties are:

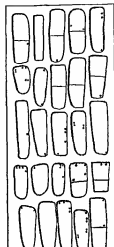
The Block and Draw Games—Two play. The dominoes are shuffled face downward on the table. The lead, or *set*, is usually decided by drawing for the highest bone, but it is sometimes held that any doublet takes precedence. The bones are then reshuffled, and each player draws at random the number of bones required for the particular form of the game usually seven. The bones left behind are called the *stock* (or, in the U.S., the bone yard).

The leader plays first, generally playing his highest domino, since at the end the player loses according to the number of pips in the bones he has left in his hand.

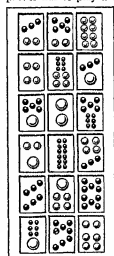
By some rules, a player after playing a double may play another bone which matches it, e.g., if he plays double six he may play another bone which has a six at one end. The second player plays to match the leader's *pose* by putting one of his bones in *juxta* position at one end, i.e., if the leader plays four-five, the second player has to play a bone which contains either a four or a five, the five being applied to the five or the four to the four. Doublets are placed *à cheval* (crosswise). If a player cannot match, he says "go," and his opponent plays, unless the Draw game—the usual game—is being played, in which case the player who cannot match draws from the stock (two bones must always be left in stock) until he finds a bone that matches. If a player succeeds in posing all his bones, he calls "Domino!" and wins the hand, scoring as many points as there are pips on the bones still held by his opponent. If neither player can match, that player wins who has the fewest pips left in his hand and he scores as many points as are left in the two hands combined (sometimes only the excess held by his opponent), but when a player has called "Go!" his adversary must match if he can, in which case the other player may be able to match in turn.

A game may be 50 or 100 points.

All Fives (or Muggins)—Each player takes five bones. If the leader poses either double five, six-four, five blank, or three-two, he scores the number of pips that are on the bone. If in the course of play a player can play such a bone as makes the sum of the end pips 5, 10, 15 or 20, he scores that number, e.g., if to two four he can play four double four (*à cheval*) he scores 10, if to six one he plays six four he scores 5. He must pose if he can match, if he cannot he draws until he can. Scores are called and taken



BY COURTESY OF THE SMITHSONIAN INSTITUTION
ESKIMO DOMINOES USED BY THE INUIT TRIBE
The number of pieces varies from 60 to 148 and a set is called *A ma zu lat* meaning standing upright side by side.



BY COURTESY OF THE SMITHSONIAN INSTITUTION
KOREAN DOMINO PIECES
The set consists of 32 pieces made of wood, bone or ivory. There are no blanks.

immediately. At the point of the domino, the winner scores in points the multiple of five which is nearest to the number of pips in his adversary's hand, e.g. he scores 25 if his adversary has 27 pips, 30 if he has 28. If neither hand can match, the lowest number of pips wins, and the score is taken as before, without addition or subtraction, according to the adversary's pips.

All Threes is played in the same manner as Mugmugs, save that three or some multiple of three is aimed at.

Threes and Fives is similar, but only one point is scored for each five or three made at the two ends, though they can be scored in combination. Thus A plays six five, B six-one, B scores 2 points for five one (two threes). A plays one five, B double-five, B now scores 8 more, 5 for five threes and 3 for three fives.

Sniff, very popular in the U.S. lends itself to skilful play better than most dominoes games. It is essentially All Fives (described above). Two may play, drawing seven bones each, or three or four, drawing five bones each. The first double played is called *sniff*. The sniff may first be put down endwise (in which case only one of its ends then counts) or sidewise, at the holder's option, thereafter it is permissible to play to this bone both endwise and sidewise, so that there are usually four "open ends" with which to reckon. One need not play, although able to, if he wishes instead to draw from the stock, but the last two bones may never be drawn, and since the holding of additional bones may be an advantage it is customary to limit each player to two draws, after which he must play if able and pass if unable to play.

Domino Whist is played by four players. Partners are drawn for as at whist, the player drawing the highest domino leads. Each player takes seven bones. There are no tricks, trumps or honours. The bones are played as in ordinary dominoes, a hand being finished when one of the players plays his last bone, or when both ends are blocked. Pips are then counted, and the holder or holders of the highest number score to their debit the aggregate number of points. The side that is first debited with 100 points loses the game.

Matador—This is a favourite and is also one of the most scientific forms of the game. It is played on a different principle from the preceding variations, the object being not to match the end number, but to pose such a number as, added to the end, will make seven, e.g. to a five a two must be played, to a three a four, etc. Seven dominoes are drawn and the highest double begins. When a player cannot make a seven on either end he must draw from stock until he secures a bone that will enable him to make seven, two bones remaining in the stock. As Matador is played with dominoes no higher than six, a blank means blocking of that end. In this case no further play can take place at that end excepting by posing a matador, which may be played at any time. There are four matadors, the 6-1, 5-2, 4-3, and double blank. It is often better to draw one or more fresh bones than to play one's last matador. In posing a double counts as a single number only, but in scoring the full number of pips is counted. When the game has been definitely blocked the player whose pips aggregate the lower number scores the number of the combined hands (some times only the excess in his opponent's hand), the game being usually 100. Matador can be played by three persons, in which case the two having the lowest scores usually combine against the threatening winner, and also by four, either each for himself or two on a side. Four players only draw five bones each.

See F. W. Lewis, *Dominoes*, A. H. Morehead, *The Modern Hoyle* (1944).

DOMINUS, the Latin word for master or owner. As a title of sovereignty the term under the republic at Rome had all the associations of the Greek *ῥήτωρ*, refused during the early principate, it finally became an official title of the Roman emperors under Diocletian. *Dominus*, the French equivalent being *sieur*, was the Latin title of the feudal (superior and mesne) lords, and also an ecclesiastical and academic title. The ecclesiastical title was rendered in English "sir," which was a common prefix before the Reformation for parsons, as in "Sir Hugh Evans" in Shakespeare's *Merry Wives of Windsor*. The academic use was for a bachelor of arts and so is still used at Cambridge and other universities. The shortened form "dom" is used as a prefix of honour for

ecclesiastics of the Roman Church and especially for members of the Benedictine and other religious orders. The same form is also a title of honour in Portugal, as formerly in Brazil, used by members of the blood royal and others on whom it has been conferred by the sovereign. The Spanish form "don" is also a title, formerly applicable only to the nobility, and now one of courtesy and respect applied to any member of the better classes. The feminine form "doña" is similarly applied to a lady.

The English colloquial use of "don" for a fellow or tutor of a college at a university is derived either from an application of the Spanish title to one having authority or position, or from the academic use of *dominus*. The earliest use of the word in this sense appears, according to the *New English Dictionary*, in South's Sermons (1660). An English corruption "dan" was in early use as a title of respect, equivalent to "master." The literary application to poets is due to Spenser's use of "Dan Chaucer, well of English undicyfled" (*Faery Queen*, IV, ii, 32).

DOMITIAN (TITUS FLAVIUS DOMITIANUS), Roman emperor AD 81–96, the second son of Vespasian, was born at Rome on Oct. 24, AD 51. When Vespasian was proclaimed emperor at Alexandria, Domitian escaped with difficulty from the temple of the capitol, which had been set on fire by the Vitellians, and remained in hiding till his father's party proved victorious. After the fall of Vitellius he was saluted as Caesar by the troops, obtained the city praetorship, and was entrusted with the administration of Italy until his father's return from the east. But although in his father's lifetime he was several times consul, and after his death was nominally the partner in the empire with his brother Titus, he took no part in public business, but lived in great retirement, devoting himself to a life of pleasure and of literary pursuits until he succeeded to the throne.

The death of Titus, if not hastened by foul means, was at least eagerly welcomed by his brother. Domitian's succession (on Sept. 13, 81) was unquestioned, and it would seem that he had intended so far as his weak volition and mean abilities would allow, to govern well. Like Augustus, he attempted a reformation of morals and religion. He erected many temples and public buildings (among them the Odeum, a kind of theatre for musical performances), and restored the temple of the capitol. He passed many sumptuary laws, and issued an edict forbidding the over cultivation of vines to the neglect of corn-growing. Finally, he took a personal share in the administration of justice at Rome, checked the activity of the informers (*delatores*) and exercised a jealous supervision over the governors of provinces. Even when Rome and Italy smarted beneath his proscriptions and extortions, the provinces were undisturbed.

Though he took the title of imperator more than 20 times, and enjoyed at least one triumph, Domitian's military achievements were insignificant. He defeated the Chatti, annexed the district of the Taunus, and established the *limes* as a line of defence, but he suffered defeats at the hands of the Quadi, Sarmatae and Marcomanni, in Dacia he received a severe check and was obliged to purchase peace (90) from Decebalus by the payment of a large sum of money and by guaranteeing a yearly tribute—the first instance in Roman history. His jealousy was provoked by the successes of Agricola in Britain, who was recalled to Rome (85) in the midst of his conquests, condemned to retirement, and perhaps removed by poison. The revolt of Antonius Saturninus, the commander of the Roman forces in upper Germany (88 or 89), marks the turning point in his reign (on the date see H. Schiller, *Geschichte der römischen kaiserzeit*, i, pt. 2, p. 524, note 2). It was speedily crushed, but from that moment Domitian's character changed. He got rid of all whom he disliked on the charge of having taken part in the conspiracy, and no man of eminence was safe against him. He was in constant fear of assassination and distrusted all around him. During the last three years of his life his behaviour was that of a madman. He sentenced to death his own cousin and nephew by marriage, Flavius Clemens whose wife he banished for her supposed leaning towards Judaism (Christianity). He was stabbed in his bedroom by a freedman of Clemens named Stephanus on Sept. 18, 96.

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DOMREMY-LA-PUCELLE, a village of eastern France, in the department of Vosges, on the left bank of the Moselle, 7 mi N of Neufchâteau by road Pop (1936) 248 Domremy was the birthplace of Joan of Arc and the cottage in which she was born still stands Above the door rise the arms of France and of Joan of Arc and in inscription of 1481 reading *Vive labour, vive le roi Louis* There are several monuments to the heroine and a modern basilica has been erected in her honour on a neighbouring hill where she is said to have heard the voices in obedience to which she took up the sword The story of the heroine is annually celebrated by a play in which the villagers take part

DON, river south Aberdeenshire Scotland rising in peat moss to the east of Glen Avon on the border of S. Inverclyde, at a height of nearly 2,000 ft It follows a generally easterly course roughly parallel with that of the Dee, and a few miles north of it, falling into the North Sea close to Old Aberdeen, after a run of 82 mi At the mouth the two rivers are only 2½ mi apart Dee and Don are excellent salmon streams

DON, a river of European Russia (anc *Tanaïs*), called *Tuna* or *Duna* by the Tatars rising in Lake Ivan (50 ft above sea level) in the province of Tula where it has communication with the Volga by means of the Yezui canal, which links it with the Upa, a tributary of the Oka, which itself enters the Volga The Don after curving east through Ryzan, flows generally south through Tambov, Orel, Voronezh and the North Caucasian area, describing in the last named a sweeping loop to the east, in the course of which it approaches within 48 mi of the Volga in 49° N In the province of Stalinsk it turns definitely southwest, and finally enters the northeast extremity of the Sea of Azov, forming a delta 130 sq mi in extent Its total length is 1,325 mi, and its drainage area is calculated at 166,000 sq mi The average fall of the river is about 54 in. to the mile

In its upper course, which may be regarded as extending to the confluence of the Voronezh in 51° 40' the Don flows for the most part through a low lying, fertile country, though in Ryzan its banks are rocky and steep and in some places even precipitous In the middle division, or from the mouth of the Voronezh to the point where it makes its nearest approach to the Volga, the stream cuts its way for the most part through Cretaceous rocks, which in many places rise on either side in steep and elevated banks, and at intervals encroach on the riverbed A short distance below the town of Rostov it breaks up into several channels, of which the largest and most southern retains the name of the river Before it receives the Voronezh the Don has a breadth of 500 to 700, or even in a few places 1,000 ft, while its depth varies from 4 to 20 ft, by the time it reaches its most eastern point the depth has increased to 8 to 50 ft, and the ordinary breadth to 700-1,000 ft, with an occasional maximum of 1,400 ft, in the lower division the depth is frequently 70 ft and the breadth in many places 1,870 ft Generally speaking the right bank is high and the left flat and low Shallow reaches are not uncommon and there are at least seven considerable shoals in the south western part of the course, partly owing to this cause, and partly to the scarcity of ship-building in the Voronezh province, the Don, although navigable as far up as Voronezh, does not attain any great importance as a means of communication till it reaches Kalach, where the railway (built in 1862) from the Volga has its western terminus. Of the tributaries of the river, the Voronezh the

Khopor, the Medveditsa and the Donets are navigable—the Donets having a course of 680 mi, and during high water affording access to the government of Kharlov The Manvch, another large affluent on the left marks the ancient line of water connection between the Sea of Azov and the Caspian sea

The lower section of the Don is subject to two annual floods, of which the earlier known as the 'cold water,' is caused by the melting of the snow in the North Caucasian area and the later, or the 'warm water,' is due to the same process taking place in the region drained by the upper parts of the stream About the beginning of June the river begins to subside with great rapidity, in August the water is very low and navigation almost ceases, but occasionally after the September rains the traffic with small craft is again practicable After the middle of the 18th century there have been five floods of extraordinary magnitude—namely in 1748, 1786, 1805, 1820 and 1845 The river is usually closed by ice from November or December to March or April, and at rare intervals it freezes in October At Ak-sai, in the delta it remains open on the average for 250 days in the year, at the mouth of the Medveditsa for 230, and at Novocherkassk, on another arm of the delta, for 246 This river supports a considerable fishing population, who despatch salt fish and caviare all over Russia Salmon and herrings are taken in large numbers The areas of calcareous soil on its banks is favourable to vine cultivation and 'Don Champagne' is in great demand

DONATELLO (diminutive of Donato) (c 1386-1466), Italian sculptor, was the son of Nicolo di Betto Bardi, a member of the Florentine Woolcombers' Guild, and was born in Florence probably in 1386 It is certain that Donatello received his first training in a goldsmith's workshop, and that he worked for a short time in Ghiberti's studio He was too young to enter the competition for the baptistry gates in 1402, from which Ghiberti issued victorious against Brunelleschi, Jacopo della Quercia Nicolo d'Arezzo and other rivals But when Brunelleschi in his disappointment left Florence and went to Rome to study the remains of classic art he was accompanied by young Donatello This Roman sojourn was decisive for the entire development of Italian art in the 15th century, for it was during this period that Brunelleschi undertook his measurements of the Pantheon dome and of other Roman buildings, which enabled him to construct the noble cupola of S Maria del Fiore in Florence, while Donatello acquired his knowledge of classic forms and ornamentation The two masters, each in his own sphere, were to become the leading spirits in the art movement of the 15th century Brunelleschi's buildings and Donatello's monuments are the supreme expression of the spirit of the early Renaissance in architecture and sculpture and exercised a potent influence upon the painters of that age

Donatello probably did not return to Florence before 1405, since the earliest works in that city that can be traced to his chisel are two small statues of 'prophets' for the north door of the cathedral, for which he received payment in Nov 1406 and 1408 In the latter year he was entrusted with the important commissions for the marble 'David,' now at the Bargello, and for the colossal seated figure of 'St John the Evangelist,' which until 1588 occupied a niche of the old cathedral façade, and is now placed in a dark chapel of the Duomo He was next employed at Or San Michele, where between 1340 and 1406 only four of the 14 niches had been filled As the result of a reminder sent by the Signory to the guilds who had undertaken to furnish the statues, the services of Cuffagni, Nanni di Banco, Ghiberti and Donatello were enlisted, and Donatello completed between 1412 and 1415 the 'St Peter,' the 'St George' (the original, now in the Bargello, has been replaced by a copy) and the 'St Mark.' He probably also assisted Nanni di Banco in his group of four saints To this early period belongs the wooden crucifix in S Croce, the most striking instance of Donatello's realism in rendering the human form and his first attempt at carving the nude It is said that this crucifix was executed in rivalry with Brunelleschi's noble work at S Maria Novella, and that Donatello, at the sight of his friend's work, exclaimed, 'It has been left to you to shape a real Christ, whilst I have made a peasant.' In

this early group of statues, from the prophets for the cathedral door to the "St. George," can be followed the gradual advance from Gothic stiffness of attitude and draping to a forceful rendering of the human form and of movement, which is a distinct approach to the classic ideal. All these figures were carved in marble and are admirably conceived in relation to their architectural setting. In fact, so strong is this tendency that the "St. Mark," when inspected at the master's workshop, was disapproved by the heads of the Guild of Linen weavers, but aroused public enthusiasm when placed *in situ*.

Between the completion of the niches for Or San Michele and his second journey to Rome in 1433, Donatello was chiefly occupied with statuary work for the campanile and the cathedral, though from this period dates the bronze figure of the Baptist for the christening font of Orvieto cathedral, which was never delivered and is now among the treasures of the Berlin museum. This, and the "St. Louis of Toulouse," which originally occupied a niche at Or San Michele and is now badly placed at S. Croce, were the first works in bronze which owed their origin to the partnership of Donatello with Michelozzo, who undertook the casting of the models supplied by his senior. The marble statues for the campanile, which are either proved to be Donatello's by documentary evidence or can be recognized as his work from their style, are the "Abraham" wrought by the master in conjunction with Giovanni di Bartolo (di Rosso), the "St. John the Baptist," the so-called "Zuccone" (Jonah?), "Jeremiah," "Habakkuk" (?), the unknown "prophet" who is supposed to bear the features of the humanist Poggio Bracciolini, and possibly he may have had a share in the completion of the "Joshua" commenced by Cuiufagni in 1415. All these statues, and the "St. John" at the Bargello, mark a bold departure from the statuesque balance of the "St. Mark" and "St. George" to an almost instantaneous impression of life. The fall of the draperies is no longer arranged in harmonious lines, but is treated in an accidental, massive, bold manner. At the same time the heads are no longer, as it were, impersonal, but almost cruelly realistic character portraits of actual people, just as the arms and legs and necks are faithfully copied from life with all their angularties and deviations from the lines of beauty. During this period Donatello executed some work for the baptismal font at S. Giovanni in Siena, which Jacopo della Quercia and his assistants had begun in 1416. Though the Florentine's share in it is confined to a relief which may have been designed, or even begun, by Jacopo, and a few statuettes, it is of considerable importance in Donatello's life-work, as it includes his first attempt at relief sculpture—except the marble relief on the socle of the "St. George"—his first female figures—"Faith" and "Hope," and his first *putti*. The relief, "Herod's Feast," shows already that power of dramatic narration and the skill of expressing the depth of space by varying the treatment from plastic roundness to the finest *staccato*, which was to find its mature expression in the panels of the altar of S. Antonio in Padua and of the pulpit of S. Lorenzo in Florence. The casting of the pieces for the Siena font was probably done by Michelozzo, who is also credited with an important share in the next two monumental works, in the designing of which Donatello had to face a new problem—the tomb of John XXIII in the baptistery (begun about 1425), and that of Cardinal Brancacci at S. Angelo a Nilo in Naples (executed in Pisa, 1427). The noble recumbent figure of the defunct on the former, the relief on the sarcophagus, and the whole architectural design, are unquestionably due to Donatello, the figure of the pope is the most beautiful tomb figure of the 15th century, and served as the model on which Rossellino, Desiderio and other sculptors of the following period based their treatment of similar problems. Donatello's share in the Naples monument is probably confined to the characteristic low relief of the "Ascension." The baptistery tomb shows how completely Donatello had mastered the forms of Renaissance architecture, even before his second visit to Rome. An earlier proof of his knowledge of classic art is his niche for the "St. Louis" at Or San Michele, now occupied by Verrocchio's "Christ and St. Thomas." Similar in treatment to the "Ascension" relief is the "Charge to St. Peter"

at South Kensington, which is almost impressionistic in its suggestion of distance and intervening atmosphere expressed by the extreme slowness of the relief.

When Cosimo was exiled from Florence in 1433, Michelozzo accompanied him to Venice, whilst Donatello went to Rome to drink once more at the source of classic art. The two works which still testify to his presence in this city, the "Tomb of Giovanni Crivelli" at S. Maria in Araceli, and the "Ciborum" at St. Peter's, bear the stamp of classic influence. Donatello's return to Florence in the following year almost coincides with Cosimo's. Almost immediately, in May 1434, he signed a contract for the marble pulpit on the façade of Prato cathedral, the last work executed in collaboration with Michelozzo, a veritable bacchanal dance of half nude *putti*, pagan in spirit, passionate in its wonderful rhythmic movement—the forerunner of the "singing tribune" for Florence cathedral, at which he worked intermittently from 1433 to 1440, and which is now restored to its original complete form at the museum of the Opera del Duomo. But Donatello's greatest achievement of his "classic period" is the bronze "David" at the Bargello, the first nude statue of the Renaissance, the first figure conceived in the round, independent of any architectural surroundings—graceful, well proportioned, superbly balanced, suggestive of Greek art in the simplification of form, and yet realistic, without any striving after ideal proportions. The same tendencies are to be noted in the bronze *putto* at the Bargello.

In 1443 Donatello was invited to Padua to undertake the decoration of the high altar of S. Antonio, but in the period preceding his departure he not only assisted Brunelleschi in the decoration of the sacristy of S. Lorenzo, towards which the bronze doors are his chief contribution, but found time to chisel, or model in wax or terra-cotta, for Cosimo and other private patrons, most of the portrait busts and small reliefs, which are now distributed over the museums of the world. His first work in Padua was the bronze crucifix for the high altar, a work immeasurably superior to the early wooden crucifix at S. Croce, both as regards nobility of expression and subtlety of form. In the very year when Donatello arrived in Padua the famous Condottiere Erasmo de' Narni, called Gattamelata, had died, and when it was decided to honour his memory with an equestrian statue, it was only natural that this master should be chosen to undertake a task from the difficulties of which all others may well have shrunk. This commission, and the reliefs and figures for the high altar, kept Donatello in Padua for ten years, though during that time he visited Venice (where he carved the wooden "St. John" at the Frari) and probably Mantua, Ferrara and Modena. In his workshop in Padua he gathered around him quite a small army of assistants, stone carvers, metal workers, painters, gliders and bronze casters. The Gattamelata was finished and set up in 1453—a work powerful and majestic in its very repose, there is no striving for dramatic effect, no exaggerated muscular action, but the whole thing is dominated by the strong, energetic head, which is modelled with the searching realism of the Zuccone and the Poggio heads. The high altar, for which Donatello executed 22 reliefs, seven statues and the crucifix, was completed in 1450, but had subsequently to undergo many changes, in the course of which the original disposition of the sculptures was entirely lost sight of, the present arrangement being due to Camillo Botto (1895). The chief features of the altar are the wonderfully animated and dramatic bronze reliefs, four in number, of the "Miracles of St. Anthony."

With the exception of another visit to Siena in 1457, of which the bronze "St. John" in the cathedral is a reminder, Donatello spent the remaining years of his life in Florence. Closely allied to the rugged "St. John" at Siena and therefore probably contemporaneous, is the repulsively ugly, emaciated "Magdalen" at the baptistery in Florence. The dramatic intensity of the "Judith" group in the Loggia de' Lanzi, which was originally placed in the court of the Medici Palace, marks it as belonging to the post Paduan period of the master's life. His last work of importance was the bronze reliefs for the pulpit of S. Lorenzo, commissioned about 1460, and finished after Donatello's death by his pupil

Bertoldo The reliefs of the "Flagellation" and "Crucifixion" at the Victoria and Albert Museum are typical examples of the master's style at this closing period of his life. He died on Dec. 13, 1466.

Donatello, whose supreme mastery had been acknowledged by Michelangelo, Raphael and the other giants of the late Renaissance, almost sank into oblivion during the 18th and early 19th centuries, and only in comparatively recent times has he been restored to the eminent position which is his due in the history of art. The full power of his genius was only revealed to the world when, at the quinqucentenary celebration of his birth, the greater part of his life-work was brought together in Florence. The large hall at the Bargello has ever since been devoted to the display of his works, the numerous original bronzes and marbles and terracottas being supplemented by casts of works at other places.

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DONATI, GIOVANNI BATTISTA (1826-1873), Italian astronomer, was born at Pisa on Dec. 16, 1826. In 1854-56 he discovered six comets, one of which, first seen on June 2, 1858, bears his name. On Aug. 5, 1864, he discovered the gaseous composition of comets by submitting to spectroscopic analysis the light of one then visible.

See *Vierteljahrsschrift der astr. Gesellschaft* (Leipzig), ix, 4; *Monthly Notices Roy. Astr. Society* xxvii, 153; *Mémoires de l'Académie des sciences et belles-lettres*, x, 125 (G. Cacciatore); *Nature*, viii, 556.

DONATIO MORTIS CAUSA (grant in case of death), in law, a gift of personal property made in contemplation of death and intended either expressly or impliedly to take complete effect only if the donor dies of the illness affecting him at the time of the gift. The conception as well as the name is borrowed from Roman law, and the distinction given by Justinian (*Inst.* ii, 7, 1) applies equally to a *donatio mortis causa* in Roman and English law. A distinction, however, has arisen between the English and civil codes, by English law delivery either actual or (when from the nature of the thing actual delivery is impossible) constructive is essential, and this delivery must pass not only the possession but the dominion of the thing given, by the civil law, delivery of possession was not essential. A *donatio mortis causa* is half way between a gift *inter vivos* and a legacy, and has some of the characteristics of each form of disposition. It resembles a legacy in that (1) it is revocable during the donor's life, (2) it is subject to death duties, (3) it is liable to satisfy debts of the testator in default of other assets. On the other hand, it resembles a gift *inter vivos* in that it takes effect from delivery, therefore the consent of the executor is not necessary. Anything may be the subject of a *donatio mortis causa*, the absolute property in which can be made to pass by delivery after the donor's death either in law or equity, this will cover bankers' deposit notes, bills of exchange and notes and cheques of a third person, but not promissory notes and cheques of the donor in favour of the donee, for the donor's signature is merely an authority for his banker to pay, which is revoked by his death.

DONATION OF CONSTANTINE (*Donatio Constantini*), the supposed grant by the emperor Constantine, in gratitude for his conversion by Pope Silverius, to that pope and his successors for ever, not only of spiritual supremacy over the other great patriarchates and over all matters of faith and worship, but also of temporal dominion over Rome, Italy and "the provinces, places and cities of the western regions."

The famous document, known as the *Constitutum Constantini*

and compounded of various elements (notably the apocryphal *Vita S. Silverii*), now universally admitted to be a gross forgery, was fabricated perhaps, at Rome, more probably in the Frankish empire, between the middle and the end of the 8th century, was included in the 9th century in the collection known as the *Falsæ Decretals*, and two centuries later was incorporated in the *Decretum* by a pupil of Gratian. The evidence for its Roman origin is internal, that for its origin in the Frankish dominions is based on the facts that the earliest manuscript containing it appears to have been written there and that the earliest certain quotation from it is by a Frankish author. It was regarded as genuine both by the friends and the enemies of the papal pretensions throughout the middle ages, though at the close of the 10th century, Leo of Vercelli, Otto III's chancellor, proclaimed its true character, as, in 1452, did the heretical followers of Arnold of Brescia. Although it has since before 800, the earliest certain appearance of it by a pope was made in 1054 by Leo IX, who was a German by birth and training. From this time forward it was increasingly employed by popes and canonists in support of the papal claims, and from the 12th century onward became a powerful weapon of the spiritual against the temporal powers. It is, however, as Cardinal Hergenrother points out, impossible to exaggerate its importance in this respect. By the partitions of the empire the donation was looked upon as the *pons et origo malorum*, and Constantine was regarded as having in his new born state, betrayed his imperial trust.

The genuineness of the *Constitutum* was first critically assailed by Laurentius Valla in 1510, whose *De falso credita et ementita Constantini donatione declamatio* opened a controversy that lasted until, at the close of the 18th century, the defense was silenced. In modern times the controversy as to the genuineness of the document has been succeeded by a debate scarcely less lively as to its date, its authorship and place of origin. The efforts of Roman Catholic scholars have been directed (after Caesar Baronius ascribed the forgery to the Greeks) to proving that the fraud was not committed at Rome while non-Roman Catholic scholars have called attention to the rarity of appeals to this document by the popes until the middle of the 15th century, when possible appeals were made not to enlarge their own territorial possessions but rather to dispose of lands newly acquired (A. J. Carlyle, *Medieval Political Theory in the West*, I, 290 (1903-28). F. Zinckens in *Eng. Hist. Rev.* 1894, IX, 625-632). The view held by E. Gibbon, Johann von Dollinger (*Papsttabelle des Mittelalters*, Eng. tr. 1871) and others, that the *Constitutum* is referred to in the letter of Adrian I to Charlemagne (758), is now largely rejected, and the same must be said of Johann Friedrich's attempt to find such reference in the letter addressed in 785 by the same pope to Constantine VI, emperor of the east, and his mother Irene. Still less safe is it to ascribe the authorship of the forgery to any particular pope on the ground of its style, for the papal letters were drawn up in the papal chancery, and the style employed there was apt to persist through several pontificates, nor is the style alone sufficient proof that it was drafted in Italy.

On one point, however, agreement seems now to have been reached, a result due to the labours of Paul Scheffer Boichorst (*Mitteilungen des Instituts für osterr. Geschichtsforschung*, x, 1889, xi, 1890), namely, that the style of the *Constitutum* is generally that of the papal chancery in the latter half of the 8th century. This being granted there is room for plentiful speculation as to where and why it was concocted. We may still hold the opinion of Dollinger that it was intended to impress the barbarian Pippin and justify in his eyes the Frank intervention in favour of the pope in Italy, or we may share the view of L. Loening that the forgery was a pious fraud on the part of a cleric of the Curia, committed under Adrian I, with the idea of giving a legal basis to territorial dominion which that pope had succeeded in establishing in Italy. The donations of Pippin and Constantine was to proclaim him as sovereign *de jure*. It is significant in this connection that it was under Adrian (c. 774) that the papal chancery ceased to date by the regnal years of the eastern emperor and substituted that of the pontificate. Thomas Hodgkin (Italy and her Invaders, vii, 151, 1899), impressed by the scant use made of this document for several centuries after its origin, regarded it as a pious romance which, when rediscovered after a long lapse of time, was accorded an authenticity not claimed by its author or his contemporaries. Dollinger's view is supported and carried a step further by G. H. Bohmer (art. "Konstantinische Schenkung," in J. Herzog-A. Hauck's *Realencyclopädie*), who by an ingenious argument endeavours to prove that the *Constitutum* was forged in 751, probably by the notary Christophorus, and was carried with him by Pope Stephen II to the court of Pippin, in 754, with an eye to the acquisition of the Exarchate. In support of this argument it is to be noted that the forged document first appears at the abbey of St. Denis where Stephen spent the winter of 754. E. Mayer (Die Schenkungen Konstantins und Pippins," *Deutsche Zeitschrift für Kirchenrecht*, 1904), on the other hand, denies that the *Constitutum* can have been forged before the news of the iconoclastic decrees of the council of Constantinople of 754 had reached Rome. He lays stress on the relation of the supposed confession of faith of Constantine, embodied in the forgery, to that

issued by Constantine V, pointing out the efforts made by the Byzantines between 756 and the synod of Gentilly in 767 to detach Pippin from the cause of Rome and the holy images. The forgery thus had a double object as a weapon against Byzantine heresy and as a defense of the papal patrimony. As the result of an exhaustive analysis of the text and of the political and religious events of the time, Mayer comes to the conclusion that the document was forged about 775, i.e., at the time when Charlemagne was beginning to reverse the policy by which in 774 he had confirmed the possession of the duchies of Spoleto and Benevento to the pope. The defense of the new Western Empire from Byzantine attacks was probably the original purpose of this forgery, but it should not be forgotten that its importance and use in disputes between the papacy and the secular power did not begin until the 11th century. None of the problems regarding the sources, place and date of the forgery, or its purpose have yet been definitely solved.

In addition to works already mentioned, see Joseph von Hergenrother, *Catholic Church and Christian State* (Freiburg im Breisgau, 1872, Eng. trans. 2 vols, 1876), W. Maîtres, *Die römische Frage unter Papst u. Karol von Gros* (Stuttgart, 1881), with text, L. Weiland, "Die Konst. Schenkung," in *Zeitschr. f. Kirchenrecht*, xiv (1887-1888), maintaining that the *Constitutum* was forged at Rome between 813 and 875, in connection with the papal claim to crown the emperors, with text, Friedrich, *Die Konst. Schenkung* (Nordlingen, 1889), with text, W. Marrens, *Die falsche Generalkonvention Konstantins des Grossen* (Munich, 1890), G. Krüger, "Die Frage der Entstehungszeit der Konst. Schenkung," in *Theologische Literaturzeitung*, xiv (1889), Laurentius Valla's treatise was issued in a new edition, with French translation and historical introduction, by A. Bonneau, *La Donation de Constantin* (Lusave 1890). J. Langen, "Entstehung und Tendenz der Konstantinischen Schenkungsurkunde," in *Historische Zeitschrift für Kirchenrecht*, 137 sqq., 185 sqq. (1888), Locmieg, "Die Entstehung der Konstantinischen Schenkungsurkunde," in *Historische Zeitschrift*, 193 sqq. (1890), G. L. Burr in *Cambridge Medieval History*, II, 586-587 (1926) (L. B. H.).

DONATISTS, a powerful sect which arose in the Christian church of northern Africa at the beginning of the 4th century. In its doctrine it sprang from the same roots, and in its history it had in many things the same character, as the earlier Novatians. The predisposing causes of the Donatist schism were the belief, early introduced into the African church, that the validity of all sacerdotal acts depended upon the personal character of the agent, and the question, arising out of that belief, as to the eligibility for sacerdotal office of the *traditores*, or those who had delivered up their copies of the Scriptures under the compulsion of the Diocletian persecution, the exciting cause was the election of a successor to Mensurius, bishop of Carthage (d. 311). Mensurius had held moderate views as to the treatment of the *traditores*, and accordingly a strong fanatical party, supported by Secundus, bishop of Tigris and primate of Numidia, had formed itself in Carthage in opposition to him. There were thus two parties, each anxious to secure the succession to the vacant see. The friends of the late bishop fixed their choice on Caecilian, the archdeacon, and secured his election and his consecration by Felix, bishop of Aptunga, before the other party were ready for action. It had been customary for the Numidian bishops to be present at the election and consecration of the bishop of Carthage, who as metropolitan of proconsular Africa occupied a position of primacy towards all the African provinces. Caecilian's party, however, had not waited for them, knowing them to be in sympathy with their opponents. Soon after Caecilian's consecration Secundus himself with 70 of the Numidian bishops arrived at Carthage. A synod of Africa was formed, before which Caecilian was summoned, his consecration was declared invalid, on the ground that Felix had been a traitor, and finally, having refused to obey the summons to appear, he was excommunicated, and the "reader" Majorinus consecrated in his stead.

To investigate the dispute Constantine issued a commission to five Gallic bishops, under the presidency of Melchades, bishop of Rome. Ten bishops appeared on each side, the leading representative of the Donatists being Donatus of Casae Nigrae. The decision was entirely in favour of Caecilian, and Donatus was found guilty of various ecclesiastical offences. An appeal was taken and allowed, but the decision of the synod of Arles in 314 not only confirmed the position of Caecilian, but greatly strengthened it by passing a canon that ordination was not invalid because performed by a traitor, if otherwise regular. Felix had previously been declared innocent after an examination of records and witnesses at Carthage. A further appeal to the emperor in

person was heard at Milan in 316, when all points were finally decided in favour of Caecilian, probably on the advice of Hosius, bishop of Cordova. Henceforward the power of the state was directed to the suppression of the defeated party. Persistent Donatists were no longer merely heretics, they were rebels and incurred the confiscation of their church property and the forfeiture of civil rights.

The attempt to destroy the sect by force had the result of intensifying its fanaticism. Majorinus, the Donatist bishop of Carthage, died in 315, and was succeeded by Donatus, surnamed Magnus, a man of great force of character, after whom the movement was named, and under whose influence it gained fresh strength from the opposition it encountered. In 321 Constantine, seeing probably that he had been wrong in abandoning his usual policy of toleration, sought to retrace his steps by granting the Donatists liberty to act according to their consciences, and declaring that the points in dispute between them and the orthodox should be left to the judgment of God. This wise policy, to which he consistently adhered to the close of his reign, was not followed by his son and successor Constantius, who, after repeated attempts to win over the sect by bribes, resorted again to persecution, many of their bishops falling victims and Donatus and others being banished. The power which they had been the first to invoke having thus declined so emphatically and persistently against them, the Donatists revived the old world alien Christianity of the days of persecution, and repeated Tertullian's question, "What has the emperor to do with the church?" (*Quid est imperatori cum ecclesia?*)

With the accession of Julian (361) an entire change took place, their churches were restored to the Donatists and their bishops reinstated, with the natural result of greatly increasing both the numbers and the enthusiasm of the party. A return to the earlier policy of repression was made under Valentinian I and Gratian, by whom the churches were again closed, and all assemblies forbidden. It was not, however, until the commencement of the 5th century that the sect began to decline, owing largely to the rise among them of a group of moderate and scholarly men like the grammarian Tychonius, who vainly strove to overcome the more fanatical section. Against the house thus divided against itself both state and church directed not unsuccessful assaults. In 405 an edict was issued by the emperor Honorius commanding the Donatists, under the severest penalties, to return to the Catholic church. On the other hand, Augustine, bishop of Hippo, after several years' negotiation, arranged a great conference between the Donatists and the orthodox, which was held under the authority of the emperor at Carthage in 411. There were present 286 Catholics and 279 Donatist bishops. Before entering on the proceedings the Catholics pledged themselves, if defeated, to give up their sees, while in the other event they promised to recognize the Donatists as bishops on their simply declaring their adherence to the Catholic church. The latter proposal, though it was received with scorn at the time, had perhaps ultimately as much influence as the logic of Augustine in breaking the strength of the schism. The discussion, which lasted for three days, turned exclusively upon the two questions that had given rise to the schism—first, the question of fact, whether Felix of Aptunga who consecrated Caecilian had been a traitor, and secondly, the question of doctrine, whether a church by tolerance of unworthy members within its pale lost the essential attributes of purity and catholicity. The Donatist position, like that of the Novatians and, earlier, of the Montanists (*q.v.*) was that the church is a society of holy persons, and that the mark of the true church is to guard the essential predicate of holiness by excluding all who have committed mortal sin, the Catholic standpoint was that such holiness is not destroyed by the presence of unworthy members in the church but rests upon the divine foundation of the church and upon the gift of the Holy Spirit and the communication of grace through the priesthood. In the words of Optatus of Mileve, *sancitas de sacramentis colligitur, non de superbia personarum pondera*. And the much wider diffusion of the orthodox church was also taken as practical confirmation that it alone possessed what was regarded as the equally essential predicate of catholicity.

The decision of Marcellinus, the imperial commissioner, was in favour of the Catholic party on both questions, and it was at once confirmed on an appeal to the emperor. The severest penal measures were enforced against the schismatics, in 414 they were denied all civil rights, in 415 the holding of assemblies was forbidden on pain of death. But they lived on, suffering with their orthodox brethren in the Vandal invasions of the 5th century, and like them finally disappearing before the Saracen onslaught two centuries later.

BIBLIOGRAPHY.—For contemporary sources see Optatus Milevitanus *De Schismate Donatistarum adversus Parmenianum*, written c. 368 (Migne, *Patrologia Latina*, vol. xi), and several of the works of Augustine. Among modern authorities reference should be made to O. Bardenheuer, *Geschichte der altkirchlichen Literatur*, III, 488–98, IV, 467–73, 514–15; J. Chapman, *Donatus the Great and Donatus of Caesari in Kivus Benedictine* 26 (1909) 13–23; P. Monceaux, *Histoire littéraire de l'Afrique chrétienne*, IV and VI (1913 and 1923); H. von Soden, *Urkunden zur Entstehungsgeschichte des Donatismus* (1913).

DONATUS, AELIUS, Roman grammarian and teacher of rhetoric, flourished in the middle of the 4th century AD. He was the tutor of St Jerome. Of his numerous works, the following are extant: the *Arts grammaticae*, most of his commentary on Terence (a compilation from other commentaries), but probably not in its original form, and a few fragments of his notes on Virgil, preserved and severely criticized by Servius, together with the preface and introduction, and life of Virgil. The *Arts*, though having little claim to originality, and based on the authorities used by Charisius and Diomedes, became so popular as a school book that in the middle ages the writer's name became a common metonymy (in the form *donatus*) for any rudimentary treatise. It is extant in the form of an *Arts Minor*, which only treats of the parts of speech, and an *Arts Major*, which deals with grammar in general at greater length.

Aelius Donatus is to be distinguished from Tiberius Claudius Donatus, the author of a commentary (*Interpretationes*) on the Aeneid (of far less value than that of Servius), who lived about 50 years later.

The best text of the *Arts* and the commentaries upon it by Servius and others is in H. Keil, *Grammatica Latina*, iv, of the commentary on Terence there is an edition by P. Wessner (1902, Teubner series) with bibliography and full account of mss. See generally E. A. Grafenhan, *Geschichte der klassischen Philologie im Altertum* i (1896); P. Rosenstock, *De Donato, Terentii explicatione* (1886); H. T. Karsten, *De Com. Don. ad Terentii fabulas origine et compositione* (Leyden, 1907). For the commentary of Tiberius Donatus see O. Ribbeck, *Prolegomena to Virgil*, Grafenhan (as above), and V. Burkas, *De Tiberii Claudii Donati in Aeneidem commentario* (1889). The text will be found in G. Fabricius's edition of Virgil (1501), ed. by H. George, i (1905 foll). See also R. Sabbadini, *Storia e Critica di Test. Latina* (Catania, 1914), dealing with the mss of the commentaries of Aelius and Tiberius.

DONAUWORTH, a town of Germany in the Land of Bavaria on the left bank of the Danube, at the confluence of the Wornitz, 25 m N of Augsburg by rail and at the junction of lines to Ulm and Ingolstadt. Pop. (1939) 6,041. It grew up during the 11th and 12th centuries under the protection of the castle of Mangoldstein, and became for a time in the 13th a seat of the duke of Upper Bavaria. The town received the freedom of the Empire in 1308, and resisted the encroachments of Bavaria till 1607, when the duke of Bavaria was authorized to punish the Protestant inhabitants for their interference with the abbot of the Heilig-Kreuz. In the Thirty Years' War it was stormed by Gustavus Adolphus (1632), and captured by King Ferdinand (1634). Important battles were fought in the neighbourhood in 1704 and in 1805. The imperial freedom restored to the town by Joseph I. in 1705 was again lost by reincorporation with Bavaria in 1714. The Kloster Kirche (monastery) a Gothic edifice, the church of the former Benedictine abbey, Heilig Kreuz, the Gothic town hall and the so called Tana-haus, which now includes both a theatre and a school are notable. The industries include machinery, brewing and saw-milling, the place is a river port, and trade is in agricultural produce.

DON BENITO, a town of western Spain, in the province of Badajoz, near the left bank of the river Guadiana, on the Madrid-Badajoz-Lisbon railway. Pop. (1940) 20,613 (mun. 20,931). Don Benito, centre of a fertile district, dates from the 15th cen-

tury, when it was founded by refugees from Don Llorente, driven out of their own town by floods from the Guadiana. Besides manufactures of oil, soap, flour, linen, lace and cloth, it has an active trade in wheat, cattle, wine and fruit, especially melons.

DONCASTER, market town, county borough, Doncaster parliamentary division, West Riding, Yorkshire, England, 156 m N of London. Pop. (est. 1938) 71,600. Area 122 sq km. It lies astride the ridge dividing the watershed of the rivers Don and Trent. It is the centre of a large coal-mining area and an important station on the L.N.E. railway, whose principal locomotive and carriage works are here. It is also served by the L.M.S. railway, stands on the Great North road, and the river Don affords water communication with the Humber and Goole. The parish church of St George (architect Sir G. G. Scott) occupies the site of an older structure, destroyed by fire in 1853. It is a fine cruciform structure of Decorated character, with a central tower 170 ft high, and contains a fine organ. St James's church was erected by the same architect and Lord Grimthorpe. Other important buildings are the guildhall, mansion house, public library, school of art, technical college, corn exchange and market hall. The grammar school was founded in 1535 and has been greatly enlarged. There is a large high school for girls and a school of art, while some of the elementary schools are the finest in the country.

The Doncaster racecourse lies 1 m S.E. of the town and is owned and managed by the corporation. The old course is 1 m 7 furlongs 70 yds long, the Sandall mile was added in 1892 and the straight mile in 1912. Race meetings are normally held in September, October and May. In September the St Leger race, which originated in 1776, is run. The grandstand was erected in 1777 but there are several other stands. Systems of electric trams, trolley vehicles and motor omnibuses connect the borough with the coal-mining towns in the neighbourhood, there being about two dozen coal mines within a 10 mile radius. Agricultural trade is extensive, though coal working is the principal industry, and there are iron, brass, wagon, wire and agricultural machine works, toffee and chocolate works, wall paper works and a woolen mill. Adjoining the borough are the Saxon and Norman ruins of Conisbrough castle and the remains of the Norman Tickhill castle. The town contains free libraries, a museum and art gallery, six public parks and a municipal swimming bath.

History.—There was a Roman station here, and numerous remains of the Roman period have been found. In the reign of Edward the Confessor, Doncaster belonged to Earl Tostig, but before 1086 it had been granted to Robert, earl of Mortain, whose successor William was attainted for treason in the time of Henry I. The overlordship then fell to the crown, and the families of Fossard, Mauley and Salvin successively held the manor as underlords. Doncaster was evidently a borough held of the crown for a fee farm rent before 1294, when Richard I granted and confirmed to the burgesses their soke and town to hold by the ancient rent and by 25 marks yearly. The town was incorporated in 1467 by Edward IV. In 1623 Ralph Salvin tried to regain the manor of Doncaster from the mayor and burgesses who, fearing that the case would go against them, agreed to pay about £3,000, in return for which he gave up his claim. Charles II in 1664 gave the town a new charter, but since this was not enrolled, the burgesses obtained another charter from James II in 1684 by which the town was governed until the Municipal Corporation Act. It was created a county borough in 1927. In 1200 a fair at Doncaster on the vigil and day of St James the Apostle was confirmed, and by the charter of 1194 the burgesses received licence to hold a fair on the vigil, feast and morrow of the Annunciation. These fairs were confirmed by Henry VII in 1505. The fairs and markets are still held under these charters.

DONDERS, FRANZ CORNELIUS (1818–1889), Dutch ophthalmologist, was born on May 27, 1818, in Tilburg, and studied at Utrecht where, after being an army surgeon, he became professor of physiology in 1847. From 1852 onwards he specialized in ophthalmology to which belong his studies of the *musculi voluntarii* (1847), the relation between convergence of visual axes and accommodation (1848), regeneration of the cornea

(1848), hypermetropia (1858), anisotropia (1860), astigmatism (1862) His *The Anomalies of Refraction and Accommodation* was published in England in 1864 Donders died in Utrecht on March 24, 1889

See E. Clarke, *A Brief Review of the Work of Donders* (1914)

DONEGAL, a county in the extreme north west of Eire, bounded north and west by the Atlantic ocean, east by Lough Foyle and the counties Londonderry and Tyrone, and south by Donegal bay and the counties Fermanagh and Leitrim The area is 1,865 sq mi Pop (1936) 142,310

Geology—The rocks of the county are chiefly igneous or archæan and, structurally, it is a continuation of the Scottish Highlands, the same north-east-south-west structural lines dominating both, as a result, probably, of post Silurian ("Caledonian") earth movements The archæan area usually forms the highest land, with quartzite standing out in white summits at Errigal (2,466 ft) in the western or Derryvagh mountains, to the south of which is lower land towards Gweebarra bay, mostly formed by igneous rock which stretches north eastwards along a valley with long lakes, and separates the Derryveagh from the Glendown mountains, the latter again archæan An important syncline of carboniferous sandstone and limestone forms the north east slopes of Donegal bay, and another one, or another part of the same one, forms the shores of Lough Foyle in Co Londonderry and is continued south Beyond the Donegal bay syncline, to the north east, is a high igneous mass (Bluestack, 2,29 ft) Much of the drainage is carried to the Foyle by the Derg and Finn rivers Donegal includes the high Inishowen peninsula between Lough Swilly and Lough Foyle, formed mainly of archæan rocks (Slieve Snacht, 2,019 ft), with some carboniferous along Lough Foyle Lough Swilly is a marked feature, its upper part is related to the synclinal lines of Donegal bay and runs south west north east, its lower part turns out of this direction, and is a feature related to the unequal denudation of igneous and archæan rocks and the general coastal sinking which has contributed so much to the complexity of Donegal's coast line

History—The greater part of Donegal was anciently called Tyrconnell (*q v*) or the country of Connall, and it was sometimes called O'Donnell's country, after the head chieftains of the district This district was formed into the county of Donegal in the reign of Queen Elizabeth, in 1585, by the lord deputy, Sir John Perrot At the head of Lough Swilly, on the summit of a hill 802 ft high are some remains of a fortress or palace of the northern Irish kings These are known as the Gruam of Aileach and evidently date from a period prior to the 12th century On Tory island there are one of the best specimens of a round tower and other remains Numerous ruins of castles along the coast prove that much attention was formerly paid to the defence of the country from invasion The principal are Kilharro castle, near Ballyshannon, Donegal castle and Burt castle Traces of religious houses, some only in traditionary or documentary records, are numerous, the ruins of that of Donegal, founded in 1474, may still be seen At Raphoe, 5 m NW of Lifford, is the cathedral of a former diocese united to that of Derry in 1835

Industries—The soil of the greater portion of the county, i.e., the granite, quartz and mica slate districts, is thin and cold, while that on the carboniferous limestone is warm and fertile In most parts of the West the patches of glacial drift form the only agricultural land Owing to the boggy nature of the soil, agriculture has not made much progress, although in certain districts (Gweedore, for instance) much land has been brought under cultivation through the enterprise of the proprietors Wheat and barley are quite an inconsiderable crop, and in this, as well as in other respects, Donegal is much behind the rest of Ulster It beats, however, a more favourable comparison as regards its live stock, as cattle, sheep and poultry are extensively kept

The linen manufacture affords employment to a number of inhabitants, especially at Raphoe, while the manufacture of excellent homespun, woollen stockings and worked muslin is carried on fairly extensively The trade in these manufactures and in the domestic produce of the county finds its principal outlets through the port of Londonderry and the inland town of Strabane Co

Tyrone The deep sea fisheries are important and are centred at Killybegs, Gweedore and Rathmullen The salmon fishery is also prosecuted to a considerable extent, the principal seats of the trade being at Ballyshannon and Letterkenny Bog union ore is mined as a gas-purifier, and the schist has been worked for stellite at Crobhy Head The fine grained sandstone of Mt Charles, near Donegal, is a well known building stone, and the granites of the north west have attracted much attention

Most of the railway lines are owned jointly by the G.N. railway (Ireland) and the I.M.S. railway, and are controlled by the Co Donegal joint committee The chief branch leaves the Great Northern line from Londonderry to Omagh at Strabane From Stranorlar one line follows the upper Finn valley and serves Glenties, whilst another line utilizes a gap to the south west and communicates with Donegal From here local lines serve the fishing villages and resorts around Donegal bay Letterkenny is also connected with Strabane by rail The county town is Lifford, practically a suburb of Strabane in Co Tyrone Other important towns are Letterkenny (2,049), Ballyshannon (2,223) and Buncrana (2,795) The Revision of Constituencies Act (1935) assigned to East Donegal four members and to West Donegal three members in Dail Eireann

DONEGAL, a small seaport and market town of Co Donegal, Eire, at the head of Donegal bay and the mouth of the river Eask Pop (1936) 1,315 There are ruins of a Jacobean castle (1610) on the site of a fortress of the O'Donnells of Tyrconnell, and of a Franciscan monastery (founded in 1474), at which were compiled the famous *Annals of the Four Masters*, a record of Irish history, completed in 1636 Donegal received a charter from James I The name is said to allude to a settlement of the Northmen Trade is hindered by shoals, which render difficult the approach to the harbour

DONELSON, FORT, an entrenched camp at Dover, Tenn., U.S.A., erected by the Confederates in the Civil War to guard the lower Cumberland river, and taken by the Federals on Feb 16, 1862 It consisted of two continuous lines of entrenchments on the land side, and water batteries commanding the river After the capture (Feb 6) of Fort Henry on the lower Tennessee the Union army under Brig Gen U.S. Grant moved to invest Donelson, two divisions marching overland while the third went by water, and the gunboat flotilla (Commodore A.H. Foote) descended the Tennessee and ascended the Cumberland to meet him Albert Sidney Johnston, the Confederate commander in Kentucky, dividing his army, had retired himself to Nashville and had thrown a large garrison under Gen Floyd into Donelson, and Grant was at first outnumbered, though continually reinforced, the latter had at no time more than three men to the Confederates' two The troops of both sides were untrained but eager

On Feb 12 and 13, 1862, the Union divisions, skirmishing heavily during the second day, took up their positions investing the fort, and on the 14th Foote's gunboats attacked the water batteries The latter received a severe repulse, Foote himself being amongst the wounded, and soon afterwards the Confederates determined to cut their way through Grant's lines On the 15th Gen Pillow attacked the Federal division of McClelland and drove it off the Nashville road, having done this, however, he halted, and even retired Grant ordered Gen C.F. Smith's division to assault a part of the lines which had been denuded of its defenders in order to reinforce Pillow Smith personally led his young volunteers in the charge and carried all before him The Confederates returning from the sortie were quite unable to shake his hold on the captured works, and, Grant having reinforced McClelland with Lew Wallace's division, these two generals reoccupied the lost position on the Nashville road On the 16th, the two senior Confederate generals, Floyd and Pillow, having escaped by steamer, the infantry left in the fort under Gen S.B. Buckner surrendered unconditionally The Confederate cavalry under Col Forrest made its escape by road The prisoners numbered about 15,000 out of a total of 18,000

See "Fort Donelson," *Military Historian and Economist*, vol 1, p. 33-62 (Cambridge, Mass., 1916), and "Campaign Against Fort Henry and Donelson," *Coast Artillery Journal*, vol lxvii, p. 389-404 (Hampton, Va., 1927)

DONGA, a Bantu word for a narrow watercourse or eroded gully. Adopted by Europeans in S. Africa from the Kaffirs, it was applied to similar ravines or watercourses elsewhere. It is almost equivalent to the Arabic *khur*, which also means the dry bed of a stream and to the Indian *nallah* (properly a watercourse).

DONGAN, THOMAS *see* LIMERICK, THOMAS DONGAN

DONGOLA, a district in the Northern province of the Anglo-Egyptian Sudan, lies wholly in the region formerly known as Nubia and extends along both banks of the Nile from about 18° N to 20° N. The rainfall is very slight, and the area of fertility is mainly confined to the lands watered by the Nile, and to the Wadi el Kab (Gab), west of and parallel to the Nile. Farther west is the extensive plateau of Jebel Abiad, and beyond, some 250 mi. due west of Debba is Bir Natrun, or Bir Sult'an, a valley whence natron is obtained. In this desert region is found the addax, the rarest of Sudan antelopes. The principal market towns are Argo, Dongola and Kareima but the administrative headquarters are at Merowe (or Merawi) on the left bank of the Nile a few miles below the 4th cataract. Other towns of local importance are Khandaq, Debba and Korti whence start caravan routes to Darfur, Kordofan and Omdurman. Old Merawi, on the right bank of the Nile, and Sanam Abu Dom, on the left bank, indicate the site of the Ethiopian city of Napata. From Kareima, on the right or northern bank of the Nile, 6 mi. above New Merawi, a railway (opened in March 1906) runs to join the main Sudan government line at Abu Hamed. From Kareima downstream the Nile is navigable to Kerma, just above the 3rd cataract.

The Dongola are Nubians in type and language, but have a large admixture of Arab, Turk and other blood. They are great agriculturists and keen traders and were notorious slave dealers. Upstream from Korti the inhabitants are Shaigia (sons of Shaik) and the Nubian tongue is replaced by Arabic. Of the semi-nomadic tribes the chief are the Hawawir, Kabbabish and Gar rasli.

History—Dongola was once part of the empire of Ethiopia (q.v.), Napata being one of its capital cities. From about the beginning of the Christian era the chief tribes were the Blemmyes and the Nobatae. The latter became converted to Christianity about the middle of the 6th century. A chieftain of the Nobatae, named Silko, before the close of that century, conquered the Blemmyes, founded a new state, made Christianity the official religion of the country, and fixed his capital at (Old) Dongola. This state, generally known as the Christian kingdom of Dongola, lasted for eight or nine hundred years. Christianity, after the wars of Silko, spread rapidly, and when the Arab conquerors of Egypt sought to subdue Nubia they met with stout resistance. Dongola, however, was captured by the Muslims in 652, and the country laid under tribute (*bakt*)—400 men having to be sent yearly to Egypt. This tribute was paid when it could be enforced, sometimes the Nubians gained the upper hand, as in 737 when their king Cyriacus, marched into Egypt to redress the grievances of the Copts. By the close of the 10th century the Nubians seem to have regained almost complete independence. They did not, however, possess any part of the Red Sea coast, which was held by the Egyptians, who, during the 9th and 10th centuries, worked the emerald and gold mines between the Nile and the Red Sea. The kingdom, according to the Armenian historian Abu Salih, was in a very flourishing condition in the 12th century. It then extended from Assuan southward to the 4th cataract, and contained several large cities. Gold and copper mines were worked. The liturgy used was in Greek. In 1173 Shams ed Daula, a brother of Saladin, attacked the Nubians and captured the city of Ibrim (Primis). The Egyptians retired, and for about 100 years the country was at peace. In 1275 the Mameluke Sultan Bibars aided a rebel prince to oust his uncle from the throne of Nubia, the sultans Kalaun and Nasir also sent expeditions to Dongola which was several times captured. Though willing to pay tribute to the Muslims, the Nubians clung tenaciously to Christianity and, despite Arab raids, the country appears during the 12th and 13th centuries to have been fairly prosperous. It is not certain how far south the authority of the Dongola kingdom (sometimes known as Mukarra) extended

Another Christian state, Aloa (Alwa), with its capital Soba on the Blue Nile, was its near neighbour on the south.

Cut off from free intercourse with the Copts in Egypt, the Nubian Christians at length began to embrace Jewish and Mohammedan doctrines. The decay of the state was hastened by dissensions between Mukarra and Aloa, but the Nubians were strong enough to invade upper Egypt during the reign of Nawayka Krestos (1342-72), because the governor of Cairo had imprisoned the patriarch of Alexandria. The date usually assigned for the overthrow of the Christian kingdom is 1351. Only the northern part of the country (as far as the 3rd cataract) came under the rule of Egypt. Nevertheless, according to Leo Africanus, at the close of the 15th century Christianity and native states still survived in Nubia, and in the 16th century the Nubians sent messengers to Abyssinia to Father Aharez, begging him to appoint priests to administer the sacraments to them—a request he was unable to grant. Thereafter the Nubian Church is without records. The region between Dongola and Shendi appeared to have been depopulated. In the north the Turks introduced in the 16th century numbers of Bosnians, whose descendants ruled the district, paying a nominal allegiance to the Porte at Ibrim Mahass, and elsewhere along the banks and on the islands of the Nile, they built castles, now in ruins. South of Hannek the kings of Sennar became overlords of the country. As the power of the Sennari declined, the Shaigia (or Shaikiyeh) attained pre-eminence in the Dongola district.

About 1812 Mamelukes fleeing from Mohammed Ali, the pasha of Egypt, made themselves masters of part of the country, destroying the old capital and building a new one lower down the Nile. In 1820 both Mamelukes and Shaigia were conquered by the Egyptians, and the Dongola province annexed to Egypt.

After the failure of the British relief expedition of 1884-85 and the Mahdist capture of Khartum it was decided to withdraw to the region of the 2nd cataract, and the Dongola province was evacuated. The British vanguard left Dongola town in June 1885 and the Mahdists occupied it at the end of August. They held the province for 11 years, during which its northern villages were depopulated and their riverside lands laid waste. It was reoccupied by Kitchener's forces in 1896, Dongola being recaptured on Sept. 23. It remained a province of the Anglo-Egyptian Sudan until 1936 when it was incorporated as a district in the Northern province. Its principal product is dates obtained from approximately 1,000,000 date trees. (L. M. B. X.)

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DONGOLA, a town of the Anglo-Egyptian Sudan, which gives its name to a district. It is situated on the west bank of the Nile, about 45 mi. above the third cataract, in 19° 10' N, 30° 39' E. It is 1,082 mi. S of Cairo by river and 638 mi. N of Khartum by the same route. It is a small, mud built market town, the headquarters of the Rural District council. Lignite is found on the east bank of the Nile opposite the town. Founded c. 1812 by Mamelukes who fled to Nubia from the persecutions of Mohammed Ali, the town is called Dongola Ordi (Dongola Camp) to distinguish it from Dongola Agusa (Old Dongola), which it supplanted. The Mahdi Mohammed Ahmed was a native of Dongola. In 1884-1885 the town was the base of the British troops in their advance on Khartum.

Dongola Agusa, 75 mi. upstream from New Dongola, now a heap of ruins, was the capital of the Nubian state usually called the Christian kingdom of Dongola. An Arab historian of the 11th century describes it as a large city with many churches, fine houses and wide streets. It is said to have been finally destroyed by the Mamelukes.

DONIZETTI, GAETANO (1797-1858), Italian musical composer, was born at Bergamo on Nov. 29, 1797. He studied at Naples under Simon Mayr, the operatic composer, and then under Mattei at Bologna. After his return to Bergamo, his father

insisted upon his giving lessons in order to earn his living. Donzetti revolted and enlisted in the army. His regiment was quartered at Venice, and here the young composer's first opera, *Enrico conte di Borgogna*, saw the light in 1818.

The success of this work, and of a second opera brought out in the following year, established Donzetti's reputation. He obtained his discharge from the army, and henceforth his operas followed each other in rapid and uninterrupted succession at the rate of three or four a year. Although he had to contend successfully with two such dangerous rivals as Rossini and Bellini, he succeeded in taking firm hold of the public, and the brilliant reception accorded to his *Anna Bolena* at Milan, where Pasta and Rubini appeared in it, earned his name beyond the limits of his own country. In 1835 Donzetti went for the first time to Paris, where, however, his *Marmora Fabero* failed to hold its own against Bellini's *Puritani*, then recently produced at the Théâtre Italien. The disappointed composer went to Naples, where the enormous success of his *Lucia di Lammermoor* (1835) consoled him for his failure in Paris. Returning to Paris he produced at the Opéra Comique what proved eventually his most popular opera, *La Fille du régiment*, but it was not till after the work had made the round of the theatres of Germany and Italy that it found favour with the French. A revival in Paris of his *Lucrezia Borgia*, produced at Milan in 1833, was interrupted by Victor Hugo's claim for infringement of copyright, and the libretto was altered. *La Favorita*, generally considered Donzetti's masterpiece, was produced in 1840. His next important work, *Linda di Chamounix*, was written for Vienna, where it was received most favourably in 1842, and the same success attended the production of *Don Pasquale* in Paris in 1843. Soon after this event the first signs of a fatal disease, caused to a great extent by overwork, began to show themselves. The utter failure of *Don Sebastian*, a large opera produced soon after *Don Pasquale*, is said to have hastened the catastrophe. A paralytic stroke in 1844 deprived Donzetti of his reason, and for four years he lingered on in a state of mental and physical prostration. A visit to his country was proposed as a last resource, but he reached his native place only to die there on April 1, 1848.

The sum total of his operas amounts to sixty-four. The large number of his works accounts for many of their chief defects. His rapidity of working made all revision impossible. It is said that he once wrote the instrumentation of a whole opera within thirty hours. And yet it may be doubted whether more elaboration would have essentially improved his work, for the dramatic last act of the *Favorita*, infinitely superior to the preceding ones, is also said to have been the product of a single night.

Without boasting the sweetness of Bellini or the sparkle of Rossini, Donzetti won the popular ear by his flow of melody and by his rare skill in writing for the voice, to which qualities may be added his power of humorous delineation, as evinced in *Don Pasquale* and *L'Elisir d'amore*, which works will probably last as long as anything he ever wrote.

See F. Cicconetti, *Vita di G. Donzetti* (1864); *Lettres inédites di Gaetano Donzetti* (ed. Essner-Eschenhoff, 1897); Ch. Malherbe, *Le centenaire de Donzetti* (1897); and A. Cametti, *Donzetti* (1907).

DONJON, the French term for the keep (*q v*) of a mediaeval castle, used in contradistinction to *dungeon* (*q v*), the prison, an anglicized spelling of the same word.

DON JUAN, a legendary character, whose story has found currency in various European countries. He was introduced into formal literature in the Spanish *El Burlador de Sevilla y conu dado de piedra*, a play which was first printed at Barcelona in 1630, and is usually attributed to Tirso de Molina, but the story of a profligate meeting a dead man to supper, and finding his invitation accepted, was current before 1630, and is not peculiar to Spain. The available evidence goes to show that Don Juan is a universal type, the subject of local myths in many countries, that he received his name in Spain, and that the Spanish version of his legend has absorbed certain elements from the French story of Robert the Devil. The character of Don Juan as the incarnation of perverse sensuality and arrogant blasphemy, may be considered as the creation of the author of *El Burlador*. The drama

was apparently more popular in Italy than in Spain, and was frequently given in pantomime by Italian actors, a company of whom took the story into France in 1657. It was dramatized by Dornmond in 1659 and by De Villiers in 1661, their attempts suggested *Le Festin de Pierre* (1665) to Molière, who substituted prose for verse, reduced the supernatural element, and inter-pointed new comic effects. The story was introduced into England by Sir Aston Cokain in his unreadable *Tragedy of Ovid* (1669), and was the theme of *The Libertine* (1676) by Shadwell. *El Burlador* was recast, but not improved, by Antonio de Zamora early in the 18th century, and a hundred years later the character was endowed with a new name in Espronceda's *Estudiante de Salamanca*. But the most curious resurrection of the type in Spain is the protagonist in Zorrilla's *Don Juan Tenorio*, which is usually played in all large cities during the first week in November, and has come to be regarded as an essentially national work. It is in fact little more than an adaptation of the elder Dumas' *Don Juan de Marana*, which, in its turn, derives chiefly from Mérimée's novel, *Les Amies du Purgatoire*. Byron's *Don Juan* resembles Ullén's murderer in nothing but his name.

The sustained popularity of the Don Juan legend is undoubtedly due in great measure to Mozart's incomparable setting of Da Ponte's mediocre libretto. In this pulse version of *El Burlador de Sevilla* the French romantic school made acquaintance with Don Juan, and hence, no doubt, the works of Mérimée and Dumas already mentioned, Balzac's *Elisir d'une longue vie*, and Alfred de Musset's *Un Matin de Malin* and *Namouna*. The legend has been treated subsequently by Flaubert and Barbey d'Aurevilly in France, by Landau and Heyse in Germany, by Sachser Masoch in Austria and in a highly modernized form by G. B. Shaw (*Man and Superman*). It has always fascinated composers. Mozart's *Don Giovanni* has supplanted the earlier operas of Le Telher, Righini, Tritto, Gardi and Gazzaniga, but Gluck's ballet music still survives, and Henry Purcell's setting—the oldest of all—has saved some of Shadwell's lapsid lyrics from oblivion.

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DONKEY *see* Ass

DONKEY-ENGINE. A steam engine of small or moderate power which works a crane or hoist, chiefly on board ship, to handle cargo and luggage. The steam is supplied by a donkey-boiler instead of being taken from the main boilers. A donkey pump is of very compact design, and suitable for being bolted to a ship's side, a column or wall, or a boiler. It is used for feeding boilers, tanks, vats, etc., and works by the direct action of a steam driven piston on a plunger in the pump cylinder. A fly-wheel helps to maintain a steady action of the pump. The smallest pumps, of the type shown (*see* p. 530), deliver about 90 gal. per hour, and the largest 4,000.

DONKIN, SIR RUFANE SHAW (1775-1841), British soldier, son of Robert Donkin (d. 1821), joined the army at the age of 14. He was divisional commander in Hastings' operations against the Mahabats (1817-18), receiving the K.C.B. as his reward. From 1820 to 1821 he administered the Cape of Good Hope with success, and named the rising seaport of Algoa bay Port Elizabeth in memory of his wife. In 1831 he became lieutenant-general and G.C.B.

See Jordan, *National Portraits*, vol. 10; *Genickman's Magazine*, vol. 1, 273.

DONNAY, CHARLES MAURICE (1859-1945), French dramatist, was born of middle class parents in Paris in 1859. He made his serious debut as a dramatist on the little stage of the Chat Noir with *Phryne* (1891), a series of Greek scenes *Lysistrata*, a four-act comedy, was produced at the Grand Théâtre in 1892 with Mme Réjane in the title part. Later plays include *Folle Entreprise* (1894), *Pension de famille* (1894), *Amants* (1895), produced at the Renaissance theatre with Mme Jeanne Granier as Claudine Rozery, *La Donlouise* (1897), *L'Afranchie* (1898), *Georgette Lameunier* (1898), *Le Torment* (1899), at the Comédie Française, *Éducation de prince* (1900), and *Oseux*

de passion (1904), in collaboration with L. Descaves, *La Bascule* (1901) *L'Autre danger*, at the *Comedie Française* (1902), *Le Retour de Jerusalem* (1903), *L'escalade* (1904), and *Paraitre* (1906). With *Amanes* he won a great success, and the play was hailed by Jules Lemaître as the *Bertram* of contemporary French drama. The whole series of plays reflects the various questions agitating society at the time, and the witty dialogue is written

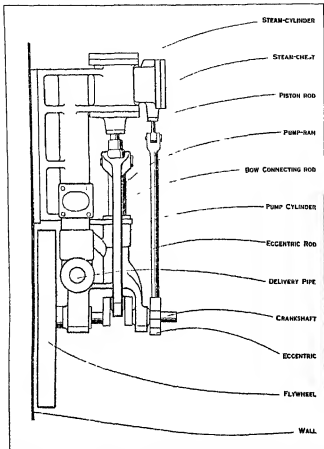


DIAGRAM OF A DONKEY PUMP. THE PUMP RAM IS WORKED DIRECT BY THE PISTON ROD OF THE STEAM CYLINDER AND THE FLYWHEEL PROVIDES A STEADY ACTION (SEE P. 529)

with an apparent carelessness that approximates closely to the language of every day. Donny died in Paris, March 31 1945.

DONNE, JOHN (1573-1631), English poet and divine of the reigns of James I., and Charles I., was born in 1573 in the parish St Nicholas Olave, in the city of London. His father was a wealthy merchant, who next year became warden of the Company of Ironmongers, but died early in 1576. Donne's parents were Catholics, and his mother, Elizabeth Heywood, was directly descended from the sister of the great Sir Thomas More, she was the daughter of John Heywood the epigrammatist. As a child, Donne's precocity was such that it was said of him that "this age hath brought forth another Pico della Mirandola." He entered Hart Hall, Oxford, Oct. 1584, and left it in 1587, proceeding, according to Walton, to Cambridge, where he remained three years. At Oxford began his friendship with Henry Walton, and at Cambridge, probably, with Christopher Brooke. Donne was "removed to London" about 1590 and in 1592 he entered Lincoln's Inn with the intention of studying the law.

When he came of age, he found himself in possession of a considerable fortune, and about the same time rejected the Catholic doctrine in favour of the Anglican communion. He began to produce *Satires*, which were not printed, but eagerly passed from hand to hand, the first three are known to belong to 1593, the fourth to 1594, while the other three are probably some years later. In 1596 Donne engaged himself for foreign service under the earl of Essex, and "waited upon his lordship"

on board the "Repulse," in the magnificent victory of the 11th of June. We possess several poems written by Donne during this expedition, and during the *Islands Voyage* of 1597, in which he accompanied Essex to the Azores. According to Walton, Donne spent some time in Italy and Spain, and intended to proceed to Palestine, "but at his being in the farthest parts of Italy, the disappointment of company, or of a wife conveys or the uncertainty of returns of money into those remote parts, damped him that happiness." There is some reason to suppose that he was on the Continent at intervals between 1595 and the winter of 1597. His lyrical poetry was mainly the result of these years, if we are to believe Ben Jonson, who told Drummmond of Hawthornden that Donne "wrote all his best pieces ere he was 25 years old." At his return to England he became private secretary to Sir Thomas Egerton, the lord keeper (afterwards Lord Chancellor Ellesmere) in whose family he remained four years. In 1600 he found himself in love with his master's niece, Anne Mote, whom he married secretly in Dec. 1601. As soon as this act was discovered, Donne was dismissed, and then thrown into the Fleet prison (Feb. 1602), from which he was soon released. His circumstances, however, were now very much straitened. His own fortune had all been spent and "troubles did still multiply upon him." Mrs. Donne's cousin, Sir Francis Wooley, offered the young couple an asylum at his country house of Pyrford, where they resided until the end of 1604.

During the latter part of his residence in Sir Thomas Egerton's house, Donne had composed the longest of his existing poems, *Of the Progress of the Soul*, not published until 1633. In the spring of 1605 we find the Donnes living at Camberwell, and a little later in a small house at Mitcham. He had by this time "acquired such a perfection" in civil and common law that he was able to take up professional work, and he now acted as a helper to Thomas Morton in his controversies with the Catholics. Donne is believed to have had a considerable share in writing the pamphlets against the papists which Morton issued between 1604 and 1607. In the latter year, Morton offered the poet certain preferment in the Church, if he would only consent to take holy orders. Donne, however, although he was at this time become deeply serious on religious matters, did not think himself fitted for the clerical life. It is probable that many, perhaps most, of his religious poems and most notably the *Holy Sonnets*, belong to the period from about 1607 to 1612, which was one of mental conflict for Donne. These exercises were not of a nature to add to his income, which was extremely small. His uncomfortable little house he speaks of as his "hospital" and his "prison", his wife's health was broken and he was bowed down by the number of his children, who often lacked even clothes and food. In the autumn of 1608, his father-in-law, Sir George More, became reconciled with them, and agreed to make them a generous allowance. Donne soon after formed part of the brilliant assemblage which Lucy, countess of Bedford, gathered around her at Twickenham, we possess several of the verse epistles he addressed to this lady. In 1609 Donne was engaged in composing his great controversial prose treatise, *Pseudo-Martyr*, printed in 1610, this was an attempt to convince Roman Catholics in England that they might, without any inconsistency, take the oath of allegiance to James I. In 1611 Donne wrote a curious and bitter prose squib against the Jesuits, entitled *Conclave Ignati*. To the period between 1602 and 1609, belongs the apology for the principle of suicide, which was not published until 1644, long after Donne's death. This work, *Euthanasiae*, is an attempt to show that "the scandalous disease of headlong dying," to which Donne himself in his unhappy moods had "often such a sickly inclination," was not necessarily and essentially sinful.

In 1610 Donne formed the acquaintance of Sir Robert Drury of Hawsted, who offered him and his wife an apartment in his large house in Drury lane. Drury lost his only daughter and in 1611 Donne published anonymously an extravagant elegy on her in two volumes, *Anniversaries*, separately entitled *The First Anniversary, An Anatomy of the World*, to which he added in 1612 *The Second Anniversary, of the Progress of the Soul*, he threatened to celebrate the "blessed Maid," Elizabeth

Drury, in a fresh elegy on each anniversary of her death, but he happily refrained from the third occasion onwards. At the close of 1611 Sir Robert Drury determined to visit Paris (but not, as Walton supposed, on an embassy of any kind), and he took Donne with him. When he left London, his wife was expecting an eighth child. It seems almost certain that his fear to have him absent led him to compose one of his loveliest poems

Sweetest Love, I do not go
For weariness of thee

He is said to have had a vision, while he was at Amiens, of his wife, with her hair over her shoulders, bearing a dead child in her arms, on the very night that Mrs. Donne, in London (or more probably in the Isle of Wight), was delivered of a still-born infant. He suffered, accordingly, a great anxiety, which was not removed until he reached Paris, where he received reassuring accounts of his wife's health. The Drurys and Donne left Paris for Spa in May 1612, and travelled in the Low Countries and Germany until September, when they returned to London. In 1613 Donne contributed to the *Lachrymae lachrymarum* of Sylvester an obscure and frigid elegy on the death of the prince of Wales, and wrote his famous Marriage Song for St. Valentine's Day to celebrate the nuptials of the elector palatine with the princess Elizabeth. About this time Donne became intimate with Robert Ker, then Viscount Rochester and afterwards the infamous earl of Somerset, from whom he had hopes of preferment at court. Donne was now in weak health, and in a highly neurotic condition. It is probable that at this time he went through a spiritual crisis which, after many misgivings on his part, ended in a determination to enter the ministry—a course which some of his friends had been urging him to adopt for no little time. At the close of 1614 the king sent for Donne to Theobalds, and "descended to a persuasion, almost to a solicitation of him, to enter into sacred orders," but Donne asked for a few days to consider. Finally, early in 1615, King, bishop of London, "proceeded with all convenient speed to ordain him, first deacon, then priest." He was, perhaps a curate first at Paddington, and presently was appointed royal chaplain.

His earliest sermon before the king at Whitehall carried his audience "to heaven, in holy raptures." In April, not without much bad grace, the University of Cambridge consented to make the new divine a D.D. In the spring of 1616, Donne was presented to the living of Keynton, in Hunts, and a little later he became rector of Sevenoaks, the latter preferment he held until his death. In October he was appointed reader in divinity to the benchers of Lincoln's Inn. His anxieties about money now ceased, but in Aug. 1617 his wife died, leaving seven young children in his charge. Perhaps in consequence of his bereavement, Donne seems to have been inspired with a peculiar fervour of devotion. His fame as a preacher, so well and nobly described by Isaac Walton in his *Life*, spread. Of the very numerous sermons preached by Donne at Lincoln's Inn, 14 have survived. His health suffered from the austerity of his life, and it was probably in connection with this fact that he allowed himself to be persuaded in May 1619 to accompany Lord Doncaster as his chaplain on an embassy to Germany. Having visited Heidelberg, Frankfurt and other German cities, the embassy returned to England at the beginning of 1620.

In Nov. 1621, James I., knowing that London was "a dish" which Donne "loved well," "carved" for him the deanery of St. Paul's. He resigned Keynton, and his preacher'ship in Lincoln's Inn (Feb. 1622). In Oct. 1623 he suffered from a dangerous attack of illness, and during a long convalescence wrote his *Devotions*, a volume published in 1624. He was now appointed to the vicarage of St. Dunstan's in the West. In April 1625 Donne preached before the new king, Charles I., a sermon which was immediately printed, and he now published his *Four Sermons upon Special Occasions*, the earliest collection of his discourses. When the plague broke out he retired with his children to the house of Sir John Danvers in Chelsea, and for a time he disappeared so completely that a rumour arose that he was dead. Sir John had married Donne's old friend, Mrs. Magdalen Herbert for whom Donne wrote two of his most ingenious poems, "The

Primrose" and "The Autumnal." The popularity of Donne as a preacher rose to its zenith when he returned to his pulpit, and it continued there until his death. Walton, who seems to have known him first in 1624, now became an intimate and adoring friend. In 1630 Donne's health, always feeble, broke down completely, so that, although in August of that year he was to have been made a bishop, the entire collapse of his health made it worse than useless to promote him. The greater part of that winter he spent at Abury Hatch, in Epping Forest, with his widowed daughter Constance Allyn, and was too ill to preach before the king at Christmas. It is believed that his disease was a malarial form of recurrent quinsy acting upon an extremely neurotic system. He came back to London, and was able to preach at Whitehall on Feb. 12, 1631. This, his latest sermon, was published, soon after his demise, as *Death's Duel*. He now stood for his statue to the sculptor, Nicholas Stone, standing before a fire in his study at the deanery, with his winding-sheet wrapped and tied round him, his eyes shut, and his feet resting on a funeral urn. This lugubrious work of art was set up in white marble after his death in St. Paul's cathedral, where it may still be seen. Donne died on March 31, 1631, after he had lain "15 days earnestly expecting his hourly change." His aged mother, who had lived in the deanery, survived him, dying in 1632.

Donne's poems were first collected in 1633, and afterwards in 1635, 1639, 1649, 1650, 1654 and 1669. Of his prose works, *Pseudomartyr* appeared in 1610, *Ignatius*, both in Latin and in English, in 1611, the *Devotions*, in 1624, the *Juvenilia* in 1633, the *LXXX Sermons* in 1640, *Bathianatos* in 1644, *Fifty Sermons* in 1649, *Essays in Divinity* 1651, his *Letters to Several Persons of Honour*, 1651, *Paradoxes, Problems and Essays* (a reprint of *Ignatius* and the *Juvenilia* with some new, and some spurious, matter), 1652, and *Six and Twenty Sermons*, 1661. Isaac Walton's *Life of Donne*, an admirably written but not entirely correct biography, preceded the *Sermons* of 1640. The principal editor of his posthumous writings was his son, John Donne the younger (1604-62), a man of eccentric and scandalous character, but of considerable talent.

The influence of Donne upon the literature of England was singularly wide and deep, although almost wholly malign. His originality and the fervour of his imaginative passion made him extremely attractive to the younger generation of poets, who saw that he had broken through the old tradition, and were ready to follow him implicitly into new fields. In the 18th century his reputation almost disappeared, to return, with many vicissitudes in the course of the 19th. The first impression of an unbiased reader who dips into the poems of Donne is unfavourable. He is repulsed by the intolerably harsh and crabbed versification, by the recondite choice of theme and expression, and by the oddity of the thought. In time, however, he perceives that behind the fantastic garb of language there is an earnest and vigorous mind, an imagination that barbores fire within its cloudy folds, and an insight into the mysteries of spiritual life which is often startling. Donne excels in brief flashes of wit and beauty, and in sudden daring phrases that have the full perfume of poetry in them. Some of his lyrics and one or two of his elegies excepted, the *Satires* are his most important contribution to literature. They are probably the earliest poems of their kind in the language, and they are full of force and picturesqueness. Their obscure and knotty language only serves to give peculiar brilliancy to the not uncommon passages of noble perspicuity.

BIBLIOGRAPHY.—Isaac Walton's *Life*, first published in 1640, and entirely recast in 1658, has been constantly reprinted. Donne's prose works have not been collected. In 1809 Edmund Gosse published in two volumes *The Life and Letters of John Donne*, for the first time revised and collected. The standard edition of Donne's *Poems* is that published in two volumes, by Professor Herbert J. C. Grierson (Oxford 1912), *A Study of Donne's Prose Works* by Evelyn M. Simpson (Oxford 1914) deals with the rest of his work and prints new letters. A full *Bibliography* by G. L. Keynes was published at the Cambridge Press in 1915.

DONNER, RAPHAEL GEORG (1693-1741), Austrian sculptor, born on May 24, 1693, at Esslingen in Lower Austria, went to Heiligenkreuz intending to take holy orders, but he was there encouraged to follow his artistic bent by the sculptor Guil-

intricately, and sometimes adding miniature buttresses and carved figures. In the smaller doors the use of the linen fold (simulating folded cloth) decoration is common. With the coming of the early Renaissance a similar kind of decoration was carried out with even greater richness, and wooden doors, in which panels crowded with figures, buttresses, simulated architectural forms and decorated mouldings give an impression of extraordinary richness are characteristic e.g., the doors of S. Maclou at Rouen, by Jean Goujon, 1540. The later Renaissance returned to more classic and simple forms. Typical are the bronze doors of the Baptistery at Florence designed by Ghiberti (1402-52). Although in the north doors he followed the Gothic scheme of Andrea Pisano's south door, in the east, despite the complexity and beauty of the figure decoration, the scheme is rigidly rectangular. The use of rectangular or square panels remained constant throughout the Italian Renaissance, but in France, from the time of Henry IV on, doors became more and more fantastic, culminating in those of the time of Louis XIV and Louis XV, with their curved beaded panels and double or triple mouldings.

In Muslim doors the enormous skill in elaborate wood framing possessed by Mohammedan carpenters finds congenial expression and the most intricate panelled types, with star shaped and polygonal panels, are common. Frequently additional decoration is given by complicated pierced and cut out metal mountings, some of which similar mountings ornament the corners of the temple doors of China and Japan. These doors are usually of two panels, the lower solid, the upper filled with elaborate grill work in wood, either based on hexagonal patterns and triangles or an intricate network of straight lines of varying angles and lengths, over which paper is pasted in lieu of glass. In Japanese houses doors are usually sliding and may have the same pattern as the walls.

Modern wooden doors continue the traditional panel type. In construction, however, solid doors are more and more giving place to those in which a core of small pieces of soft wood is covered by sheets of veneers, enabling the occasional abandonment of panel and the making of flush doors which are commonly used in hospitals. Another characteristic modern development has been the tremendous increase in the number and variety of metal doors in connection with fire proof construction. These are of two types: metal covered or kalamein, in which a core of wood is covered with metal sheets, carefully soldered and locked to gether, and hollow metal, in which a frame of structural metal sections is encased with metal plates. In both of these types, for structural reasons, the panel design is usually perpetuated, but flush pattern hollow metal doors are becoming more and more common. The use of top and bottom pivots instead of hinges is frequent in exterior doors, particularly where there are several doors in a row, in order to avoid vertical bars or mullions between them. Elaborate mechanical development of all types of locks, hinges, pivots, door checks and door closers is noteworthy. (See DOORWAY.)

(T F H)

DOORWAY, in architecture, the entrance of a building, room or enclosure, especially the framing of such an opening. In primitive construction with brick or rubble, opening frames were usually of wood, and consisted of uprights or jambs on each side, and lintels or heads at the top. Such doorways occurred in the archaic work in Greece, and evidences of wooden frames exist in Tyrins from about the 13th century B.C. and in the Heraeum at Olympia, where the early, crude arrangement was preserved all through. In wooden framed buildings the lintel is usually framed between the uprights which continue up beyond it. Examples of this arrangement are represented in certain Egyptian mastaba tombs of the second, third and fourth dynasties. Where building is all in cut stone, no separate door frame is necessary, but decorative lines are, nevertheless, frequently carried around the opening, as a legacy from other and earlier types of building.

In Egyptian work, although the doorway jambs are not indicated, and the banding of the cut stone wall is frequently carried, unbroken, straight to the opening, the head was expressed by means of a projecting cornice. This cornice was of the usual *cavetto* or concave type, and often carried a decoration in the centre, formed of the winged globe symbolizing the sun. In some

of the doorways in the stone screen walls of later Egyptian temples it was necessary for the door opening to be carried up higher than the height of the screen, to allow banners and the sacred boats to be carried through in processions. In order to accomplish this and still preserve the doorway form, the head was not complete and was formed merely by stones with small projections inward from the jambs, ornamented, however, like the complete lintels, as in the famous Ptolemaic temple at Edfu (237 to 57 B.C.).

In archaic Etruria as well as in Greece doorways were frequently smaller at the top than at the bottom, in order to lessen the length of the lintel, and apparently in both countries, at nearly the same time, the idea occurred of decorating the jambs and lintel by means of a continuous moulding, running up the sides and across the top. As the lintel was frequently longer than the combined width of opening and jamb stones, and the moulding was cut round the outside, projections in the architrave or moulding were formed at the level of the lintel. These are called keys or *cronettes*. Examples of this occur in the Beule gateway of the Acropolis at Athens, in many Etruscan tombs from the 7th to the 5th century B.C., and in the temple of Hercules at Corn (72 B.C.). In the Etruscan examples the lintel keys are sometimes further decorated by down-curving pendants. In the developed classic treatment the moulding around the jamb and heads is treated as an architrave, usually with two or three bands and a raised moulding on the outside. Frequently a frieze and cornice are added, sometimes with consoles (*q.v.*), which are always set on the outside of the architrave moulding, as in the doorway of the Erechtheum (*q.v.*) at Athens, completed 408 B.C., and in the colossal doorway of the temple of Jupiter at Baalbek (c. A.D. 120) which is 20 ft. wide and 45 ft. high. The doorway of the Pantheon at Rome (A.D. 110-125), of the same width, still possesses the original Roman bronze door frame, door and transom screen.

In both the Romanesque and Gothic periods church doorways were among the most characteristic features of the styles. They were formed by means of an elaborate series of recesses in the thickness of the wall, usually in steps or orders, which ran not only up the sides, but also in an arch over the top, leaving a lunette (*q.v.*) or *tympanum* (a section of vertical wall) between the under side of the arch and the horizontal head of the door opening. These steps or orders were ornamented with mouldings, carvings and sculpture, occasionally columns were placed at the side. In Gothic work statues often take the place of columns, and bands of angels, under little canopies (*q.v.*), encircle the arch between the mouldings. The *tympanum* and door lintel are also richly sculptured, and there is often a central pier dividing the door opening in two, frequently carrying a statue, especially in the Gothic. A moulding projecting from the wall surface and called a drip or hood mould frequently surrounds the entire arch.

In the Renaissance period doorway design returned to generally classic lines. In the early Renaissance, however, classic motives of great complexity were used for doorway decoration in a manner far different from the usual Roman or Greek precedent. Colonnets, gables (half figures used as supports), pediments and arches with decorated lunettes are common, especially fantastic are the examples found in the transitional Renaissance of Germany, France and England. With increasing knowledge of classic detail more sober treatments prevailed. The use of columns and pilasters with pediments remained general. During the baroque period these basically classic motives received the typical fantastic and imaginary treatment. Noteworthy among these later Renaissance doorways are those of England and America in the late 18th and early 19th centuries, in which side-lights at each side of the door and a fanlight above, often with rich decorative leading, are all enclosed in a single doorway frame.

In Muslim countries doorways achieve enormous importance, the door itself being often merely an incident in a rich composition running the entire height of the wall. This usually takes the form of an arched niche or recess, sometimes crowned with a stalactite vault, sometimes simply a high pointed arch, as in the magnificent tile lined mosque doorways of Persia.

Chinese and Japanese doorways are commonly simple, the type of timber framing allowing little decorative treatment. Occa-



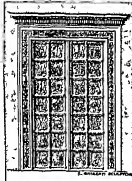
AMERICAN COLONIAL
TAVERN ALEXANDRIA VA
In Metropolitan Museum, N. Y.



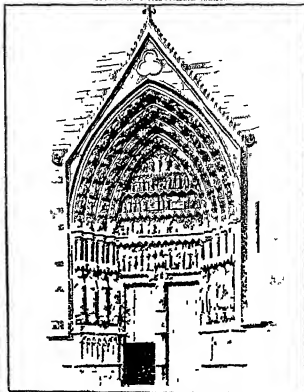
MODERN GERMAN
CHILE HAUS (AN OFFICE BUILDING) HAMBURG



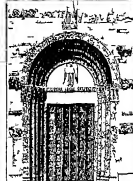
CHINESE
SUMMER PALACE PEKING



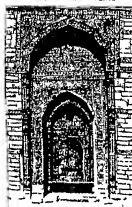
EARLY ITALIAN RENAISSANCE
FROM BAPTISTERY FLORENCE



FRENCH GOTHIC
SOUTH TRANSEPT DOORWAY AMIENS CATHEDRAL



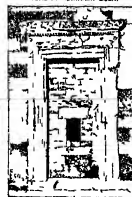
ITALIAN LOMBARD ROMANESQUE
SAN MICHELE PAVIA



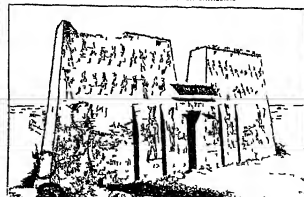
INDIAN MAHOMEDAN
TOMB OF ALTANAH DELHI



TURKISH
MOSQUE OF RUSTEN PASHA
CONSTANTINOPLE



ANCIENT GREEK
ERECHTHEION ATHENS



ANCIENT EGYPTIAN
TEMPLE AT EDFU



ANCIENT ROMAN
PANTHEON ROME

MODERN GERMAN CHILE HAUS BY COURTESY OF THE GERMAN RAILROADS INFORMATION BUREAU; INDIAN MAHOMEDAN TOMB BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIP COMPANY

arched doorways with ornamented lunettes are found in gites, temples or palaces, especially in northern China. Through the art nouveau movement of the '90s give rise to fantastic doorway schemes the general modernist trend is a return to simplicity. Exceptions are, however, frequent certain modernist doorways, particularly of commercial build, are rich with carved ornament. (See ARCHITECTURAL ART, ARCHITECTURE, BYZANTINE AND ROMANESQUE ARCHITECTURE, CONSOLE, DOOR.)

DOPE, any thick liquid or semiliquid, paste preparation or ture used as a sauce, lubricant, etc. The term was used in a lubricant in the United States in 1876 in the *Virginia City Editorial Enquirer* (Nev.) "Nothing was known of the tenses of 'dope'—a preparation of pitch which being applied to bottom of the shoes enables the wearer to glide over snow ened by the warmth of the sun."

ope is also the absorbent material—mud, sawdust vegetable ribent, etc.—which is used to hold and absorb a liquid in cer manufacturing processes, e.g., making high explosives. Abent dope such as greasy cotton waste is packed round the s of railway cars to reduce friction.

eronautics, dope is any of various varnishlike products h are applied to fabric surfaces of aeroplanes to make them t, strong, waterproof, etc. It is also the material applied to fabric of a balloon to reduce gas leakage.

U.S. slang the term refers to a drug, especially a harmful hich is taken by a narcotics addict. In slang slang it is a drug given to a race horse to stimulate it temporarily so means advance and confidential information or forecast id on such information or data. It is a slang expression for apid person. Used as a verb, it means "to stupefy with a drug" also to work out or infer a solution, project, plan, etc. The United States the term is used in the jargon of photog y for a preparation which consists chiefly of cellulose deriva s in solution and is used to make the transparent back of a tive film, dope is also a liquid varnish used in retouching tives. Fuel dope is a material added to gasoline to improve performance of the engine.

he word is apparently derived from the Dutch *doop* which ns sauce, drippings, etc.

OPPER, CORNELIS (1870–1939), Dutch composer and ductor, was born at Stads kanaal, near Groningen, on Feb. 7, 1870. He studied at the Leipzig conservatory, 1887–90. After lecturing operas in Holland and the United States, he became stant conductor to Willem Mengelberg at the *Concertgebouw*, sterdam, in 1908.

opper composed seven symphonies, including *Rembrandt* 2), *De Amsterdamsche* (no. 6) and *Zuiderzee-Symphonie* 7). His composition for orchestra *Canzona Gothica* (1910) me well known outside his own country. He also wrote sev operas and choral works. He died in Amsterdam on Sept. 18, 1939.

OPPLER, ALBERT FRANZ (1821–1883), Austrian poser and flutist, was born at Lemberg on Oct. 16, 1821. His er, who later was an obstet in Warsaw and Vienna, gave him first instruction in music. After making his debut in Vienna, went on several concert tours with his younger brother Karl ipler (1815–1900), who under his father and brother became accomplished flutist at a very young age. Albert Doppler be e first flutist at the Pest theatre, Hungary, where in 1847 his opera *Benvenuto* was performed. He went to Vienna in 1858 became first flutist in the orchestra of the Vienna opera. He also assistant conductor of the ballet and later became the ductor. In 1865 he was named professor of flute at the Vienna servatory. His works include the operas *Ilko*, *Afanasia*, *nda*, *Salvator Rosa*, *Die beiden Husaren*, *Judit*, a comic et, *Margot* (Berlin, 1891), and many overtures and compo ns for the flute. He died at Baden, near Vienna, on July 27, 1883.

arl Doppler was conductor at the National theatre, Pest, and he Hofoper in Vienna, 1862–65, and *Hofkapellmeister* in Stutt., 1865–98. He wrote the opera *Erzabeth* with his brother and

Frnz Erkel and also wrote several Hungarian operas, ballets, and flute pieces. He died at Stuttgart on March 10, 1900.

DOPPLER, CHRISTIAN JOHANN (1803–1853), Austrian physicist, was born at Salzburg, on Nov. 20, 1803. He was educated at Salzburg and Vienna, and became, in 1850, director of the Physic Institute and professor of experimental physics at Vienna. He died at Venice on March 17, 1853. Doppler's earliest writings were on mathematics, but his name is associated with his work in physics. In 1812 he published a paper "Über des farbige Licht der Doppelsterne" which contained what is now known as Doppler's principle (see LIGHT 1803 and Interference). He drew the analogy between the sound coming from a moving source and the light coming from a moving star, i.e. the pitch of sound from a moving source varies, so Doppler thought the colour of the light from a star would be altered.

The principle was verified experimentally for sound by C. H. D. Buys Ballot in 1845, but the correct explanation in the optical case was given by Armand Fizeau in 1858.

Doppler's principle is applied to the motion of stars in the light of sight and is used for the discovery of double stars (see STAR).

DOPPLER EFFECT, the change in the observed frequency of a vibration owing to relative motion between the observer and the source of the vibration. In sound (*q.v.*) this effect is an everyday experience, e.g., when a ringing bell is passed at any speed above about 10 m.p.h. the pitch of the note suddenly sounds lower.

The Doppler effect for light waves is evident in spectroscopy (*q.v.*, see also LIGHT 1803 and Interference).

DOPPLERITE, a naturally occurring organic substance found in amorphous, elastic or jellylike masses, of brownish-black colour, in peat beds in Styria and in Switzerland. It is tasteless, insoluble in alcohol and ether, and is described by Dana as an acid substance, or mixture of different acids, related to humic acid.

DORAN, JOHN (1807–1878), English author, was born in London of Irish parentage on March 11, 1807. He became a tutor with several distinguished families, and while travelling on the continent contributed journalistic sketches to *The Literary Chronicle*, a paper which was afterward incorporated with *The Athenaeum*. His play *Justice or the Venetian Jew* was produced at the Surrey theatre in 1824, and in 1830 he began to write translations from French, German, Latin and Italian authors for *The Bath Journal*. After some years of travel on the continent, he became in 1841 literary editor of *The Church and State Gazette*, and in 1852 under the title of *Filia dalorosa* produced a memoir of Maria Thérèse Charlotte, duchesse d'Angoulême. Two years later he became a regular contributor to *The Athenaeum*. He succeeded Hepworth Dixon as editor of *The Athenaeum* for a short time in 1869, until he became editor of *Notes and Queries* in 1870. His most elaborate work, *Their Majesties' Servants*, a history of the English stage from Thomas Betterton to Edmund Kean, was published in 1860, and was supplemented by *In and About Drury Lane*, which was written for *Temple Bar* and was not published in book form until 1885. Among his other works may be mentioned *Table Traits and Habits of Men* (1854), *The Queens of the House of Hanover* (1855), *Knights and their Days* (1856), *Monarchs retired from Business* (1856), *The History of Court Fools* (1858), an edition of the *Bentley Ballads* (1858), *The Last Journals of Horace Walpole* (1859), *The Princess of Wales* (1860), and *Memoirs of Queen Adelaide* (1861). These were followed by *A Lady of the Last Century* (1873), an account of Elizabeth Montagu and the blue stockings, *London in the Jacobite Times* (1871), and *Memoirs of our Great Towns, with Anecdotic Clearings concerning their Writings and their Oddities* (1878), a humorous work. Doran was married to Emma Gilbert, the daughter of a captain in the royal navy, at Reading, Berks, on July 3, 1834. He died in London on Jan. 25, 1878, and was survived by two children, Alban Doran, an only son, and Florence, an only daughter, who was married to Andreas Holtz of Twyford Abbey, near Ealing, Middlesex.

See *The Times*, Jan. 28, 1878, *Illustrated London News*, Feb. 9, 1878, and *Annual Register* (1878).

DORAT, CLAUDE JOSEPH (1734-1780), French man of letters, was born in Paris. He obtained a great vogue by his *Repons, d'Abolard à Heloise*, and followed up this first success with a number of heroic epistles, *Les Victimes de l'Amour*, ou *lettres de quelques écrivains célèbres* (1776). Besides light verse he wrote comedies, fables and novels. He was mad enough to draw down on himself the hatred both of the philosophic party and of their arch enemy, Charles Palissot, and thus cut himself off from the possibility of academic honours. *Le Tartuise littéraire* (1777) attacked La Harpe and Palissot, and at the same time D'Alembert and Mlle de Lespinasse. Dorat died in Paris on April 29, 1780.

See his *Oeuvres complètes* (20 vols., 1764-80), G. Desnoiretères, *Le Chevalier Dorat et les poètes légers au XVIII^e siècle* (1887). For the bibliographical value of his works, see Henry Cohen, *Guide de l'amateur de livres à figures et à vignettes du XVIII^e siècle* (editions of Ch. Méhl, 1876, and R. Postals, 1887).

DORCHESTER, DUDLEY CARLETON, Viscount (1573-1632), English diplomatist, son of Antony Carleton of Baldwin Brightwell, Oxfordshire, was born on March 10, 1573, and educated at Westminster school and Christ Church, Oxford, where he graduated M.A. in 1600. As secretary to the earl of Northampton his name was associated with the Gunpowder Plot, but he succeeded in clearing himself. In 1610 he was knighted and was sent as ambassador to Venice, where he concluded the Treaty of Asti. In 1616 he was appointed ambassador to Holland. In his house at The Hague the unfortunate Elector Frederick and the princess Elizabeth took refuge in 1621. Carleton returned to England in 1625 with the duke of Buckingham, and was made vice-chamberlain of the household and a privy councillor. After an abortive mission to France he returned in 1626 and sought in the House of Commons (he had been a member since 1604) to defend his patron, the duke of Buckingham. Created Baron Carleton of Imbercourt, and, after another mission to The Hague, Viscount Dorchester (1628) he supported the conferences between Buckingham and Contarini for a peace with France on the eve of the duke's intended departure for La Rochelle, which was prevented by Buckingham's assassination. In December 1628 he was made principal secretary of State, and died on Feb. 15, 1632.

His voluminous correspondence, remarkable for its clear, easy and effective style and for the writer's grasp of the main points of policy, covers practically the whole history of foreign affairs during the period 1610-1628, and furnishes valuable material for the study of the Thirty Years' War. His letters as ambassador to The Hague, Jan. 1626 to Dec. 1630, were first edited by Philip Yorke, afterwards second earl of Hardwicke, with a biographical and historical preface in 1757, his correspondence from The Hague, in 1627 by Sir Thomas Phillips in 1851, other letters in printed in the *Cabala* and in *The Court and Times of James I. and Charles I.* but by far the greater portion remains in manuscript in the State papers.

DORCHESTER, GUY CARLETON, 1st Baron (1724-1808), British general and administrator, was born at Strabane, Co. Tyrone, Ireland on Sept. 3, 1724. He served in 1759 in America as quartermaster-general, under his friend Wolfe. He was wounded at the capture of Quebec and promoted to the rank of brigadier-general. From 1766 to 1778 he was governor-general of Canada. His justice and kindness greatly endeared him to the recently conquered French Canadians, and did much to hold them neutral during the War of American Independence. He ordered the first codification of the civil law of the province, and was largely responsible for the passing of the Quebec Act. On the American invasion of Canada in 1775 he was compelled to abandon Montreal and narrowly escaped capture, but defended Quebec (q.v.) with skill and success. In October of the same year he destroyed the American flotilla on Lake Champlain. In 1777 he was superintended in his command of the military forces by Maj. Gen. John Burgoyne, and asked to be recalled. He returned, however, to America in May 1782 as commander-in-chief, remaining till November 1783. In 1786 he was again sent to Canada as governor-general and commander of the forces, with the title of Baron Dorchester. Many important reforms marked his rule, he kept the country loyal to the British crown amid the ferment caused by the French Revolution. In 1791 the province was divided into Upper and Lower Canada by the Constitutional Act. Of this

division Carleton disapproved, as he did also of a provision tending to create in the new colony an hereditary aristocracy. In 1796 he insisted on retiring. He died in England on Nov. 10, 1808. On the death in 1897 of the 4th baron (a grandson) the title became extinct, but was revived in 1899 for his cousin and co-heiress Henrietta Anne as Baroness Dorchester.

See J. C. Dent, *Canadian Portrait Gallery* (Toronto 1880), A. G. Bradley, *Life of Guy Carleton Lord Dorchester* (1907). Most of his letters and state papers are calendared in Brynmor's *Reports on Canadian Archives* (Ottawa, 1885, seq.).

DORCHESTER, a market town and municipal borough and the county town of Dorsetshire, England, in the Western parliamentary division, 13½ mi. WSW from London by the SR and also served by the Weymouth section of the GW Ry. Pop. (est. 1938) 10,230. Area 2.6 sq. mi. It stands on an eminence on the right bank of the river Frome, within a wide open tract of beautiful views, 6 mi. N of the English channel at Weymouth bay. St. Peter's church is a Perpendicular building with a fine tower. All Saints and Holy Trinity churches were rebuilt in the last century, but St. George's, Fordington, retains Norman and Transitional details. Of public buildings the principal are the town hall, market house and corn exchange, shire hall, the interesting county museum, the county hospital and the former county, now government, prison. The grammar school, in modern buildings, was founded in 1569. A statue to Thomas Hardy, the poet and novelist, was unveiled in 1931. There is also a statue to William Barnes, the Dorsetshire poet (1801-1886). Hardy was born near Dorchester, which is the "Casterbridge" of the Wessex novels. A room containing part of his study and other memorabilia was opened in the museum in 1939. The town is noted also for its ale. It is a place of considerable agricultural trade, and large sheep and lamb fairs are held annually.

Durnovaria, at the intersection of a number of Roman roads, was a Romano-British country town of considerable size, probably successor to a British tribal centre of the Durotriges. The walls can be traced in part, and many mosaics, remains of houses, etc., have been found. The notable remains of a Roman amphitheatre, seen at Maumbury Rings, near the town. Maiden castle, on a hill 2 mi. SW, is a vast earthwork encircled by gigantic entrenchments and ramparts, the whole occupying 120 ac. Excavations in 1934 indicated that the hill was the site of an important town in Iron Age times. Another smaller encampment is at Poundbury close by, and barrows and numerous other remains have been found in the vicinity. Little mention of Dorchester (*Dorcestre*, *Dorcestre*) occurs in Saxton annals, but a charter from Aethelstan to Milton abbey in 939 is dated at *villa regalis quae dicitur Dorcestria*, and at this period it possessed a mint. According to the Domesday survey it was a royal borough and had contained 172 houses, of which 100 had been totally destroyed since the conquest. Mention is made of a castle at Dorchester in records of the 12th and 13th centuries, and the Franciscan priory, founded some time before 1331, is thought to have been constructed out of its ruins. The latter was suppressed among the lesser monasteries in 1536. Edward II granted the borough to the bailiffs and burgesses at a fee farm rent of £20 for five years.

The first charter of incorporation, granted by James I. in 1610, established a governing council, which Charles I. in 1629 enlarged, while also incorporating the freemen of the borough with power to make laws for the regulation of the markets and trade. Dorchester returned two members to parliament from 1295 until the Representation of the People act (1868) reduced the number to one, in 1885 the representation was merged in the county. Edward III granted to the burgesses the perquisites from three fairs, and three weekly markets. Elizabeth granted an additional three days' fair at Cudlemas. Markets are now held on Wednesdays and Saturdays and fairs in February, May, July, August, October and November. The cloth industry which flourished during the 16th century never recovered from the depression following the Civil War. The malting and brewing industries came into prominence in the 17th century when there was also a considerable serge manufacture, which has since declined.

DORCHESTER, a large village in the Henley parliamentary division of Oxfordshire, England, 9 mi. SSE of Oxford by road,

on the west bank of the river Thame, 1 mi. from its junction with the Thames. Pop. of civil parish (1931) 774. At Duke hill close to the present village there was a Roman station, and facing across the Thames, the double isolated mound known as Wittenham Clumps (historically *Smodon*), is the site of ancient earthworks. In Dorchester itself the chief point of interest is the abbey church of St Peter and St Paul. This consists of a nave of great length, primarily of the transitional Norman period, a choir with arcades of the finest Decorated work, north choir aisle of the close of the 13th century, south choir aisle (c. 1300) and south nave aisle (c. 1320). The tower (western) is an erection of the late 17th century. The eastern bay of the choir is considered to have been added as a Lady chapel, and the north window is a magnificent example of a "Jesse window," in which the tracery represents the genealogical tree of Jesse, the complete execution of the design being carried on in the glass. The ancient sedilia and piscina are very fine. The Decorated windows on the south side of the church form a beautiful series, and there are early monuments and brasses of great interest.

Dorchester (*Dorcama*, *Dorchestre*, *Dorchestre*) was conquered by the West Saxons about 560. It occupied a commanding position at the junction of the Thames and the Thame, and in 635 was made the seat of a bishopric which at its foundation was the largest in England, comprising the whole of Wessex and Mercia, Birinus, apostle of the West Saxons, becoming its first bishop. The witenagemot of Wessex was held at Dorchester three times in the 9th century, and in 958 Aethelstan held a council here. In the 11th century the town is described as small but remarkable for the majesty of its churches, and c. 1086 the bishop's stool was removed to Lincoln by Remigius, the 23rd bishop. According to Domesday, Dorchester was held by the bishop of Lincoln. In 1140 Alexander bishop of Lincoln founded the abbey of Black Canons at Dorchester, of which the only remains are the abbey church. The town declined in importance after the removal of the cathedral, but in 1939 it was made a see suffragan to Oxford.

DORCHESTER, a residential and manufacturing district of Boston, Massachusetts, U.S.A., a separate town until 1870, between the Neponset river on the south and South Boston and Boston proper on the north. A ridge, with an average height of about 100 ft. above the sea, extends through the district from north to south and commands delightful views of Boston bay to the east and of the Blue hills to the south.

The Robert Pierce house, built in 1640, stands on its original site on Oakton avenue, and is one of Dorchester's landmarks. The Barnard Capen house, built about the same time, was moved to Milton. The James Blake house (1648) maintained by the Dorchester Historical society, has a library and a museum.

Not far away is the old Dorchester burying ground, which dates from 1634, it has many curious epitaphs, and contains the graves of Barnard Capen, who died in 1638 (probably the oldest marked grave in the United States), of William Stoughton (1631-1701), chief justice of the court which tried the Salem "witches" in 1692, and founder of the original Stoughton hall, Harvard, and of Rich and Mather.

Dorchester was founded by about 140 colonists from Dorsetshire, England, with whom the movement for planting the colony in Massachusetts Bay was begun under the leadership of Rev John White. They organized as a church while at Plymouth, England, in March 1630, then embarked in the ship "Mary and John," arrived in Boston bay two weeks before Governor Winthrop with the rest of the fleet, and in June selected Savin Hill as the site for their settlement. At the time the place was known as Mattapanock, but they named it Dorchester. In Oct. 1633, a town Government was organized, and the example was followed by the neighbouring settlements, this seems to have been the beginning of the town meeting form of government in America. Up to this time Dorchester was the largest town in the colony, but dissatisfaction arose with the location (Boston had a better one chiefly on account of the deeper water in its harbour), and in 1635-37 many of the original settlers removed to the valley of the Con-

necticut where they founded Windsor. New settlers, however, arrived at Dorchester and in 1639 that town established a school supported by a public tax, this was the first free school in America supported by direct taxation or assessment on the inhabitants of a town. It was the fortification of Dorchester Heights, under orders from Gen. Washington, on the night of March 4-5, 1776, that forced the British to evacuate Boston.

See W. D. Orcutt, *Good Old Dorchester* (Cambridge, 1893), and The Dorchester Book (Boston, 1899).

DORDOGNE, an inland department of south-western France, formed in 1790 from nearly the whole of Périgord, a part of Agenais, and small portions of Limousin and of Angoumois. Area 3,561 sq. mi. Pop. (1946) 387,643. It is bounded N. by Haute-Vienne, W. by Charente, Charente Maritime and Gironde, S. by Lot-et-Garonne, and E. by Lot and Corrèze. Situated on the western slopes of the Massif Central, Dordogne consists in the north-east and centre of sterile plateaus sloping towards the west, where they end in a region of pine forests known as the Double. The greatest altitudes are found in the highlands of the north, where many points exceed 1,300 ft. in height. Many beautiful river valleys, of the Dordogne, the Isle, with the Dronne and the Auvézère, and the Vézère converge towards the southwest of the department. The climate is mild, but rather humid, especially in the north-east. Agriculture prospers in the south and south-west of the department, especially in the valleys of the Dordogne and Isle, but the rest of its surface is covered to a great extent by woods and heath. Pasture and fowling amply suffice for the raising of large flocks and herds. The vine, cultivated mainly in the neighbourhood of Bergerac, and tobacco are important sources of profit. Wheat and maize are the chief cereals and potatoes are largely grown. The truffles of Périgord are famous for their abundance and quality. The plum and cider-apple yield good crops. In the forests the prevailing trees are the oak and chestnut. The chestnuts are much used as food by the people and for fattening hogs, reared in large numbers. The walnut is extensively grown for its oil. The cement, mill-stone, peat, potter's clay and fireclay. The leather industry and the preparation of preserved foods are important, and there are brick and tile works, earthenware manufactures and iron works. Exports consist of truffles, wine, chestnuts and other fruit, live stock, poultry and minerals of various kinds. Dordogne is served by the Orleans railway, the Dordogne, the Isle and the Vézère furnish nearly 200 mi. of navigable waterway. It is divided into the four arrondissements of Périgueux, Bergerac, Nontron and Sarlat, with 47 cantons and 587 communes, and belongs to the ecclesiastical province of Bordeaux, to the académie (educational division) of Bordeaux and to the region of the XII army corps, which has its headquarters at Limoges. Its court of appeal is at Bordeaux.

Périgueux, the capital, and the other principal towns are treated in separate articles. Bourdellès has two finely preserved châteaux, one of the 14th century, with an imposing keep, the other in 16th century Renaissance. Both buildings are contained within the same fortified enceinte. The château of Biron (17th century and later) has a beautiful chapel of late Gothic and early Renaissance workmanship. The château of Jumilhac-le-Grand is of the 15th century. Dordogne possesses several mediaeval *bastides*, the most perfect of which is Monpazier. At Cadouin there are the remains of a Cistercian abbey. Its church is a fine Romanesque building, while the cloister is excellent Flamboyant. St Jean-de-Côle has an interesting Romanesque church and a château of the 15th, 16th and 18th centuries. In the rocks of the valley of the lower Vézère there are prehistoric caves of great importance for the study of Palaeolithic man. Troglodytic dwellings are to be found in many other places in Dordogne.

DORDOGNE, a river of central and south-western France, rising at a height of 5,640 ft. on the Puy-de-Saucy, a section of the volcanic core of the Plateau Central in the department of Puy-de-Dôme, and flowing to the Gironde, with which it unites at Bec d'Ambès to form the Gironde estuary. It has a length of 295 m. and the area of its basin is 9,214 sq. miles. The Dordogne is a good example of a consequent stream of the

western section of the Plateau Central. In its course it cuts across a large number of geological formations, as do its two great right bank tributaries, the Vézère and the Isle. The Dordogne descends rapidly from its source and enters deep gorges as it flows through the Archaean plateau-country, rich in granites, until it reaches Beaulieu (département of Corréze) where it enters a wide fertile valley and is joined by the Cère. Entering the département of Lot, it abandons a south westerly course for a westerly course. It now flows through limestone country, often in gorges with the Causses above on both sides. It traverses the département of Dordogne, where it receives the Vézère. The lower course of the latter is through a calcareous country, and its many caves have made it classic ground for the study of Palaeolithic man. Below the town of Bergerac the Dordogne enters the département of Gironde, and is joined by the Isle at Labourne. The river is some 3,300 yd wide at its union with the Garonne, 45 m from the sea. In its lower course it flows over Tertiary material. There are important bridges at Cubzac-les-Ponts. There is much river traffic after the confluence with the Vézère over the last 112 m of its course. The estuary of the Gironde is one of the most conspicuous features of the western coast of France, and the highest tides ascend the Dordogne as far as Pessac, a distance of approximately 100 m from the ocean.

DORDRECHT (abbreviated *Dordt* or *Dort*, old name THURDRECHT), in the province of South Holland, Holland, and a junction station 12½ mi SE of Rotterdam. It is connected with Papendrecht and Zwijndrecht on the opposite shore. Pop. (1940) 62,007. Dordrecht was founded by Count Dirk III of Holland in 1018, becoming a town about 1200. One of the first towns in the Netherlands to embrace the reformed religion and to throw off the yoke of Spain, it was in 1572 the meeting place of the deputies who asserted the independence of the United Provinces. In 1618 and 1619 it was the seat of the synod of Dort (*q.v.*). It fell to German troops in 1940.

Dordrecht presents a picturesque appearance with its busy quays and numerous canals and windmills, its quaint streets and curiously gabled houses. The Groote Kerk, of Our Lady, with a massive tower, dates from the 14th century and contains some finely carved stalls (1540) by Jan Terveen Aertsz, and a remarkable pulpit (1759). In the town museum is an interesting collection of paintings, including pictures by some of the old masters, some of whom were natives of Dordrecht. Close to the museum is one of the old city gates, rebuilt in 1618, and now containing a collection of antiquities belonging to the Oud Dordrecht Society. The harbour of Dordrecht still has a large trade, but much has been diverted to Rotterdam. Large quantities of wood are imported from Germany, Scandinavia and America. There are numerous saw mills, shipbuilding yards, sugar refineries, etc.

DORÉ, PAUL GUSTAVE, (1832–1883), French artist, the son of a civil engineer, was born at Strasbourg on Jan. 6, 1832, and died in Paris on Jan. 23, 1883. In 1848 he came to Paris and secured a three years' engagement on the *Journal pour rire*. His facility as a draughtsman was extraordinary, and among the books he illustrated in rapid succession were Balzac's *Contes drolatiques* (1855), Dante's *Inferno* (1861), *Don Quixote* (1863), *The Bible* (1865), *Paradise Lost* (1866), *The Fables of La Fontaine* (1867), and the works of Rabelais (1873). He painted also many large and ambitious compositions of a religious or historical character, and had some success as a sculptor. Doré's illustrations had a great popular success over a long period of years, especially in England and America. See W. B. Jerrold, *Life of Gustave Doré* (1891).

DORIA, ANDREA (1466–1560), Genoese *condottiere* and admiral, was born at Oneglia of an ancient Genoese family. Being left an orphan at an early age, he became a soldier of fortune, and served first in the papal guard and then under various Italian princes. But it was as a naval captain that he became famous. For several years he scoured the Mediterranean in command of the Genoese fleet, waging war on the Turks and the Barbary pirates. In the meanwhile Genoa had been recaptured by the French, and in 1522 by the Imperialists. But Doria now veered round to the

French or popular faction and entered the service of King Francis I, who made him captain general. In 1524 he relieved Marseilles, which was besieged by the Imperialists, and helped to place his native city once more under French domination. But Francis was mean about payment, and he resented the king's behaviour in connection with Savona, which he delayed to hand back to the Genoese as he had promised, consequently on the expiry of Doria's contract we find him in the service of the emperor Charles V (1528). He ordered his nephew Tullipino, who was then blockading Naples in concert with a French army, to withdraw, and sailed for Genoa, where he expelled the French once more and re-established the republic under imperial protection. He reformed the constitution in an aristocratic sense, and put an end to the factions which divided the city. He refused the lordship of Genoa and even the dogship, but exercised predominant influence in the councils of the republic until his death. He was given two palaces, many privileges, and the title of *Liberator et Pater Patriae*. As imperial admiral he commanded several expeditions against the Turks, capturing Corona and Patras, and co-operating with the emperor himself in the capture of Tunis (1535). Charles found him an invaluable ally in the wars with Francis, and through him extended his domination over the whole of Italy. Doria's defeat by the Turks at Preveza in 1538 was said to be not in voluntary, and designed to spite the Venetians, whom he detested. He accompanied Charles on the ill-fated Algerian expedition of 1541, of which he disapproved, and by his ability just saved the whole force from complete disaster. For the next five years there was hardly an important event in Europe in which he had not some share. After the peace of Crepy between Francis and Charles in 1544 he hoped to end his days in quiet. But he had many enemies, and in 1547 the Plesco conspiracy to upset the power of his house took place. His nephew Giannettino was murdered, but the conspirators were defeated, and Andrea showed great vindictiveness in punishing them. He was implicated in the murder of Pier Luigi Farnese, duke of Parma (see FARNESI), who had helped Plesco. Other conspiracies followed, of which the most important was that of Giulio Cibo (1548), but all failed. Doria successfully opposed the emperor Charles's repeated attempts to have a citadel built in Genoa and garrisoned by Spaniards, neither blandishments nor threats could win him over to the scheme. Nor did age lessen his energy, for in 1550, when eighty-four years old, he again put to sea to punish the raids of his old enemies the Barbary pirates, but with no great success. War between France and the Empire having broken out once more, the French seized Corsica, then administered by the Genoese Bank of St. George, Doria was again summoned, and he spent two years (1553–1555) in the island fighting the French with varying fortune. He returned to Genoa for good in 1555, and gave over the command of the galleys to his great-nephew Giovanni Andrea Doria. Andrea Doria died on Nov. 25, 1560, leaving his estates to Giovanni Andrea. The family of Doria Pamphili-Landi (*q.v.*) is descended from him and bears his title of prince of Melfi. Doria was a man of indomitable energy and a great admiral. If he appears unscrupulous and even treacherous he did but conform to the standards of 16th century Italy.

See E. Petit, *André Doria* (Paris, 1887) which is an accurate and documented biography, indicating all the chief works on the subject, but the author is perhaps unduly harsh in his judgment of the admiral. F. D. Guerrazzi, *Vita di Andrea Doria* (3rd ed., Milan, 1874). Among the earlier works L. Capponelli's *Vita di Andrea Doria* (Italian edition, Genoa, 1863) and V. Sigonuzzi's *Vita di Andrea Doria* (1576) may be mentioned. See also "Documenti spagnoles genovesi del l'Archivio di Simancas" in the *Atti della Società ligure di storia patria*, vol. viii, the *Archivio storico italiano* (serie iii tome iv parte 1, 1866) contains a bibliography, but a great deal has been published since that date.

DORIANS In classical times a fourfold division ran through the Greek world, linguistic and partially social. The Dorians represent one section of this division, the remaining three being Aeolians, Ionians and Arcado-Cyprians or Achaeans. They were settled in the Peloponnese where they were the dominant race, in the Sporades and in Crete, in south-western Asia Minor, and in a string of colonies along the eastern and southern coasts of Sicily. Between Mounts Parnassus and Oeta was a small district

called Doris, whose inhabitants in historic times spoke an Aeolic dialect. They were distinguished from other Greeks by their dialect, by a calendar of festivals, and by certain social and political institutions. The worship of Apollo and of Heracles was looked upon by the Greeks as being in some sense more particularly Dorian, though not confined to Dorian peoples.

The Doric dialect, of which there were several varieties, was allied with a group known as North-west Greek, spoken in Phocis, Ionia, and Elis, as opposed to Aeolic, Ionic, Attic and Arcado-Cyprian, which may be said to have formed loosely an eastern group. Some of its characteristics are the retention of τ where Attic shows σ in verbal endings such as $\delta\delta\omega\tau\iota$, in $\kappa\alpha\tau\alpha\iota$ as the termination in the *hundreds* in place of $\kappa\alpha\tau\alpha\iota$ etc., the formation of the nominative plural of the article in $\tau\alpha\iota$, $\rho\alpha\iota$, $\delta\epsilon\alpha$, $\tau\acute{o}\kappa\alpha$, $\tau\acute{o}\kappa\alpha$ for $\delta\tau\epsilon$, $\tau\acute{o}\tau\epsilon$, $\tau\acute{o}\tau\epsilon$ etc., the termination of the first person plural active in $-\mu\epsilon\varsigma$ instead of $\mu\epsilon\upsilon$, e.g., $\phi\epsilon\rho\omicron\mu\epsilon\varsigma$, the formation of the future in $-\sigma\omega$, the lengthening of ϵ and o to η and ω in place of ϵ and $o\upsilon$, the reduction of intervocalic σ to h and in some cases its complete disappearance. The Cretan dialects showed peculiarities of their own. The Doric dialects continued in use until displaced by the *koiné* based upon Attic, which became the common language of Greece in Hellenistic times. The modern Zakonian dialect spoken in the neighbourhood of Sparta exhibits characteristics which entitle it to be regarded as the descendant of an ancient Doric dialect, possibly Laconian. Within the Doric group Laconian inclined in certain respects to agreement with Aeolic where Corinthian and Argolic show rather more similarity to Ionic.

It is clear that the Dorians were a conquering stratum of the population in the Peloponnese. Beside the fact that a non-Doric dialect survived in Aradia closely akin to the dialects of Cyprus, the social structure of the Doric cities provides evidence that the Dorians had conquered and were holding in subjection a former population. Sparta was the armed camp of a close aristocracy which alone possessed political rights. The majority of the population, known as Helots, were serfs, hostile to their masters and reeking into rebellion whenever opportunity presented itself. Between the Helots and the Spartan families was a class known as *perioeci* ($\rho\epsilon\upsilon$) who were not slaves but did not enjoy Spartan rights. In the 8th and 7th cent. B.C. Sparta's expansion and

Homer's time were a small Thessalian tribe, and the extension of their name illustrates the possibility of a similar process in the case of that of the Dorians. The inheritance of Dorus was in central Greece between that of Aeolus in Thessaly and of Xuthus in the Peloponnese. Under Aegimius, a descendant of Dorus, the Dorians acquired the country between Mounts Parnassus and Oeta, thenceforward known as Doris. An alliance took place between Aegimius and the Heraclidae, Hyllus son of Heracles being adopted by Aegimius. There followed the expeditions to the Peloponnese to assist the Heraclidae to recover their inheritance there. The route of the invasion was through Aetolia and Elis, the Corinthian Gulf being crossed at Naupactus. After several attempts the conquest of the Peloponnese was achieved. Thucydides dates the invasion 80 years subsequent to the Trojan War, and it was generally regarded as having taken place in the second half of the 12th or early in the 11th century. Megara and Corinth were conquered rather later. From the alliance between Aegimius and the Heraclidae dated the threefold Dorian division into Hylleis, Dymanes and Pamphyli.

A second tradition, current in the 4th century, brought the Argive Dorians to the eastern Peloponnese by sea. Their starting-point is not stated. It is assumed to be the Malac gulf, which is the nearest sea-coast to Doris in central Greece. The Cretan Dorians were regarded as an offshoot of this expedition from which they were considered to have separated in Histiaeotis.

The facts of the Dorian overlordship in the Peloponnese show the invasion and conquest to have been historical, and light may be thrown upon the whereabouts of the former homes of the invaders by the names of the three Dorian tribes. Hylleis is the name of a large and widespread Illyrian tribe settled upon the Dalmatian coast of the Adriatic and centring around the promontory known anciently as Hyllis, now as Sabioncello. Indeed the name Illyrni may be identical with that of the Hylleis except for an additional suffix. Again the tribal name Dymanes has a termination frequent in Epirus and exemplified in such names as Atintanes, Athamanes, Akarnanes, etc. Both these names point decisively to the north-west and confirm the tradition of an invasion across the Corinthian gulf from Aetolia to Elis, of an Illyrian or Epirote tribe. What of the Pamphyli? The second tradition, that the Dorian conquerors of Argolis reached the east coast of the Peloponnese by sea, has already been mentioned. Is it possible that it is wrongly assumed that the starting point of this expedition was the Malac gulf, and that such an invasion took place, but from Crete and the south-eastern Aegean? Is it too bold to connect the name Pamphyli with the familiar Anatolian Pamphylia? In Homeric times Dorians are recorded only in Crete. The constitution of Lycurgus at Sparta was traditionally derived from Crete. We know that the Achaeans were in pre-Homeric times in the eastern Aegean and later in the Peloponnese and the Greek mainland. Thus a Dorian migration from east to west across the Aegean would have merely followed in the wake of previous Achaean migrations, while Dorian attacks upon the Peloponnese from Crete would have been no more than repetitions of previous Minoan history. Thus an invasion of the Achaean Peloponnese by northern hordes was coincident with attacks from Crete and the Aegean. It may well have been designedly coincident, one set of invaders calling in the other as allies, and such an amalgamation may well explain the double kingship at Sparta. If the name Dorian first applied to a small tribe in Crete and later became extended to the new masters of the Peloponnese as a whole, this fact is no stranger than the increase of scope of the name Hellenes, which underwent an even wider development. The Parnassian Doris was never in historical times the home of Dorians. It represents perhaps no more than a coincidence of name, which is not surprising and far from unparalleled, especially if it connects with the root of $\delta\rho\upsilon\varsigma$, $\delta\omicron\rho\upsilon$, *tree*, etc. It is possible that the northern invaders occupied it for a time before their irruption into the Peloponnese.

A widely held view would bring all Greek-speaking peoples by land to Greece from the north in three successive waves, Ionian, Achaean and Dorian, the first two being the promoters of Mycenaean civilization. This presupposes an original "Helladic" popula-

ant a decision. The other Doric cities of the Peloponnese, notably Argos and Corinth, though their constitutions differed widely from that of Sparta, presented similar strata of population, between whom a social and political compromise had been reached. Sparta was not typical but peculiar. The so-called constitution of Lycurgus, however, under which she was governed, was closely effected in Dorian Crete. The double kingship suggests pre-historical amalgamation. Owing to Sparta's dominant position in the Dorian world in historical times the rest of Greece was inclined to regard what was peculiarly Spartan as typically Dorian. The rivalry of race between Dorian and Ionian underlay the struggles of the Greek world until at least the 4th century, being prominent in the Peloponnesian War at the close of the 5th century.

When and from what direction did the Dorian invasion of the Peloponnese take place? Homer knew of Dorians only in Crete. The mainland of Greece was inhabited in Homeric times by a people called Achaeans, which was the general name for Greeks afterwards replaced by the name Hellenes. In the Hesiodic genealogies Dorus appears as a son of Hellen beside Aeolus and Xuthus the father of Ion and Arctus. It is evident that at that time (7th or 6th century) these four divisions were regarded as comprising together the whole Greek world. The Hellenes or

tion of Greece, whose language is unknown and whose origin is unexplained. All Greek settlements in the Aegean, Asia Minor and Cyprus were on this view colonized from the mainland of Greece.

Doris was also in historical times the collective name of the Dorian cities in south-western Asia Minor, corresponding with Ionia and Aeolia. Whether or not Dorians had dwelt in this region since Homeric times, that is to say, since a date previous to their occupation of the Peloponnese, these cities had received an influx of population from the Peloponnese and looked to it in historical times as the home of their mother cities.

See *ACHAEANS, IONIANS, GREECE, History*.

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DORIA-PAMPHILII-LANDI, a princely Roman family of Genoese extraction. The founder of the house was Ansaldo d'Orta, consul of Genoa in the 12th century, but the authentic pedigree is traced no further back than to Paolo d'Orta (1335). The most famous member of the family was Andrea Doria (q.v.). The marquises of Civiez and the county of Cavallanone were conferred on the family in 1576, the duchy of Tursi in 1594, the principality of Avella in 1607, the duchy of Avigliano in 1613. In 1760 the title of *Reichsfürst* or prince of the Holy Roman Empire was added and attached to the lordship of Torriglia and the marquessate of Borgo San Stefano, together with the qualification of *Hochgeboren*. That same year the Dorias inherited the fiefs and titles of the house of Pamphilii-Landi of Gubbio, patricians of Rome and princes of San Martino, Valmontano, Val di Toro, Bardi and Cupriano. The Doria-Pamphilii palace in Rome, a splendid edifice, was built in the 17th century, and contains a valuable collection of paintings. The Villa Doria Pamphilii with its gardens is one of the loveliest round Rome. During the siege of 1849 it was Garibaldi's headquarters.

DORIC ORDER, in architecture, the simplest and earliest perfected of the Greek orders, adopted and developed in a modified form by the Romans, characterized by a simple, moulded capital, and the existence in the frieze of upright, grooved forms, known as triglyphs separated by squares, known as metopes (see *Order*).

DORION, SIR ANTOINE AIMÉ (1816-1891), Canadian lawyer and statesman, was born at Sainte Anne de la Perade on Jan. 17, 1816 of an old Liberal family. He studied law under Cherrier, was called to the bar in 1842, and rose rapidly in his profession. At the time that Dorion commenced the study of law, Canada was entering upon a new phase of her political life. The rebellion of 1837 had resulted in the suspension of the constitution of 1791 and the union of provinces, effected under the Imperial Act of 1840, was framed to compel the obedience of the refractory population. The elections of 1854 had brought new blood into the ranks of the Liberal party, young men eager to carry out measures of reform, and Dorion was chosen as leader. Under the coalition brought about by the meeting between the Tories of Upper Canada and the Liberals of the lower province old abuses were removed, and after the abolition of seigniorial tenure and clergy reserves, it appeared that the political atmosphere was clear. In 1856 the question of representation by population was again prominent. Upper Canada had increased, and it contributed a larger share to the revenue, and demanded proportionate representation. Macdonald, who became prime minister in 1856 and had formed a new government with Cartier in 1857, maintained that no amendment to the constitution was necessary, that existing conditions were satisfactory. Brown, on the opposite side of the House, declared that representation by population was imperative, with or without constitutional changes, and Dorion appears to have suggested the true remedy, when he gave notice of a motion in 1856—

That a committee be appointed to inquire into the means that should be adopted to form a new political and legislative organization of the heretofore provinces of Upper and Lower Canada, either by

the establishment of their former territorial divisions or by a division of each province, so as to form a federation, having a federal government and a local legislature for each one of the new provinces, and to deliberate as to the course which should be adopted to regulate the affairs of united Canada, in a manner which would be equitable to the different sections of the province.

Dorion was in advance of the time. He understood the true principle of federative union as applicable to Canada. But he did not pursue this idea. On Aug. 2, 1858 he formed an administration with Brown, but was forced to resign after being in office three days. When the question of confederation was discussed a few years later he opposed the scheme, believing there was nothing to justify the union at the time. In 1873 he became minister of justice in the Mackenzie government, and secured the passage of the Electoral Law of 1874 and the Controverted Elections Act. Dorion sat as a member of the assembly for the province of Canada for the city of Montreal from 1854 to 1861, for the county of Hochelaga from 1862 to 1867, as member of the House of Commons for the county of Hochelaga from 1867 to July 1872, and for the county of Napierville from Sept. 1872 to June 1874, when he was appointed chief justice of the province. In 1878 he was created a knight bachelor. He died at Montreal on May 31, 1891.

See Fennings Taylor, *Dorion, a Sketch* (Montreal, 1865), "Sir Antoine Aimé Dorion," by Sir Wilfrid Laurier, in *The Week* (1887).

DORIS, a small district in central Greece, between Mts. Oeta and Parnassus, containing the headwaters of the Cephissus. This little valley, which nowhere exceeds 4 m. in breadth and has but four small townships, owed its importance partly to its command over the road from Heracleia to Amphissa, but chiefly to its prestige as the alleged mother country of the Dorian conquerors of Peloponnesus (see *DORIAN*). Its history is mainly made up of petty wars with Oetaeans and Phocians. In 457, the Spartans, admitting their claim to be the Dorian metropolis, sent an army to their aid, and again during the second Sacred War (356-346). Except for mention of its cantonal league in 196, Doris passed early out of history.

See Strabo, pp. 477, 427, Herodotus 1. 56, viii. 31, Thucydides 1. 107, iii. 92, Diodorus xii. 29, 33, W. M. Leake, *Travels in Northern Greece*, chap. xi. (1835).

DORISLAUS, ISAAC (1595-1649), Anglo-Dutch lawyer and diplomatist, was born at Alkmaar, Holland, the son of a minister of the Dutch Reformed Church. He was educated at Leyden, removed to England about 1627, and was appointed to a lectureship in history at Cambridge, where his attempt to justify the Dutch revolt against Spain led to his early resignation. In 1629 he was admitted a commoner of the College of Advocates. In 1632 he made his peace at court, and on two occasions acted as judge advocate, in the bishops' war of 1640 and in 1642 in the army commanded by Essex. In 1648 he became one of the judges of the admiralty court, and was sent on a diplomatic errand to the States General of Holland. He assisted in preparing the charge of high treason against Charles I., and, while negotiating an alliance between the Commonwealth and the Dutch republic, was murdered at The Hague by royalist refugees on May 10, 1649.

DORKING, a market town and urban district in the Regent parliamentary division of Surrey, England, with three (including Box Hill, four) railway stations on the Southern railway, about 26 m. S.W. of London. Pop. of urban district (1938) 17,110. Area 15 sq. mi. It lies at the edge of the North Downs in the sheltered valley of the river Mole, near the base of Box Hill, and is noted for the beauty of its countryside. It is the centre of an extensive residential district. The parish church of St. Martin's is a handsome edifice rebuilt in 1873. Lume of exceptionally good quality is burned in the neighbourhood and is derived from the Lower Chalk formation. Dorking gives its name to a well-known breed of fowl distinguished by its having five toes. Several fine mansions are in the vicinity of the town, notably that of Deepdene, containing part of a gallery of sculpture collected by Thomas Hope, the author of *Anastasis*. The Roman road of Stone street, which crossed from the Sussex coast to the Thames, passed near the present churchyard of St. Martin. The district has literary associations, including the names of George Meredith, who lived and is buried here, Fanny Burney, Malthus and others.

DORLÉANS, LOUIS (1542-1629), French poet and political pamphleteer, was born in Paris. He studied under Jean Daurat, and after taking his degree in law began to practise at the bar with but slight success. After the league had arrested the royalist members of parliament, he was appointed (1589) advocate general. His *Avertissement des catholiques anglais aux Français catholiques* went through several editions, and was translated into English. Dorléans was proscribed when Henry IV entered Paris. He took refuge in Antwerp, but was arrested nine years later, and returned to Paris, where he was soon imprisoned for sedition. The king, however, released him after three months in the Conciergerie.

DORMAN, THOMAS (d. 1577?), Catholic theologian, was born at Berkhamstead, Hertfordshire. His uncle Thomas Dorman of Agmondesham (Amersham), Buckinghamshire, supported him while he studied at the Berkhamstead free school, where he was a student of Richard Reeve, a well known protestant teacher.

In 1547 Thomas Harding, a Catholic scholar, sent Dorman to Winchester school. He later attended New College, Oxford, and was elected a probationer fellow. He became a fellow of All Souls' college in 1554 and was awarded the degree of bachelor of civil law in 1558.

Opposing the religious changes made after the accession of Queen Elizabeth in 1558, Dorman left England. In Antwerp he was urged by Harding, who was in exile, to continue his studies. Dorman became a student of theology in Louvain, and in 1565 he was graduated as bachelor of divinity from the University of Douai, in northern France, founded by Philip II of Spain in 1562. The university later awarded him the doctorate.

Dorman assisted in the establishment of the English college, founded at Douai in 1568 by William Allen. In 1572 or 1577, Dorman died in the city of Tournai.

His theological works include *A Prouse of Certeyme Articles in Religion demed by Mr Jewel* (Antwerp, 1564), *A Disproufe of Mr Alex. Newell's Reproufe* (Antwerp, 1565), *A Request to Mr Jewel that He keep His Promise made by Solemn Protestation in His Late Sermon at Paul's Crosse, 15 June, 1567* (London, 1567, Louvain, 1567).

DORMER, in architecture, a projection from a sloping roof, containing a window. Dormers may occur either on the face of the wall or high up on the roof, their roofs may be gabled, hipped, flat or with one slope. Wherever steep, high roofs are common, dormers are common, in order to light the space within. Simple dormers, frequently in several rows, characterize the steep roofs of Teutonic countries, but in the late Gothic and early Renaissance periods, certain dormers, whose fronts were on the wall line of the building, were built in masonry and richly decorated. Similar elaborate dormers, usually with gabled roofs, are characteristic of the French châteaux from the time of Louis XII to that of Louis XIV, and of Tudor work in England and Scotland, examples of dormers, ornamented with pinnacles, tracery and buttresses, occur in the Palais de Justice at Rouen (end of the 15th

century). Heidelberg castle (1556), and the châteaux of Blois and Chambord (time of Francis I) show characteristic Renaissance enrichment. The term "dormer" arose from the windows being those of sleeping rooms. The phrase "dormer beam" is the equivalent of the modern sleeper.

DORMITORY, the name given in monasteries to the monks' sleeping apartment. It sometimes formed one long room, but was more generally subdivided into as many cells or partitions as there were monks. The dormitories were sometimes of great length, that of the monastery of San Michele in Bosco near Bologna, now suppressed, is said to have been over 400 feet. In some of the larger Elizabethan mansions the space in the roof constitutes a long gallery, which in those days was occasionally utilized as a dormitory. The name dormitory is also applied to the large bedrooms with a number of beds, in schools and similar modern institutions, and also to any institutional building whose purpose is to furnish sleeping quarters for pupils or others, irrespective of whether or not they are divided into individual rooms.

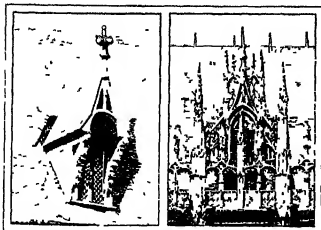
DORMONT, a residential borough of Allegheny county, Pa., U.S., on the southern edge of Pittsburgh. The population was 13,405 in 1950 and 12,974 in 1940 by federal census.

Incorporated in 1909, Dormont adopted the council manager form of government in 1922 under an ordinance passed by the city council. The name was derived from the French *mont d'or*, or golden mount.

DORMOUSE, a small rodent, *Muscardinus avellanarius*, is the sole representative of its genus, but belongs to the family Gliridae (often, Muscardinidae), this contains a number of old world species. All the dormice are small rodents, of arboreal habits, and for the most part of squirrel like appearance, some of their most distinctive features being internal. In the more typical members of the group, forming the subfamily Glirinae, there are four pairs of cheek teeth, which are rooted and have transverse enamel folds. As the characters of the genera are given in the article RODENTIA it will suffice to state that the typical genus *Glis* is represented by the European edible dormouse, *G. glis*, a gray species with black markings and about 8 in. long, known in Germany as the *Siebenschläfer*, the genus ranges from continental Europe to Japan. The common dormouse *Muscardinus avellanarius*, ranging from England to Russia and Asia, is of the size of a mouse. The fur is tawny above and paler beneath, with a white patch on the throat. The third genus is represented by the continental *lerot*, or garden dormouse, *Ehomyz quercinus*, which is a large chestnut coloured species, with black cheeks.

There are several local forms or races. A large number of African species belong to the genera *Claviglis* and *Graphomys*. In their arboreal life and the habit of sitting up on their hind legs with their food grasped in the forepaws, dormice are like squirrels, from which they differ in being completely nocturnal. They live either among bushes or in trees, and make a neat nest for the reception of their young, which are born blind. The species inhabiting cold climates construct a winter nest in which they hibernate, waking up at times to feed on an accumulated store of nuts and other food. Before retiring they become very fat, and at such times the edible dormouse is a favourite article of diet on the continent. The young are generally four in number, and are produced twice a year. They are born blind, but in a marvellously short period are able to cater for themselves, and their hibernation begins later in the season than with the adults. A second subfamily is represented by the Indian *Platacanthomys* and the Chinese *Typhlomys*, in which there are only three pairs of cheek teeth, the teeth have oblique cross ridges, the palate is fenestrated and the bullae are small. (J. E. H.)

DORNBIRN is a township in the Austrian province of Vorarlberg, at the foot of the Brezgenzerwald. The name is a collective appellation for four straggling villages—Dornbirn, Hatlerdorf, Oberdorf and Haselstaufen—chiefly important as small centres manufacturing textiles and iron goods with motive power from the Dornbirner Ach, a tributary of the Rhine. Pop. (1948) 22,516. Germany annexed the township in 1938.



LEFT: DORMER TYPE OF DORMER. RIGHT: DORMER TYPE OF DORMER. (Faint text, likely a watermark or credit line.)

of Sir Thomas Wyatt, the marquessate of Dorset again became extinct, but in 1604 Thomas Sackville (see the account of the family under SACKVILLE, 1ST EARL) was created earl of Dorset (see below) and his descendant, the 7th earl, was created duke in 1720. In 1843 the titles became extinct.

THOMAS GREY, 1ST MARQUESS OF DORSET (1451-1501), was the elder son of Sir John Grey, 7th Lord Ferrers of Groby (1432-61), by his wife, Elizabeth Woodville, afterwards queen of Edward IV. He fought for Edward at Tewkesbury, in 1475 he was created marquess of Dorset. After the death of Edward IV Dorset and his brother, Richard Grey, supported their half brother, the young Edward V, thus incurring the enmity of Richard duke of Gloucester, afterwards Richard III. Richard Grey was arrested and beheaded at Pontefract in June 1483, while the marquess saved his life by flight. Dorset was one of the leaders of the duke of Buckingham's insurrection, and when this failed he joined Henry earl of Richmond in Brittany, but he was left in Paris when the future king crossed to England in 1485. After Henry's victory at Bosworth the marquess returned to England and his attainder was reversed, but he was suspected and imprisoned when Lambert Simnel revolted, he had however, been pardoned, had marched into France and had helped to quell the Cornish rising, when he died on Sept. 20, 1501.

Dorset's sixth son, Lord Leonard Grey (c. 1490-1541), went to Ireland as marshal of the English army in 1535, and in 1536 was appointed lord deputy in succession to Sir William Skeffington. He was accused, probably with truth, of favouring the family of the Geraldines, to whom he was related, and quarrelled fiercely with the rival family of the Butlers. Returning to England in 1540 he was condemned to death for treason. He was beheaded on July 28, 1541 (See R. Bagwell, *Ireland under the Tudors*, vol. 1, 1885).

THOMAS GREY, 2ND MARQUESS OF DORSET (1477-1530), the eldest son of the 1st marquess, fled to Brittany with his father in 1484. He spent some years in prison under Henry VII, but was highly favoured by Henry VIII, who gave him command in France in 1512, and in 1533 made him warden of the Scottish eastern and middle marches. He was famous for his skill in the tournament. He died on Oct. 10, 1530.

His eldest son, Henry Grey, 3rd marquess of Dorset, was in 1551 created duke of Suffolk (q.v.). A younger son, Lord Thomas Grey, was beheaded in 1554 for sharing in the rebellion of Sir Thomas Wyatt, another son, Lord John Grey, was also sentenced to death for his share in this rising, but his life was spared by the efforts of his wife, Mary, daughter of Sir Anthony Browne. Under Elizabeth, Lord John, a strong Protestant, was restored to the royal favour. He died on Nov. 19, 1569. In 1603 his son Henry (d. 1614) was created Baron Grey of Groby, and in 1628 his great-grandson Henry was made earl of Stamford (For the 1st earl of Dorset, see SACKVILLE, THOMAS).

EDWARD SACKVILLE, 4TH EARL OF DORSET (1591-1652), son of the 2nd earl, succeeded his brother Richard, the 3rd earl (1590-1624), in 1624. He had attained much notoriety by killing Edward Bruce, 2nd Lord Kinloss, in a duel, and in 1620 he fought for James I's son-in-law, Frederick V, elector palatine of the Rhine, at White Hill, near Prague. In the House of Commons, where he represented Sussex, Sackville defended Bacon and advocated an aggressive policy for the recovery of the Rhenish Palatinate, twice he was ambassador to France, and he was interested in Virginia, and the Bermuda islands. Under Charles I he was a privy councillor and lord chamberlain to Henrietta Maria. At the outbreak of the Civil War, he joined the king at York, but he endeavoured to secure peace. At Oxford he was lord chamberlain to the king and lord president of his council, but Charles did not altogether approve of his pacific attitude. He died on July 17, 1652. His wife Mary (d. 1645), daughter of Sir George Curson, was governess to the sons of Charles I, the future Charles II and James II.

CHARLES SACKVILLE, 6TH EARL OF DORSET (1638-1706), English poet and courtier, son of Richard Sackville, 5th earl (1622-77), was born on Jan. 24, 1638, and succeeded to his father's estates and title in 1677. In Charles II's first parliament

he sat for East Grinstead, Sussex. He won a reputation as courtier and wit at Whitehall, where he bore his share in the excesses for which Sir Charles Sedley and the earl of Rochester were notorious. In 1662 he and his brother Edward, with three others were indicted for the robbery and murder of a tanner named Hoppy. The defence was that they were in pursuit of thieves, and mistook Hoppy for a highwayman. In 1665 he volunteered to serve under the duke of York in the Dutch war. His famous song, "To all you Ladies now at Land," was written, according to Prior, on the night before the victory over "foggy Opdm" off Harwich (June 3, 1665). Dr Johnson, with the remark that "seldom any splendid story is wholly true," says that the earl of Orery had told him it was only retouched on that occasion. In 1667 Pepys laments that he had lured Nell Gwyn away from the theatre, and that with Sedley the two kept "merry house" at Epsom. Next year the king was paying court to Nell, and her "Charles the First," as she called him, was sent on a "sleeveless errand" into France to be out of the way. His gaiety and wit did not especially recommend him to James II. He retired from court at the beginning of the new reign. Dorset concurred in the invitation to William of Orange, who made him privy councillor, lord chamberlain (1689), and knight of the Garter (1692). During William's absences in 1695-98 he was one of the lord justices of the realm.

He was a generous patron of men of letters. Dryden's "Essay on Satire" and the dedication of the "Essay on Dramatic Poesy" are addressed to him. Walpole (*Catalogue of Noble Authors*, iv) says that he had as much wit as his first master, or his contemporaries, Buckingham and Rochester, without the royal want of feeling, the duke's want of principle or the earl's want of thought, and Congreve reported of him when he was dying that he "slabbered" more wit than other people had in their best health.

The fourth act of *Pompey the Great*, a tragedy translated out of French by certain persons of honour, is by Dorset. The satires for which Pope classed him with the masters in that kind seem to have been short lampoons, with the exception of *A Faribaird Catalogue of our Most Eminent Ninnies* (reprinted in *Bibliotheca Curiosa*, ed. Goldsmid, 1885). *The Works of the Earls of Rochester, Roscommon and Dorset, the Dukes of Devonshire, Buckinghamshire, etc., with Memoirs of their Lives (1731)* is catalogued (No. 20,841) by H. G. Bohn in 1841. His *Poems* are included in Anderson's and other collections of the British poets.

LIONEL CRANFIELD SACKVILLE, 1ST DUKE OF DORSET (1688-1765), the only son of the 6th earl, was born on Jan. 18, 1688. He succeeded as 7th earl of Dorset in 1706, and was created duke of Dorset in 1720. He was twice lord steward of the household, twice lord-lieutenant of Ireland, and lord president of the council from 1745-51. His second viceroyalty of Ireland (1750-55) was stormy and ended in dismissal. The duke died on Oct. 10, 1765. He left three sons. Charles, the 2nd duke, John Philip (d. 1765), and George, who took the additional name of German in 1770, and in 1782 was created Viscount Sackville (q.v.).

CHARLES SACKVILLE, 2ND DUKE OF DORSET (1711-1769), an associate of Frederick, prince of Wales, was a member of parliament for many years and a lord of the Treasury under Henry Pelham, he died on Jan. 5, 1769. His nephew, John Frederick (1745-1799), 3rd duke, was ambassador in Paris from 1783 to 1789, and lord steward of the household from 1789 to 1799, he died on July 10, 1799, and was succeeded by his only son, George John Frederick (1793-1815). When the 4th duke died unmarried in Feb. 1815, the titles passed to his kinsman, Charles Sackville German (1767-1843), son and heir of the 1st Viscount Sackville, who thus became 5th duke of Dorset. When he died on July 29, 1843, the titles became extinct.

DORSET, a south western county of England, bounded north-east by Wiltshire, east by Hampshire, south by the English Channel, west by Devon and north-west by Somerset. The area is 973 square miles.

In the centre of the county the chalk hills of the western downs sweep south-west from Cranborne Chase through Blandford, Milton Abbas and Frampton to Dorchester. Here the chalk outcrop narrows and turns south-eastward by Portland and Bournemouth to West Lulworth, whence it is continued eastward as the Purbeck hills. Within this rim of chalk is a fringe of Reading

beds and London clay which may be traced from Cranborne through Wimborne Minster, near Bere Regis and Puddletown, then southeastward through West Knighton, Winfrith and Lulworth, and along the northern side of the Purbeck hills to Studland. Bounded by this arc and occupying the eastern portion of the county is a low lying region of sands, gravel and clay, probably an extension of the Hampshire basin. Denudation has revealed the Wealden beds in the vale between Lulworth and Swanage, and also near East Chaldon. The town of Shaftesbury stands upon a hill of Greensand, while the Upper Greensand also forms the high ground above Lyme Regis, Golden Cup and Pilsden and Lewesden Pans. It is thought that a stream following the syncline of the Frome valley, the Solent and the Spithead was at one time the chief feature of the drainage. Subsidence, however, has resulted in the tributaries of this stream now finding their way independently to the sea. The Stour rises in Wiltshire and flows with a general southeasterly course, to join the Hampshire Avon near its mouth. It receives the Cale and Ludden, which drain the Vale of Blackmore, in its upper course, and breaches the western downs in its middle course between Sturminster Newton and Blandford.

The small rivers Puddle or Trent and the Frome flow across the eastern plain and almost unite their mouths in Poole harbour.

In the northwest the Yeo flows northward to join the Parret and so sends its waters to the Bristol channel. The Char, the Brit and the Bridr, drain the southwest. Lulworth Cove is an excellent example of differential marine erosion. Chesil Bank has been formed from debris accumulated there by up channel currents.

Archaeology and History.—Several beakers indicate early settlement. One handled beaker found 3 mi. from Dorchester, on the Ridgeways hill, may imply influences from eastern England (*See* *Excavations in Arch. Camb.* vol. lxxv, pt. 1, p. 19). Numerous interments of cremated bones (yielding many cinerary urns but few incense cups), disc-barrows resembling those of Wiltshire, unchambered barrows and stone circles, testify to the importance of Dorset in the Bronze age. The sheltered waters of Weymouth, with access to the well drained chalk uplands of the interior, favoured maritime trade. At Wareham was found a palisade of a type largely confined to southern England and northern France, which has been considered as an indication of early intercourse with neighbouring parts of the continent (*See* Crawford, in *L'Anthropologie*, tome xiv, 1913, pp. 641-649). The numerous earthworks, of which the best known is Maiden Castle, may have been constructed to guard the principal routes from the coast. The finding of La Tène brooches at Woodcuts, Werne, Blandford and Maiden Castle (Dorchester) suggests contacts with north-western France during the Early Iron age (*See* Fox, *Arch. Camb.*, vol. lxxvii, pt. 1, pp. 67-112).

The kingdom of Wessex originated with the settlement of Cedric and his followers in Hampshire in 495. In 705 the West Saxon see was transferred to Sherborne, and many religious houses were founded later. In 787 the Danes landed at Portland, and in 833 they arrived at Charmouth and fought with Egbert. The shire is first mentioned by name in the Saxon Chronicle in 845. During the following 2½ centuries Dorset was constantly ravaged by the Danes.

Several of the West Saxon kings resided in Dorset, and Aethelwold and Aethelbert were buried at Sherborne, and Aethelred at Wimborne. In the reign of Canute Winton was the shire town. Dorset formed part of Harold's domain, and its resistance to the Conqueror was punished by the devastation of Dorchester, Wareham, Shaftesbury and Blandford.

No Englishman retained important estates after the conquest, and at the time of the survey the bulk of the land, except 46 manors held in the king, was in the hands of religious houses, the abbots of Cerne, Milton and Shaftesbury being the most wealthy. There were 272 mills, and nearly 80 men were employed in working all along the coast. Minis existed at Shaftesbury, Wareham, Dorchester and Blandford, the three former having been founded by Aethelstan. King John frequently hunted in the county. In

the time of Egbert, Wessex was divided into definite *pagi*, each under an ealdorman, which no doubt represented the later shires. Under the *Inquisitio Geldi*, drawn up two years before the Domesday survey, mentions the 39 pre conquest hundreds of Dorset. The 33 hundreds and 21 liberties of the present day retain some original names, but boundaries have changed. Until the reign of Elizabeth, Dorset and Somerset were united under one sheriff. After the transference of the West Saxon see from Sherborne to Sarum, in 1075, Dorset remained part of that diocese until 1542, when it was included in the newly formed diocese of Bristol. The vast power and wealth monopolized by the Church in Dorsetshire tended to check the rise of any great county families.

The three chief churches are the abbey church of Sherborne (qv), Wimborne Minster (qv) and Milton Abbey church, a Decorated and Perpendicular structure erected on the site of a Norman church.

Dorset took no active part in the struggles of the Norman and Plantagenet period. In 1627 the county refused to send men to La Rochelle. On the outbreak of the Civil War the general feeling was in favour of the king, and in 1643 Lyme Regis and Poole were the only garrisons in the county left to the parliament. By 1644, however, parliament had gained the whole county except Sherborne and the Isle of Portland. The remains of Corfe castle (qv) and of Sherborne castle may still be seen. The general aversion of Dorset people to warlike pursuits is demonstrated at this period by the rise of the "clubmen," so called from their appearance without pikes or firearms at county musters, whose object was peace at all costs. In the 14th century Dorset produced much wheat and wool and had a prosperous clothing trade, which declined after the ravages of the plague in 1626. The hundred of Pimperne produced saltpetre in the 17th century, and the serge manufacture was introduced about this time. Portland freestone was first brought into use in the reign of James I, and after the Great Fire it was extensively used by Sir Christopher Wren. In the 18th century Blandford, Sherborne and Lyme Regis were famous for their lace. The county returned two members to parliament in 1290, in 1572 the county and nine boroughs returned a total of 20 members. Under the Reform Act of 1832 the county returned three members, and Corfe castle was disfranchised. Lyme Regis was disfranchised in 1868 and the remaining boroughs in 1885. Under the Representation of the People act, 1918, the county returns four members.

Agriculture and Industries.—The climate is mild, and in some sheltered spots semi-tropical plants flourish. Much fine timber appears in the richer soils, in some of the sheltered valleys of the chalk district, and more especially upon the Greensand, though many woods have been cleared. In 1939 there were only 97,525 ac. of arable land, but 318,108 ac. (76.5% of the total acreage under crops and grass) of permanent grass, including 69,173 ac. of rough grazing ground, the chalk downs being celebrated for sheep walks. The chief crops were oats (16,282 ac.), wheat (15,561 ac.) and turnips and swedes (11,204 ac.). Barley and mangolds followed, with 8,430 ac. and 3,017 ac. respectively. Devons, Shorthorns and Herefords are the most common breeds of cattle, and dairy farming is extensively carried on. The National Trust owned 9 ac. in the county in 1942.

The quarries of the Isles of Portland and Purbeck are important. The first supplies a much used white freestone. Purbeck marble was used for many of the most famous Gothic churches in England. A valuable product of Purbeck is a white pipeclay, exported to the potteries of Staffordshire from Portland. Some shipbuilding is carried on at Poole, and ships are made at several towns. Other small manufactures are those of flux and lamp in the neighbourhood of Blandford and Brimstoner, or bricks, tiles and pottery in the Poole district, and of nets (fishing, as the industry is called) in some of the villages. There are silk mills at Sherborne and elsewhere. The chief ports are Poole, Weymouth, Swanage, Blandford and Lyme Regis. The harbour of refuge at Portland, under the aegis of an important fortified naval station.

The main line of the Southern railway serves Gillingham and Sherborne, in the north of the county. Branches of this system serve Wimborne, Poole, Swanage, Dorchester, Weymouth and

Portland The last two towns, with Bridport, are served by the Great Western railway, the Somerset and Dorset line follows the Stour valley by Blandford and Wimborne, and Lyme Regis is the terminus of a light railway from Axminster on the Southern ry.

The population of the administrative county was, in 1938, 252,240. An increase in the county population of 3% between Sept. 1939 and Feb. 1941 was caused by wartime movements. The county contains eight municipal boroughs, and four urban districts. It and Poole each have a court of quarter sessions and there are nine petty sessional divisions. The dialect of the county, distinguishable from those of Wiltshire and Somersetshire, yet bearing many common marks of Saxon origin, is admirably illustrated in some of the poems of William Barnes (q.v.). Many towns, villages and localities are readily to be recognized from their descriptions in the "Wessex" novels of Thomas Hardy (q.v.).

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DORT, SYNOD OF. An assembly of the Reformed Dutch Church, with deputies from Switzerland, the Palatinate, Nassau-Hesse, East Friesland, Bremen, Scotland and England, called to decide the theological differences existing between the Arminians (or Remonstrants) and the Calvinists (or Counter-Remonstrants), was held at Dort or Dordrecht (q.v.) in 1618 and 1619. The government of Louis XIII. prohibited the attendance of French delegates. During the life of Arminius a bitter controversy had sprung up between his followers and the strict Calvinists, led by Francis Gomarus, his fellow professor at Leyden, and, in order to decide their disputes, a synodical conference was proposed, but Arminius died before it could be held. The essential contentions of the Arminians were the denial of irresistible predestination and the affirmation that Christ died for all men, not only for the "elect". In 1614, at the instance of the Arminian party, an edict was passed by the states general, in which toleration of the opinions of both parties was declared and further controversy forbidden, but this act only served, by rousing the jealousy of the Calvinists, to fan the controversial flame into greater fury. Gradually the dispute pervaded all classes of society, and religious questions became entangled with political issues, the partisans of the house of Orange espoused the cause of the stricter Calvinism, whereas the bourgeois oligarchy of republican tendencies, led by Oldenbarnevelt and Hugo Grotius, stood for Arminianism. In 1617 Prince Maurice of Orange committed himself definitely to the Calvinist party, found an occasion for throwing Oldenbarnevelt and Grotius into prison, and furthermore in 1617 called a synod intended to crush the Arminians. This synod, which was assembled at Dort in November 1618, was strictly national—called by the national authority to decide a national dispute, and not intended to have more than a national influence. The foreign deputies were invited to attend, only to assist by their advice in the settlement of a controversy which concerned the Netherlands church alone, and which the Netherlands church alone could decide. At the fourth sitting it was decided to cite Simon Episcopus (q.v.) and other Remonstrants to appear within fourteen days before the synod, to state and justify their doctrines. It was also agreed to allow the Arminian deputies to take part in the deliberations, only on condition that they forebore to consult with, or in any way assist, their cited brethren, but this they refused. When Episcopus and the others cited appeared, the former surprised the deputies by a bold and outspoken defence of his views, and even went so far as to say that the synod, by excluding the Arminian deputies, could now only be regarded as a schismatic assembly. The Remonstrants were asked to file copious explanations of the points in dispute (*Sententia Remonstrantium*) but objecting to the manner in which they were catechized, they were dismissed from the synod. The synod then proceeded in their absence to judge

them from their published writings, and came to the conclusion that as ecclesiastical rebels and trespassers they should be deprived of all their offices. The synodical decision in regard to the five points is contained in the canons adopted at the 136th session held on April 23, 1619, the points were unconditional election, limited atonement, total depravity, irresistibility of grace, final perseverance of the saints. These doctrinal decisions and the sentence against the Remonstrants were, at the 144th sitting, read in Latin before a huge audience in the great church. The Remonstrants were required to subscribe the condemnation and many of them refused and were banished. "The canons of Dort represent the last effort of rigid Calvinistic orthodoxy to meet the difficulties and objections besetting their system both from a popular and a theological point of view." (See REMONSTRANTS.)

See W. A. Curtis, art. "Confessions, Christian" in *Hastings Encyclopedia of Religion and Ethics*, vol. iii, p. 868, H. C. Rogée in Herzog-Hauck, *Religionenzyklopädie*, vol. iii, p. 798; Schaaf, *Credo of Christendom*, p. 550 ff. (3rd ed., 1877); Hall, *Harmony of Protestant Confessions* (1847), p. 539 (positive and negative canons in English), for references to the sources and full Latin text; Müller, *Die Bekenntnisschriften der reformierten Kirche* (1903), and *Acta der Nationalen Synode te Dordrecht* (Leyden, 1887).

DORTMUND, a town of Germany, in the Prussian province of Westphalia, on the Emscher, in a fertile plain, 50 m. E. from Düsseldorf by rail. Pop. (1939) 537,000.

Dortmund, the Thotmannia of early history, was already a town of some importance in the 9th century. In 1005 the emperor Henry II. held here an ecclesiastical council, and in 1016 an imperial diet. The town was walled in the 12th century, and in 1387–1388 successfully withstood the troops of the archbishop of Cologne for twenty-one months. About the middle of the 13th century it joined the Hanseatic League. In 1803 Dortmund lost its rights as a free town, and was annexed to Nassau. The French occupied it in 1806 and in 1808 it was made over by Napoleon to the grand duke of Berg, and became the chief town of the department of Ruhr. Through the cession of Westphalia by the king of the Netherlands, on May 31, 1815, Dortmund became a Prussian town.

The old walls were abolished in 1863 but the centre of the town retains a mediaeval aspect. Its ancient buildings include Reinoldskirche, with fine stained glass windows, Marienkirche, the nave of which dates from the 11th century, and Petruskirche, with a curious altar, and the Dominican church, with beautiful cloisters. The 13th century town hall was restored in 1899 and now contains the municipal antiquarium museum. Dortmund owes its development to its situation in the centre of the Westphalian coal basin. In the immediate vicinity are also extensive beds of iron ore, and the town competes with Essen, Oberhausen, Duisburg and Hagen in the products of the iron industry. These in Dortmund include steel rails, mining plant, wire ropes, machinery, safes and sewing machines. Its airfield, oil tanks and factories were constant targets for British bombers in World War II. It is a railway centre and is also connected with the river Ems by the Dortmund-Ems canal, 170 m. in length.

DOSITHEUS MAGISTER, Greek grammarian, flourished at Rome in the 4th century A.D. He was the author of a Greek translation of a Latin grammar, intended to assist the Greek-speaking inhabitants of the empire in learning Latin. The Latin grammar used was based on the same authorities as those of Chansius and Diomedes. Dositheus contributed very little of his own. Some Greek Latin exercises by an unknown writer of the 3rd century, are of value as illustrating the social life of the period and the history of the Latin language. Of these *Hermeneumata*, the third book, containing a collection of words and phrases from every day conversation has been preserved. A further appendix consisted of anecdotes, letters and receipts of the emperor Hadrian, fables of Aesop, extracts from Hyginus, a history of the Trojan War, and a legal fragment, *De mansuetudinis*.

EDITIONS—*Grammatica* in H. Kell, *Grammatica Latina*, vii and separately (1871); J. Tolkein (Lips. 1913); *Hermeneumata* by G. Götze (1892) (in G. Lowe's *Corpus glossariorum Latinarum*, m.) and E. Böcking (1848), which contains the text (including the legal fragment). See also C. Lachmann, *Verück über Dositheus* (1837); H. Hagen, *De Dositheo magistro quae feruntur glossae* (1877).

DOSSERET, or impost block, in architecture, the block of stone sometimes used in the Byzantine style above the capital (q.v.) of a column. It has the form of a truncated pyramid, with the large side up, and therefore furnishes ample bearing for carrying the arches and vaults above it.

DOSSO DOSSI, GIOVANNI (1479-1542), Italian painter, the head of the Ferrarese school in the 16th century. His real name was Giovanni de Lutero. His father, Niccolò de Lutero a native of Trent, settled at Ferrara, and Giovanni and his brother Battista (d. 1549) were probably born at Dosso, a village near Mantua. Vasari does not mention the name of their master, but according to Scamilli they studied under Lorenzo Costa, while Morelli suggests that their first teacher was G. Paucetti. We know by documentary evidence that Battista was in Rome in 1519, there is, however, no proof that Dosso studied in Rome.

His work is Ferrarese, though his colour is under Venetian influence.

From 1514 Dosso was in the service of Alfonso d'Este. He painted portraits of the Este family, he decorated the ducal palaces and executed designs for tapestries and majolica. The two brothers Dosso, though not always on good terms with one another, often co-operated, as in the decoration of the ducal palace of Ferrara, of the palace of the Gonzaghi at Mantua (1512), of the Villa Imperiale near Pesaro, and of the bishop's palace at Trent (1532). Dosso died at Ferrara shortly before Aug. 27, 1542. He was a friend of his compatriot Ludovico Ariosto, and, like this great poet, loved to depict romantic scenes from pagan myths or from legends of Christian chivalry. His fantastic "Circe" in the Galleria Borghese might be an illustration of Ariosto's poetry. The admiration was reciprocal, for in the *Orlando Furioso* (c. 1530), 2 Dosso ranks with Leonardo, Michelangelo, Raphael, Titian, Bellini and Mantegna. Dosso was a poet in his colour schemes. His shadows are saturated with colour, his lights sparkling and strong. He was an innovator in landscape painting, for he made the scenery take part in the drama enacted by the figures. Thus the background in the "Adoration of the Magi" (National Gallery, London) is illuminated by a supernatural light.

Nearly all the frescoes of Dosso are much damaged or have perished. However, a number of oil paintings have survived. Besides those mentioned above the following are his chief works: the altarpiece in the cathedral of Modena representing the "Madonna and Saints", the altarpiece of the cathedral of Ferrara representing "St. Bartholomew and John the Baptist" which has passed into the Chigi collection, the "Four Fathers of the Church" in the Dresden gallery, this gallery also contains several pictures from the ducal palace of Ferrara, some by Dosso and others designed by him and completed by his brother and Girolamo Cippi.

The gallery at Modena contains some fine examples and several of his works are at Hampton Court Palace.

See *Vasari, Le vite de' pittori* (ed. Milanesi, vol. v), Laderchi, *Storia dell'arte* (1795), I. Lermohoff (Morelli), *Galleria Borghese e Doria Pamfili and Galleria a Dresden*, E. Gardner, *The Painters of the School of Ferrara* (1911), C. Zwanziger, *Dosso Dosso* (1911). H. Mendelsohn *Dosso Dosso* (1913).

DOST MOHAMMED KHAN (1793-1863), founder of the dynasty of the Barakzai in Afghanistan, was born in 1793. His elder brother, the chief of the Barakzai, Fateh Khan, took an important part in raising Mahmud to the sovereignty of Afghanistan in 1800 and in restoring him to the throne in 1809. But Mahmud secured his assassination in 1818, and thus incurred the enmity of his tribe. After a bloody conflict Mahmud was deprived of all his possessions but Herat, the rest of his dominions being divided among Fateh Khan's brothers. Of these Dost Mohammed received Ghazni, to which in 1826 he added Kabul, he at once found himself involved in disputes with Ranjit Singh, the Sikh ruler of the Punjab, who used the deposed Saduzai prince, Shuja ul-Mulk, as his instrument. In 1834 Shuja made a last attempt to recover his kingdom. He was defeated by Dost Mohammed under the walls of Kandahar but Ranjit Singh seized the opportunity to annex Peshawar. The recovery of this fortress became the Af-

ghan Amir's great concern. Rejecting overtures from Russia, he sought alliance with England, and welcomed Alexander Burnes to Kabul in 1837. But the governor general, Lord Auckland, did not respond to the Amir's advances. Dost Mohammed was enjoined to abandon the attempt to recover Peshawar, and to place his foreign policy under British guidance. In return he was only promised protection from Ranjit Singh, of whom he had no fear. He replied by renewing his relations with Russia, and in March 1839 a British force under Sir Willoughby Cotton advanced through the Bolan pass, and on April 25, it reached Kandahar. Shah Shuja was proclaimed Amir and entered Kabul on Aug. 7, while Dost Mohammed sought refuge in the Hindu Kush. On Nov. 4, 1840, he surrendered. He remained in captivity during the British occupation, during the disastrous retreat of the army of occupation in Jan. 1842 and until the recapture of Kabul in the autumn of 1842. He was then freed.

On his return from India Dost Mohammed was received in triumph at Kabul. From 1846 he renewed his policy of hostility to the British and allied himself with the Sikhs, but after the defeat of his allies at Gujrat on Feb. 21, 1849, he led his troops back into Afghanistan. In 1850 he conquered Balkh, and in 1854 acquired control over the southern Afghan tribes by the capture of Kandahar. On March 30, 1855, he concluded an offensive and defensive alliance with the British government. In 1857 he declared war on Persia in conjunction with the British and in July a treaty was concluded by which the province of Herat was placed under a Barakzai prince. During the Indian mutiny Dost Mohammed punctiliously refrained from assisting the insurgents. His later years were disturbed by troubles at Herat and in Bukhara. These he composed for a time, but in 1862 a Persian army, acting in concert with Ahmad Khan, advanced against Kandahar. The old Amir called the British to his aid and, putting himself at the head of his warriors, drove the enemy from his frontiers. On May 26, 1863, he captured Herat, but on June 9 he died suddenly in the midst of victory, after playing a great role in the history of central Asia for 40 years. He named as his successor his son, Sher Ali Khan.

See Mohan Lal, *Life of Dost Mohammed Khan* (London, 1846).

DOSTOIEVSKI, THEODORE (FYODOR) MIKHAYLOVICH (1821-81), Russian writer, b. Moscow Oct. 30 (o.s.), 1821, his father of Ukrainian extraction, his mother of Moscow merchant stock. He was educated in Moscow, and at the School of Military Engineers in St. Petersburg (Leningrad). In 1841 he obtained a commission in the army, but three years later he left the service to devote himself to literature. In 1845 he completed his first novel, *Poor Folk*. Its publication, in the following year, was one of the great events which marked the coming of a new literary age in Russia. Dostoevski came to be regarded as the most promising of the young novelists. But his second novel, *The Double*, published before the end of the same year (1846) disappointed the critics, and his success began to wane. He continued, however, to work with great productivity for the next three years, producing a great number of novels and stories, among which the most important are *Mr. Prokharchin*, *The Landlady* and *Netochka Nezvanova*. These early works display the strong influence of Gogol, and to a less extent of Balzac. Unlike the later work they betray intense interest in problems of form, and a great variety and conscious originality of verbal expression. Passionate sympathy with the humiliated and the down-trodden, and intense interest in morbid psychology (*The Double*) are already very apparent. In *Netochka Nezvanova* (1849) appears for the first time that type of "proud girl" which was to play such a prominent part in the great novels of his maturity. Though Dostoevski had quarrelled with the liberal litterateurs owing to their failure to appreciate *The Double* and to their constant prickings, and his morbid self-consciousness suffered from the systematic teasing of some of them (especially Turgenev), he continued to be intimate with another circle of advanced young men who, under the guidance of Petrashevski, met to study the French socialists and discuss social and political reform in Russia.

The reactionary wave that followed 1848 brought with it the arrest (April 23, 1849) and trial of the Petrashevski circle.

Dostoevski and the other "conspirators" were condemned to deportation, but a bogus sentence of death was read to them and mock preparations for the execution were gone through the real sentence being communicated to them only at the last moment before the expected volley (Dec 21, 1849). These moments produced a fatal impression on Dostoevski and he alludes to them more than once in his later work. His epilepsy, the first traces of which go back to before the sentence, was greatly aggravated by it. For four years Dostoevski was a convict in the penal settlement of Omsk. These years profoundly changed his mind, and it was then that he evolved his new Christianity, which was essentially based on worshipping Christ because he was worshipped by the Russian people. Early in 1854 he was released from prison and transferred to a private to a unit stationed in Siberia. In 1855, he had his commission restored to him, and in 1859 he was finally amnestied and allowed to live in the capitals. In Siberia he fell in love and married Marie Isaeva, a sensual and crude woman, who brought him no happiness. From 1856 onwards he was able to resume his literary work. His first novel after these seven years of enforced silence was the *Memor of Stepanchikov* (English version—*The Family Friend*) (1859), written in Siberia. Its central figure of Foma Opiskin is one of the greatest, and most repulsive, satirical character creations in Russian literature. After his return to St. Petersburg he published *The House of Death* (1861), in which he embodied his prison impressions, and which remained till after his death the most generally popular of his works, and *The Insulted and the Injured* (1862), in which the influence of the more sentimental aspects of Dickens are plainly apparent.

At the same time he engaged in journalism, trying to steer an independent course between the conservatives and the freethinking radicals. His programme was a democratic and Christian nationalism, equally hostile to reaction and to aesthetic radicalism, and inspired by a faith in the Russian peasant people, as the depository of supreme spiritual values. With his brother Michael and several other valuable allies, he started a review, *Vremya* (*The Times*) which, in spite of hostility from both right and left, succeeded in winning the public ear and was financially a success. In 1863 it was, however, suppressed by the Government on what soon proved a misunderstanding. The Dostoevskis were allowed to revive the review under a new name (*Epokha*), but the new publication failed to revive the success of its predecessor. Michael Dostoevski died (1864), and after a year and more of struggle against adverse circumstances Dostoevski succumbed, discredited the review and found himself burdened with debts he was unable to pay, besides the obligation of keeping his brother's family.

This crisis coincided with a profound crisis of his inner life. His first wife died. Before her death he had already become intimate with Pauline Suslova, a young woman of sensual, proud and "demonic" character. His brief intimacy with her appears to have been one of the crucial experiences of his life. In 1863 he travelled with Pauline abroad, strengthening his aversion from bourgeois civilization and contracting the gambling habit. In 1864 he published *Letters from the Underworld* which marks a turning point in his work and from which we must date the final maturity of his genius. After the failure of *The Epoch* Dostoevski became a victim to the callous exploitation of publishers, for whom he had to work by writing with superhuman speed such works as *Crime and Punishment* (1866) and *The Gambler* (1867). While writing when he employed as secretary Anna Grigorievna Shtikina, whom in 1867 he married. This coincided with a complete financial collapse. He went abroad to escape his creditors, and for four years he lived there, passing much of his time at the gambling house of Baden-Baden. Only gradually, by dint of hard work at the series of novels that have since made his name famous in the world was he able once again to support himself.

In 1871 he returned to Russia, and soon obtained a situation as editor of a conservative weekly (1873-74). After 1876 he published and edited a journal of his own, *An Author's Diary*, in which he continued the line of national and democratic Christianity started by the *Vremya*. He became influential as a journalist

and his last years were spent in comparatively favourable circumstances. His contemporary fame reached its culminating point in 1880, after his address on the unveiling of the Pushkin memorial, the most characteristic and impassioned of his non-literary work. He died on Jan 28, 1881. His funeral was accompanied by an inspiring public demonstration.

The work that has made Dostoevski a world classic belongs to the last 17 years of his life. The series of his great novels is ushered in by *Letters from the Underworld* (1864) which may be considered as the central work of Dostoevski. It marks the crisis which changed him, from the humanitarian idealist and dreamer of his early years, into the tragic creator of his full maturity. As in his great novels, the main subject is the problem of human liberty and of the justification of God and the World Order. The great novels that followed were *Crime and Punishment* (1866), *The Idiot* (1868-69), *The Demons* (1871, Eng version *The Possessed*) and *The Brothers Karamazov* (1880), to which must be added *The Gambler* (1867), *The Eternal Husband* (1870), *A Raw Youth* (1875) and some shorter pieces included in *An Author's Diary*. These last, though much shorter, are sometimes of first-rate importance for the understanding of Dostoevski (especially *Bobok* and *The Dream of a Quaker Fellow*). In these works Dostoevski gave his full measure as one of the greatest novelists of all times, and as a personality of exceptionally deep significance. For psychological imagination, for power of dramatic construction, for the convincingness and reality of his characters he has no equals. As a thinker, we have to distinguish between the "Christian and national" element of his journalistic writings and of the less inspired parts of his novels (*viz.*, the preachings of Father Zossima in *The Brothers Karamazov*), and the profound Jobean and Promethean questioning of the main great novels, whose only peers in modern times are Pascal and Nietzsche. His influence on Russian literature was greatest between 1895 and 1915. His ideas always loomed larger than his imaginative creation. Europe began to show a passionate interest in him from about 1905. His influence on French, German and English literature within the last 20 years has been considerable.

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DOETHAN, a city in the extreme southeastern part of Alabama, U.S., the county seat of Houston county. It is on federal highways 84, 231 and 241, and is served by the Atlanta and St. Andrews Bay, the Altantic Coast Line and the Central of Georgia railways. Pop (1950) 21,536, (1940) 17,194, by the federal census. Doethan is the centre of a profitable farming and stock raising region. The Orangeburg and Norfolk soils drain well and encourage a high state of cultivation. A number of small diversified manufacturing industries are located in Doethan. The city was founded in 1884 and incorporated in 1885.

DOUAI, a town of northern France, capital of an arrondissement in the department of Nord, 20 mi S of Lille on the Northern railway between that city and Cambrai. Pop (1946), 37,258. Douai, the site of which was occupied by a castle (*Castrum Duacense*) as early as the 7th century, belonged in the middle ages to the counts of Flanders, passed in 1384 to the dukes of Burgundy, and so in 1477 with the rest of the Netherlands to Spain. In 1667 it was captured by Louis XIV, and was ceded to France by the treaty of Utrecht in 1713. Historically Douai is

important as the centre of the political and religious propaganda of the exiled English Roman Catholics. In 1562 Philip II of Spain founded a university here, in which several English scholars were given chairs, and in connection with this William Allen (*q.v.*) in 1568 founded the celebrated English college. It was here that the "Douai Bible" was prepared. There were also an Irish and a Scots college and houses of English Benedictines and Franciscans. All these survived till 1793, when the university was suppressed. The modern university is at Lille. Douai stands in a marshy plain on the banks of the Scarpe which supplies water to a canal on the west. The old fortifications, of which the Porte de Valenciennes (15th century) survives are now boulevards and gardens. The industrial towns of Dornignies, Sin Noble and Améche are practically suburbs of Douai. The church of Notre Dame (12th and 14th centuries) possesses a fine altar piece (early 16th century) of wooden panels painted by Jean Bellelégambé of Douai. The handsome hotel de ville, partly of the 15th century, has a lofty belfry. The Palais de Justice (18th century) was formerly the town house (*refuge*) of the abbey of Marchiennes. Houses of the 16th, 17th and 18th centuries are numerous. The municipal museum contains a good library, and a fine collection of sculpture and paintings but was damaged in World War I.

Douai is the seat of a court of appeal, a court of assizes and of a subprefect and has a tribunal of first instance, a board of trade arbitrators, an exchange, a chamber of commerce and a branch of the Bank of France. Its educational institutions include a lycée, training colleges, a school of mines, an artillery school, schools of music, agriculture, drawing, architecture, etc. and a national school for instruction in brewing and other industries connected with agriculture. In addition to other iron and engineering works, Douai has a large cannon foundry and an arsenal, coal mining and the manufacture of glass bottles and chemicals are carried on on a large scale in the environs, among the other industries are flax spinning, ropemaking and the manufacture of farm implements, oil and sugar. Trade, which is largely water-borne, is in grain and agricultural products, coal and building material.

See F. Brasseur, *Hist du château et de la châtellenie de Douai* (Douai, 1877-87); C. Mine, *Hist pop de Douai* (ib. 1861); B. Ward, *Dawn of the Catholic Revival* (London, 1900); Handecquer, *Hist du Collège anglais, Douai* (Reims, 1898); Daucoune, *Etablissements britanniques à Douai* (Douai, 1881).

DOUARNENEZ, a fishing-port of western France, in the department of Finistère, on the southern shore of the Bay of Douarnenez 15 mi NW of Quimper by rail. Pop. (1936), 10,556. About 800 boats, and between 3,000 and 4,000 men, carry on the sardine fishery from June to December, and the preserving of the fish is an important industry. Mackerel and tunny fishing, boat-building and rope and net making also occupy the inhabitants. There is a lighthouse on the small island of Tristan off Douarnenez.


DOUBLE, twice as much, or large, having two parts, having a part repeated (from the Mid Eng *double*, through the Old Fr *double*, from Lat *duplus*, twice as much). The word appears as a substantive with the special meaning of the appearance to a person of his own apparition, generally regarded as a warning, or of such an apparition of one living person to another, the German *Doppelgänger* (see APPARITIONS). "Double" is also used of a person whose resemblance to another is peculiarly striking or remarkable, so that confusion between them may easily arise.


Double or doubles, in music, is an old and now obsolete term for instrumental variations, derived possibly from the fact that more often than not each succeeding variation "doubled" the notes of the preceding one, two quavers taking the place of one crotchet, and so on. The word "doubles" is also applied in bell-ringing terminology to a "change" in which two pairs of bells change places.

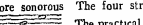
DOUBLE BASS, the largest member of the violin family and the lowest in pitch (Fr *contrebasse*, Ger *Kontrabass*, Gross Bass Geige; Ital *contrabbasso, violone*). The double bass differs slightly in construction from the other members of the family in that it has more slanting shoulders (one of the features of the *viola da gamba*, see VIOLIN). Formerly, too, the double bass was made with a flat back—another characteristic of the viol family—

whereas now the back is as often found arched as flat.

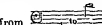
The technique of the double bass presents certain difficulties inherent in an instrument of such large proportions. The stretches for the fingers are very great, almost double those required for the violoncello, and owing to the thickness of the strings great force is required to press them against the finger board when they are vibrating.

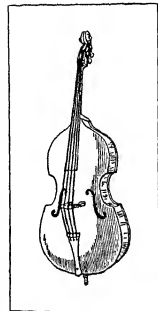
The double bass sometimes has three strings tuned, in England and Italy in fourths , in France and Germany

in fifths , the real sounds being an octave lower.

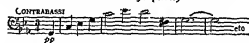
Owing to the scoring of modern composers, however, it was found necessary to adopt an accordance of four strings in order to obtain the additional lower notes required, although this entailed the sacrifice of some beauty of tone, the three stringed instrument being more sonorous. The four strings are tuned in fourths .

The practical compass of the double bass

extends from  (real sounds) with all chromatic



BY COURTESY OF CARL FISCHER, INC.
DOUBLE BASS LAST SURVIVING
REPRESENTATIVE OF THE EARLIER
VIOLS



These opening bars are played *so* by cellos and double basses, a daring innovation of Beethoven's which caused quite a consternation at first in musical circles. Still more striking is the famous passage, suggesting the gambols of an elephant, which the double basses are called on to play at the opening of the trio of the same movement.

The remote origin of the double bass is the same as that of the violin. It was evolved from the bass viols, though whether the transformation took place simultaneously with that of the violin from the treble viol, or preceded it, has not been definitely proved.

Giovanni Bottesini (1822-89) was the greatest virtuoso on the double bass that the world has ever known. Before him, Domenico Dragonetti (1763-1846) also enjoyed great fame, while more recently Kussevitsky, who later exchanged the bow for the bâton and became a world renowned conductor, was for some years a leading exponent of the instrument.

DOUBLE ENTRY—see BOOKKEEPING

DOUBLE FUGUE, in music, a fugue with two subjects, worked together or interwoven (See FUGUE.)

DOUBLE JEOPARDY The 5th Amendment to the U.S. Constitution provides no one shall be "twice put in jeopardy" no one punished or acquitted of an offense may be tried

DOUBLE LIABILITY, in the United States, applies to the stockholders' liability in certain corporations, signifying that, in case of insolvency, the stockholders may not only lose the amount which they invested in their stock but may also be called upon ratably for the concern's indebtedness up to an additional amount equal to the full par value of the stock. Thus double liability does not apply to stocks of ordinary business corporations but to banking corporations. The laws of most States make State chartered banks subject to double liability, and the national banking laws make double liability apply to the stock of national banks. The national bank act in providing for double liability on national bank stock provides "except that shareholders of any banking association now existing under state laws having not less than five million dollars of capital actually paid in and a surplus of twenty per centum on hand, both to be determined by the Comptroller of the Currency, shall be liable only to the amount invested in their shares." At the time of the passage of the act, the National Bank of Commerce of New York city met the above requirements and so its stock became the exception to the double liability for national banks

DOUBLE-NAME PAPER, notes, bills of exchange or acceptances bearing two names, each of which represents a separate interest and each of which is responsible for the payment. The names may represent a signature and an endorsement, or two signatures. The former class is often known as endorsed paper, and both classes are commonly known as two name paper. Trade acceptances and bankers' acceptances necessarily have two or more names and both the drawer and the acceptor are liable for the payment (See ACCEPTANCE, BILL OF EXCHANGE, NOTE, DRAFT)

DOUBLE REFRACTION, the resolution, on entering a non-isotropic medium, of light into two rays travelling with different velocities (See LIGHT)

DOUBLE STAR see BINARY SYSTEM AND STAR

DOUBLE-STOPPING, a musical term signifying the playing of two notes simultaneously on a stringed instrument of the violin family. In strictness the term should not be applied when one of the notes is an "open" one and has therefore not entailed any "stopping," i.e., pressing down of the string against the fingerboard by the finger, whereby its vibrating length is shortened, but in practice the distinction is not observed.

DOUBLET, a close fitting garment, with or without sleeves, extending from the neck to a little below the waist, worn from the 14th century to the time of Charles II, when it began to be superseded by coat and waistcoat. The doublet was introduced into England from France, and was originally padded for defence or warmth. "Doublet" is also used of a pair or couple, as in philology, one of two words differing in form, but represented by an identical root, e.g. "alarm" or "alarum", in optics, of a pair of lenses, combined to correct aberration. In the work of the lapidary a doublet is a counterfeit gem, made by cementing two pieces of plain glass or crystal on each side of a layer of glass (colored or otherwise) and the edges are polished, so that portions

of the two pieces of glass are cemented together, so that the light passing through the doublet is refracted in such a manner as to give the appearance of a single gem.

DOUBS, a river of eastern France, rising in the Jura at the foot of the Noirmont ridge, at a height of 3,074 ft., and flowing into the Saône. It is 269 m. long, though, owing to the fact that it doubles back upon itself, the distance from source to mouth in a direct line is only 56 miles. Its basin has an area of 3,020 sq. miles. The river begins by flowing north east and traverses the Lake of St. Point and passes Pontarlier. Thenceforth its course lies chiefly through wooded limestone gorges of great grandeur. After skirting the town of Morteau, below which it expands into the Lake of Challexon and descends over the Fall of the Doubs (88 ft.), the river for about 28 m. forms the frontier between France and Switzerland. It flows in the latter country for some distance and then turns abruptly westward. Thus far the Doubs has been flowing between the folds of the Jura, but when it comes against the shattered southern face of the old block of the Vosges its course is rapidly altered. After turning westward it finds its way through this complicated country by turning north, and finally, at Voujeaucourt, south-west. Below that town the river is joined by the canal from the Rhone to the Rhine, to accommodate which its course has been canalized as far as Dôle. The Doubs passes Clerval and Baume-les-Dames to Besançon. The lower section of its course is in the great

while the rest of the department is traversed by the remaining three mountain ranges, the highest and most easterly of which contains the Mont d'Or (4,800 ft.). Besides the Doubs the chief rivers are its tributaries, the Dessoubre, watering the east of the department, and the Loue its south western portion. The climate is in general cold and rainy, and the winters are severe. The soil is stony and loamy, and at the higher levels there are many peat-bogs. In its agricultural aspect the department may be divided into three regions. The highest, on which the snow usually lies from six to eight months in the year, is in part barren, but on its less exposed slopes is occupied by forests of fir trees, and affords good pasturage for cattle. In the second or lower region the oak, beech, walnut and sycamore flourish, and the valleys are capable of cultivation. The region of the plain is the most fertile, and produces all kinds of cereals as well as hemp, vegetables, vines and fruit. Cattle rearing and dairy-farming receive much attention, large quantities of cheese, of the nature of Gruyere, are produced, mainly by the co-operative cheese factories or *franchises*. The rivers of the department abound in gorges and falls of great beauty. The most important manufactures are watches, made chiefly at Besançon and Morteau, hardware (Hermoncourt and Valentigney), and machinery. Large iron foundries are found at Audincourt (pop. 9,308) and other towns. Distilling and paper are also carried on. Exports include watches, live-stock, wine, vegetable, iron and hardware, cattle, hides, timber, coal, wine and machinery are imported. Large quantities of goods, in transit between France and Switzerland, pass through the department. Among its mineral products are building stone, rock salt and lime, and there are peat workings. Doubs is served by the Paris-Lyon railway, the line from Dole to Switzerland passing, via Pontarlier, through the south of the department. The canal from the Rhone to the Rhine traverses it for 84 miles.

The department of Doubs is divided into the arrondissements of Besançon, Baume les-Dames, Montbéliard and Pontarlier, with 37 cantons and 636 communes. It belongs to the *académie* (educational circumscription) and the diocese of Besançon, which is the capital, the seat of an archbishop and of a court of appeal, and headquarters of the VII army corps. Besides Besançon the chief towns are Montbéliard and Pontarlier (20,000). Ornans, a town on a feudal castle. Montbenoit on the Doubs near Pontarlier has the remains of an Augustine abbey (13th to 16th centuries), the cloisters are of the 15th century, and the church contains fine 16th century stalls. Morteau has the Maison Perussier, of the Renaissance period. Baume-les-Dames owes the affix of its name to a Benedictine convent founded in 763, to which only noble ladies were admitted. Numerous antiquities have been found at Mandeuve (near Montbéliard), on the site of the Roman town of *Epomanduodurum*.

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structural depression between the Cote d'or and the Jura. After passing Dôle it leaves the high ground and enters the plain of the Saône. Here it receives the waters of the Loue, which also has a complicated structural history, finding its way, like the Doubs, between the outer folds of the Jura—sometimes parallel with them and sometimes cutting across them, and finally falling into the great structural depression with the lower Doubs and Saône. The Doubs reaches the Saône at Verdun sur le Doubs. The river is navigable only for approximately 8 miles above its mouth.

DOUCE, FRANCIS (1757–1834), English antiquary, was born in London. He interested himself in antiquities, and was for a short time keeper of manuscripts in the British Museum. He left his books, illuminated manuscripts, coins, etc., to the Bodleian library, his own manuscript works to the British Museum, but they were returned, and his printings, carvings and miscellaneous antiquities to Sir Samuel Meyrick, who published an account of them, entitled *The Doucean Museum*. His published works are *Illustrations of Shakespeare and Ancient Manners* (2 vols., 1807), and *Dissertation on the Various Designs of the Dance of Death* (1833), the substance of which had appeared forty years before. He also contributed a considerable number of papers to the *Archæologia* and *The Gentleman's Magazine*.

DOUGHBOY, in the 17th century, signified "dumpling." During the American Civil War it was applied to the mass buttons on uniforms and thence to infantrymen. At a period not exactly ascertained the word was supposed to come from the dough like appearance of a uniform soiled by moistened pipe clay. Again, infantrymen were said to march in "dough" during wet weather. "Adobe" furnishes a similar derivation, although it may be a "popular etymology," or wholesale transference of a foreign word to an English meaning and spelling. "Doughboys" was a favourite designation for the United States soldiers during the World War. See J. H. Moss, *Officers' Manual* (1909), G. P. Krapp, *The English Language in America* (2 vols., 1926).

DOUGHERTY, PAUL (1877–1947), American painter, was born at Brooklyn (N.Y.), on Sept. 6, 1877. He was educated at the Brooklyn Polytechnic Institute and the New York Law School, where he took the degree of LL.B. in 1898. He then spent five years in Europe, devoting himself to the study of art. His first picture was exhibited at the Paris Salon in 1901. He was chiefly concerned with marine subjects, in which he achieved great success, being awarded the Osborne Prize (1906), the Inness Gold Medal and the Carnegie Prize, National Academy of Design (1913), the gold medal at the San Francisco exposition (1915), and the Altman Prize (1918). Among his more important pictures are "October Seas," "The Road to Cayey," and "Lake Louise," in the Metropolitan Museum, New York City; "The Land and the Sea," in the Corcoran gallery, Washington; "Tlood Tide," in the Carnegie Institute, Pittsburgh; "Moonlight Cove," in the Toledo museum; "Sun and Storm," in the National gallery, Washington; and "A Freshening Gale," in the Albright Art gallery, Buffalo. He died on Jan. 9, 1947, at Palm Springs, Calif.

DOUGHTY, SIR ARTHUR GEORGE (1860–1936), Canadian historian and archivist, was born March 27, 1860, at Maidenhead, England, educated at Oxford, and Dickinson college, Carlisle, Pa. He went to Montreal as a journalist and private secretary, becoming in 1901 joint librarian of the provincial records, and in 1904 Dominion archivist and keeper of the records. He was appointed deputy minister in 1912, in which year he also became joint editor, with Adam Shortt, of the series, *Canada and its Provinces*. His chief works are *Tennyson* (1893), *Siege of Quebec* (6 vols., 1901); *Documents Relating to the Constitutional History of Canada* (1907–18), *The Cradle of New France* (1908), *The Acadia Exiles* (1915), and *The Canadian Archives and its Activities* (1924).

DOUGHTY, CHARLES MONTAGU (1843–1926), British traveller and writer, younger son of the Rev. C. M. Doughty of Thiberton Hall, Suffolk, was born on Aug. 19, 1843. He was prevented by an impediment in speech from entering the navy, and his education was continued at King's college, London, and at Caius and Downing colleges, Cambridge, where he graduated in

natural science in 1865. He turned then to independent travel and study, freely adventuring in his chosen fields of geology, archaeology and philology. And he did so in no half-hearted way. In Norway, Oxford, Leyden, Louvain, Italy, Spain, North Africa and Greece he served a long novitiate in wandering and scholarship which led him at last to Syria, Palestine and his adventures in Arabia.

In Nov. 1876 Doughty set out from Damascus with a pilgrim caravan. At Madain Salih he left the Hajj, and surveyed the Al-Hijr monuments and inscriptions. He then decided to reach independently the oasis of Khairah, and to this end attached himself to wandering Bedouins. Dependent on their movements, his dangers were now multiplied and his life was repeatedly endangered by the inevitable suspicion, fanaticism and treachery which on occasion broke through the respect and hospitality which Doughty's courageous personality compelled. He reached Khairah from Tama in the summer of 1877, was sent back to Hail, thence to Al-Qasim, Buraidah and Anazir. From there, after some months, he travelled southwards towards Mecca and reached safety at Jidda in Aug. 1878. The story of this great journey, which threw many fresh lights on the geology, hydrography and ethnology of Arabia, Doughty told in *Travels in Arabia Deserta* (1888, abridged edition 1926). Doughty was less concerned to produce a chronicle or work of information than to create, out of his unique experience, an unique monument of what he considered pure English prose. To him, this meant the achievement of an Elizabethan directness of utterance and the renunciation of all post-Elizabethan growths in syntax and vocabulary. He succeeded. His profound literary sense had told him aright when it inspired him to treat his remote and lonely adventures in this bare, majestic style.

The later years of Doughty's life, mostly spent in England, were given over to poetry. Essentially, indeed, he was always a poet, in his deep comprehension of the values of words no less than in his power of penetrating into the living past, whether of a country's physical structure or of its people and their life. Fourteen years' labour produced his epic, *The Dawn in Britain* (1906), his other long poems and poetic dramas including *The Cliffs* (1909), *The Clouds* (1912), *The Titans* (1916) and *Man-soul* (1920, new edition 1923). Like *Arabia Deserta*, the poems he wrote reflect his Elizabethan predilections. He died at Sissinghurst, Kent, on Jan. 20, 1926. (J. H. M.)

DOUGHTY-WYLLIE, CHARLES HOTHAM MONTAGU (1868–1915), British soldier and consul, was born at Leston, Suffolk, on July 23, 1868, and was educated at Winchester and Sandhurst, from which he passed into the Royal Welch Fusiliers in 1889. He was on active service in India in the Hazara (1897) and Chitral (1895) campaigns. He also served with great distinction in the Egyptian campaign of 1898, in the Boer War, in the China Field Force (1900), and as special service officer in Somaliland. But the field in which his remarkable force of character was most clearly shown was in the Near East. In Sept. 1906 Doughty-Wyllie was appointed military consul at Konieh, in Anatolia, and in 1909 Cilicia was added to his area. In that year an attempted massacre of the Christian population of Adana was stopped by his courage and quickness, when he collected a small group of Turkish regulars, and saved the Armenian quarter. The next four years were spent as consul at Addis Ababa, Abyssinia, but the outbreak of war brought him back to England. He was attached to Sir Ian Hamilton's staff for the Gallipoli expedition, and went ashore with the first batch of troops on the "River Clyde." His gallant exploit on V Beach on April 26, 1915, when he captured Hill 141 in hand-to-hand fighting, cost him his life. Doughty-Wyllie was buried on the spot.

See an article, based on personal knowledge, by D. G. Hogarth, in the *Diet Nat. Biog. Supp.* 1912–21 (1927).

DOUGLAS, the name of a Scottish noble family, now represented by the dukes of Hamilton (Douglas-Hamilton, heirs male), the earls of Home (Douglas-Home) who also bear the title of Baron Douglas of Douglas, the dukes of Buccleuch and Queensberry (Montagu Douglas-Scott), the earls of Morton (Douglas), the earls of Wemyss (Wemyss Charters Douglas),

and the baronets Douglas of Carr, of Springwood, of Glenherve, etc. The marquessate of Douglas and the earldom of Angus, the historic dignities held by the two chief branches of the family, the Black and the Red Douglas, are merged in the Hamilton peerage. The name represented the Gaelic *dubh glas*, dark water, and Douglasdale, the home of the family in Lanarkshire, is still in the possession of the earls of Home. The first member of the family to emerge with any distinctness was William de Douglas, or Douglas, whose name frequently appears on charters from 1175 to 1213. He is said to have been brother, or brother-in-law, of Freskin of Murray, the founder of the house of Murray. His second son, Bruce (d. 1222), became bishop of Moray, while the estate fell to the eldest, Sir Archibald (died c. 1240).

SIR WILLIAM OF DOUGLAS (d. 1298), called "*le hardy*," Archibald's grandson, first formally assumed the title of lord of Douglas. He gave a grudging allegiance to John de Baliol, and swore fealty to Edward I. In 1291, but when the Scottish barons induced Baliol to break his bond with Edward I, he commanded at Berwick Castle, which he surrendered after the sack of the town by the English in 1296. After a short imprisonment Douglas was restored to his Scottish estates on renewing his homage to Edward I, but his English possessions were forfeited. He joined Wallace's rising in 1297, and died in 1298, a prisoner in the Tower of London.

His son, SIR JAMES OF DOUGLAS (1286-1330), lord of Douglas, called the "Good," was educated in Paris. On his return he found an Englishman, Robert de Clifford, in possession of his estates. His offer of allegiance to Edward I being refused, he cast in his lot with Robert Bruce, whom he joined before his coronation at Scone in 1306. From the battle of Methven he escaped with Bruce and the remnant of his followers, and accompanied him in his wanderings in the Highlands. In the next year they returned to the south of Scotland. He twice outwitted the English garrison of Douglas and destroyed the castle. One of these exploits, carried out on Palm Sunday, March 19, 1307, with barbarities excessive even in those days, is known as the "Douglas Larder." Douglas routed Sir John de Mowbray at Ederford Bridge, near Kilmarnock, and was entrusted with the conduct of the war in the south, while Bruce turned to the Highlands. He made many successful raids in the English border, which won for him the dreaded name of the "Black Douglas" in English house-holds. Through the capture of Roxburgh Castle in 1314, by stratagem, the assaults being disguised as black oxen, he secured Teviotdale, and at Bannockburn, where he was knighted on the battlefield, he commanded the left wing with Walter the Steward. During the 13 years of intermittent warfare that followed he repeatedly raided England. He slew Sir Robert de Nevill, the "Peacock of the North," in single combat in 1316, and in 1319 he invaded Yorkshire, in company with Randolph, defeating an army assembled by William de Melton, archbishop of York, at Mitton-on-Swale (Sept. 20), in a fight known as "The Chapter of Myton." In 1322 he captured the pass of Byland in Yorkshire, and forced the English army to retreat. He was rewarded by the "Emerald Charter," granted by Bruce, which gave him criminal jurisdiction over the family estates, and released the lords of Douglas from various feudal obligations. In a daring night attack on the English camp in Weardale in 1327 Douglas came near capturing Edward III. himself. After laying waste the northern coun-

try of Douglas, The inheritance fell to his brother, a churchman, Hugh the "Dull" (b. 1294), who surrendered his lands to David II, and a regrant was made to William Douglas, next referred to.

WILLIAM DOUGLAS, 1ST EARL OF DOUGLAS (c. 1327-1384), had been educated in France, and returned to Scotland in 1348. In 1353 he killed in Ettrick forest his kinsman, William, the knight of Liddesdale (c. 1300-1353), known as the "Flower of Chivalry," a descendant of a younger son of the original William de Douglas. Some of the Liddesdale funds fell to his kinsman and murderer, who was created earl of Douglas in 1358. In 1357 his marriage with Margaret, sister and heiress of Thomas, 13th earl of Mar, eventually brought him the estates and the earldom of Mar. He was one of the securities for the payment of David II's ransom, and in consequence of the royal misappropriation of some moneys raised for this purpose, Douglas was for a short time in rebellion in 1363. In 1364 he joined David II in seeking a treaty with England which should deprive Robert the Steward, formerly an ally of Douglas, of the succession by putting an English prince on the Scottish throne. The independence of Scotland was to be guaranteed, and a special clause provided for the restoration of the English estates of the Douglas family. On the accession of Robert II he was nevertheless reconciled, becoming justiciar of southern Scotland, and the last years of his life were spent in making and repelling border raids. He died at Douglas in May 1384, and was succeeded by his son James. By his wife's sister-in-law, Margaret Stewart, countess of Angus in her own right, and widow of the 13th earl of Mar, he had a son George, afterwards 1st earl of Angus.

JAMES, 2ND EARL OF DOUGLAS AND MAR (c. 1358-1388), married Lady Isabel Stewart, daughter of Robert II. In 1385 he made war on the English with the assistance of a French contingent under John de Vienne. He allowed the English to advance to Edinburgh, wisely refusing battle, and contented himself with a destructive counter-raid on Carlisle. In 1388 Douglas captured Hotspur Percy's pennon in a skirmish near Newcastle. Percy sought revenge in the battle of Otterburn (Aug. 1388), which ended in a victory for the Scots and the capture of Hotspur and his brother, though Douglas fell in the fight. The struggle, narrated by Froissart, is celebrated in the English and Scottish ballads called "Chevy Chase" and "The Battle of Otterburn." The earl left no legitimate male issue. His natural sons William and Archibald became the ancestors of the families of Douglas of Drumlanck (see QUEENSHERRY EARLS, MARQUESSSES AND DUKES OF) and Douglas of Cavers. His sister Isabel became countess of Mar inheriting the lands of Mar and his unentailed estates.

The earldom and entailed estates of Douglas reverted by the patent of 1358 to ARCHIBALD DOUGLAS, 3RD EARL OF DOUGLAS, called "The Grim" (c. 1328-c. 1400), a natural son of the "good" Sir James. He was warden of the western marches, lord of Galloway in 1369, increased his estates by his marriage with Joanna Moray, heiress of Bothwell, and by his purchase of the earldom of Wigton in 1372. During the intervals of war with the English he imposed feudal law on the border chieftains, drawing up a special code for the marches. He was twice sent on missions to the French court. The power of the Black Douglas overshadowed the Crown under the weak rule of Robert III., and in 1399 he arranged a marriage between David, duke of Rothesay, the king's son and heir, and his own daughter, Marjory Douglas. A natural son of Archibald, Sir William of Douglas, lord of Nithsdale (d. 1397), married Egidy, daughter of Robert III.

Archibald the Grim was succeeded by his eldest son, ARCHIBALD, 4TH EARL OF DOUGLAS, 1st duke of Touraine, lord of Galloway and Annandale (1369?-1424), who married in 1390 Lady Margaret Stewart, eldest daughter of John, earl of Carrick, afterwards King Robert III. In 1400 March and Hotspur Percy had laid waste eastern Scotland as far as Lothian when they were defeated by Douglas (the master of Douglas) near Ples on. With the regent, ROBERT, duke of Albany, he is suspected of complicity in the murder (March 1402) of David duke of Rothesay, who was in their custody at Falkland Castle but who he actually declared guilty of by the parliament. In the year Douglas raided England and was taken prisoner at Homildon Hill by the Percys. He

His half-brother, Sir Archibald, created Edward Baliol at Annan in 1332, and had just been appointed regent of Scotland for David II. when he risked a pitched battle at Halidon Hill, where he was defeated and killed (1333), with his nephew William, lord

fought on the side of his captors at Shrewsbury (1403), and was taken prisoner by the English king, Henry IV. He became reconciled, during his captivity, with the earl of March, whose lands had been conferred on Douglas, but were now, with the exception of Annandale, restored. He returned to Scotland in 1409, but was in constant communication with the English court for the release of the captive king, James I. In 1412 he had visited Paris, when he entered into a personal alliance with John the Fearless, duke of Burgundy, and in 1423 he commanded a contingent of 10,000 Scots sent to the help of Charles VII against the English. He was made lieutenant general in the French army, and received the peerage duchy of Touraine with remainder to his heirs male. The new duke was defeated and slain at Verneuil (1424) with his second son, James, his persistent ill-luck earned him the title of the Tyneman (the loser).

ARCHIBALD, 5TH EARL OF DOUGLAS (c. 1391-1439), succeeded to his father's English and Scottish honours, though he never touched the revenues of Touraine. He fought at Baugé in 1421, and was made count of Longueville in Normandy.

His two sons, WILLIAM, 6TH EARL (1423?-1440), and David, though they were little more than boys at the time of their father's death in 1439, were summoned to court by Sir William Crichton, lord chancellor of Scotland, on Nov. 24, 1440, and, after a mock trial in the young king's presence, were beheaded forthwith in the courtyard of Edinburgh Castle. This murder broke up the dangerous power wielded by the Douglasses. The lordships of Annandale and Bothwell fell to the Crown, Galloway to the earl's sister Margaret, the "Fair Maid of Galloway", while the Douglas lands passed to his great-uncle JAMES DOUGLAS, 7TH EARL OF DOUGLAS, called the "Gross", of Balvany (1371-1444), lord of Aberdeen and Aberdour, earl of Avondale (c. 1437), younger son of the 3rd earl.

The latter's sons, WILLIAM (c. 1425-1452) and JAMES (1426-1488), became 8th and 9th earls respectively. Archibald became earl of Moray by marriage with Elizabeth Dunbar, daughter and co-heiress of James, earl of Moray. Hugh was created earl of Ormond in 1445, John was lord of Balvany, Henry became bishop of Dunkeld.

The power of the Black Douglasses was restored by the 8th earl, who recovered Wigton, Galloway and Bothwell by marriage (by papal dispensation) with his cousin, the Fair Maid of Galloway. He was soon high in favour with James II, and procured the disgrace of Crichton, his kinsmen's murderer, by an alliance with his rival, Sir Alexander Livingstone. In 1450 James raided the earl's lands during his absence on a pilgrimage to Rome, but their relations seemed outwardly friendly until, in 1452, the king invited Douglas to Stirling Castle under a safe conduct, in itself, however, a proof of strained relations. There James demanded the dissolution of a league into which Douglas had entered with Alexander Lindsay, the "Liger" earl (4th) of Crawford. On Douglas's refusal the king murdered him (Feb. 22) with his own hands, the courtiers helping to despatch him. The tales of the hanging of Sir Herbert Horries of Terregles and the murder of McLeilan of Bombie by Douglas rest on no sure evidence.

JAMES DOUGLAS, 9TH EARL (and last), denounced his brother's murderers and took up arms, but was obliged by the desertion of his allies to submit. He obtained a papal dispensation to marry his brother's widow, in order to keep the family estates together. He intruded with the English court, and in 1455 rebelled once more. Meanwhile another branch of the Douglas family, known as the Red Douglas, had risen into importance (see ANGUS, EARLS OF), and George Douglas, 4th earl of Angus (d. 1463), great-grand son of the 1st earl of Douglas, took sides with the king against his kinsmen. James Douglas, again deserted by his chief allies, fled to England, and his three brothers, Ormond, Moray and Balvany, were defeated by Angus at Arkinholm on the Esk. Moray was killed, Ormond taken prisoner and executed, while Balvany escaped to England. Their last stronghold, the Threave in Galloway, fell, and the lands of the Douglasses were declared forfeit, and were divided among their rivals, the lordship of Douglas falling to the Red Douglas, 4th earl of Angus. In England the earl of Douglas was employed by Edward IV. In 1461 to negotiate

a league with the western highlanders against the Scottish kingdom. In 1484 he was taken prisoner while raiding southern Scotland, and was relegated to the abbey of Lindores where he died in 1488.

The title of Douglas was restored in 1633 when WILLIAM, 11th earl of Angus (1589-1660), was created 1ST MARQUESS OF DOUGLAS by Charles I. In 1645 he joined Montrose at Philiphaugh and was imprisoned in 1646 at Edinburgh Castle, only obtaining his release by signing the Covenant. His eldest son, Archibald, created earl of Ormond, Lord Bothwell and Harbottle, in 1651, predeceased his father, Lord James Douglas (c. 1617-1645) and his half-brother, Lord George Douglas (c. 1636-1692), created earl of Dumbarton in 1675, successively commanded a Scots regiment in the French service. William (1635-1694), created earl of Selkirk in 1646, became 3rd duke of Hamilton after his marriage (1656) with Anne, duchess of Hamilton in her own right. By the failure of heirs in the elder branches of the family the dukes of Hamilton (q.v.) became heirs male of the house of Douglas.

JAMES DOUGLAS, 2ND MARQUESS OF DOUGLAS (1646-1700), succeeded his grandfather in 1660. His eldest son, John, by courtesy earl of Angus, raised a regiment of 1,200 men, first known as the Angus regiment, later as the Cameronians (26th Foot). He was killed at its head at Steinkirk in 1692. The younger son, ARCHIBALD, 3RD MARQUESS (1694-1761), was created duke of Douglas in 1703, but the dukedom became extinct on his death, without heirs, in 1761. He was a consistent supporter of the Hanoverian cause, and fought at Sheriffmuir. The heir presumptive to the Douglas estates was his sister, Lady Jane Douglas (1698-1753), who in 1746 secretly married Colonel, afterwards Sir, John Stewart of Grandall, by whom she had twin sons, born in Paris in 1748. These children were alleged to be spurious, and when Lady Jane and the younger of the two boys died in 1753, the duke refused to acknowledge the survivor as his nephew, but in 1760 he was induced, under the influence of his wife, to revoke a will devising the estates to the Hamiltons in favour of Lady Jane's son, Archibald James Edward Stewart (1748-1827), 1st Baron Douglas of Douglas (c. 1790) in the British peerage. The inheritance of the estates was disputed by the Hamiltons, representing the male line, but the House of Lords decided in favour of Douglas in 1769. Three of his sons succeeded Archibald Douglas as Baron Douglas, but as they left no male issue the title passed to the earls of Home, Cospatrick Alexander, 11th earl of Home, having married a granddaughter of Archibald, 1st Baron Douglas. Their descendants, the earls of Home, represent the main line of Douglas on the female side.

BIBLIOGRAPHY—David Hume of Godscroft (1567?-1630), who was secretary to Archibald Douglas, 8th earl of Angus, wrote a *History of the House and Race of Douglas and Angus*, printed under his daughter's superintendence (Edinburgh, 1644). He was a partial historian, and his account can only be accepted with caution. Modern authorities are Sir William Fraser, *The Douglas Book* (4 vols., Edinburgh, 1885), and Sir H. Maxwell, *History of the House of Douglas* (3 vols., 1902). See also G. E. C. (Osborne), *Peerage, and Douglas's Scots Peerage, Calendar of State Papers, Scottish Series, The Hamilton Papers*, etc.

DOUGLAS, SIR CHARLES WHITTINGHAM HORSLEY (1830-1914), British general, was born on July 17, 1850, at the Cape of Good Hope. Entering the army when 19, he saw service with the 92nd Highlanders in the Afghan War of 1879-80, in the Boer War of 1881, in the Sudan campaign of 1884 and in the South African War of 1899-1901. In 1895 he had been made deputy assistant adjutant-general at Aldershot, in 1898 he became a colonel, in 1904 adjutant general at the War Office and member of the new Army Council, in 1909 general officer commanding in chief, southern command, in 1910 full general, 1912 inspector-general, home forces, and in 1914 chief of the Imperial General Staff. Up to the time of his death on Oct. 25, 1914, he assisted Kitchener at the War Office.

DOUGLAS, DAVID (1798-1834), Scottish botanist, was born at Scone, Perthshire. After being a gardener at the botanical gardens of Glasgow, he went to Oregon in 1823 as a collector to the Royal Horticultural Society, in 1825 pushing on to British Columbia where he discovered many new plants, trees and birds, and in 1827 reaching Hudson Bay. From 1830 to 1834 he explored

California and the Fraser river region. He died in the Sandwich islands July 12, 1834. He introduced into Britain many trees, shrubs and plants and gave his name to the Douglas spruce.

DOUGLAS, GAVIN (1474?-1522), Scottish poet and bishop, third son of Archibald, 5th earl of Angus (called the "great earl of Angus" and "Bell the Cat"), was born c. 1474, probably at one of his father's seats. He was a student at St Andrews, 1489-94, and thereafter it is supposed at Paris. In 1496 he obtained the living of Monymusk, Aberdeenshire, and later he became parson of Lynton (*mod* Linton) and rector of Hauch (*mod* Prestonkirk), in East Lothian, and about 1501 was preferred to the deanery or provostship of the collegiate church of St Giles, Edinburgh, which he held with his parochial charges. From this date till the battle of Flodden, in Sept. 1513, he appears to have been occupied with his ecclesiastical duties and literary work. Indeed all the extant writings by which he has earned his place as a poet and translator belong to this period. After the disaster at Flodden he was completely absorbed in public business. Three weeks after the battle he, still provost of St Giles, was admitted a Burgess of Edinburgh, his father, the "Great Earl," being then civil provost of the capital. The latter dying soon afterwards (Jan. 1514) in Wigtownshire, where he had gone as justiciar, and his son having been killed at Flodden, the succession fell to Gavin's nephew Archibald (6th earl). The marriage of this youth to James IV's widow on Aug. 6, 1514 did much to identify the Douglases with the English party in Scotland, as against the French party led by Albany, and incidentally to determine the political career of his uncle Gavin. During the first weeks of the queen's sorrow after the battle, Gavin, with one or two colleagues of the council, acted as personal adviser, and it may be taken for granted that he supported the pretensions of the young earl. The first outcome of the new connection was his appointment to the abbacy of Aberbrothock by the queen regent, before her marriage, probably in June 1514. Soon after the marriage she nominated him archbishop of St Andrews, in succession to Elphinstone, archbishop-designate. But Hepburn, prior of St Andrews, having obtained the vote of the chapter expelled him, and was himself in turn expelled by Forman, bishop of Moray, who had been nominated by the pope. In the interval, Douglas's rights in Aberbrothock had been transferred to James Beaton, archbishop of Glasgow. The breach between the queen's party and Albany's had widened, and the queen's advisers had begun an intrigue with England, for the removal of the royal widow and her young son to Henry's court. In those deliberations Gavin Douglas took an active part, and for this reason stimulated the opposition which successfully thwarted his preferment.

In Jan. 1515 on the death of George Brown, bishop of Dunkeld, the queen nominated him to the see, which he ultimately obtained, though not without trouble. For the earl of Athole had forced his brother, Andrew Stewart, prebendary of Craig, upon the chapter, and had put him in possession of the bishop's palace. The queen appealed to the pope and was seconded by Henry VIII, and the pope's sanction was obtained on Feb. 18, 1515. Some of the correspondence of Douglas and his friends incident to this transaction was intercepted. When Albany came from France and assumed the regency, these documents and the "purchase" of the bishopric from Rome contrary to statute were made the basis of an attack on Douglas, who was imprisoned in Edinburgh Castle, thereafter in the castle of St Andrews (under the charge of his old opponent, Archbishop Hepburn), and later in the castle of Dunbar, and again in Edinburgh. The pope's intervention procured his release, after nearly a year's imprisonment. The queen meanwhile had retired to England. After July 1516 Douglas appears to have been in possession of his see, and to have patched up a diplomatic peace with Albany.

On May 17, 1517 the bishop of Dunkeld proceeded with Albany to France to conduct the negotiations which ended in the Treaty of Rouen. He was back in Scotland towards the end of June. Albany's longer absence in France permitted the party-faction of the nobles to come to a head in a plot by the earl of Arran to seize the earl of Angus, the queen's husband. The issue of this plot was the well-known fight of "Clear-the-Causeway," in which

Gavin Douglas's part stands out in picturesque relief. The triumph over the Hamiltons had an unsettling effect upon the earl of Angus. He made free of the queen's rents and abducted Lord Traquair's daughter. The queen set about to obtain a divorce, and used her influence for the return of Albany as a means of undoing her husband's power. Albany's arrival in Nov. 1521, with a large body of French men-at-arms, compelled Angus, with the bishop and others, to flee to the Borders. From this retreat Gavin Douglas was sent by the earl to the English court, to ask for aid against the French party and against the queen, who was reported to be the mistress of the regent. Meanwhile he was deprived of his bishopric, and forced, for safety, to remain in England, where he effected nothing in the interests of his nephew. The declaration of war by England against Scotland, in answer to the recent Franco-Scottish negotiations, prevented his return. His case was further complicated by the libellous animosity of Beaton, archbishop of St Andrews (whose life he had saved in the "Clear-the-Causeway" incident), who was anxious to thwart his election to the archbishopric of St Andrews, now vacant by the death of Forman. In 1522 Douglas was stricken by the plague which raged in London, and died at the house of his friend Lord Dacre. During the closing years of exile he was on intimate terms with the historian Polydore Vergil, and one of his last acts was to arrange to give Polydore a corrected version of Major's account of Scottish affairs. Douglas was buried in the church of the Savoy, where a monumental brass (removed from its proper site after the fire in 1864) still records his death and interment.

Douglas's literary work, now his chief claim to be remembered, belongs, as has been stated, to the period 1501-13, when he was provost of St Giles. He left four poems.

1. *The Palace of Honour*, his earliest work, is a piece of the later type of dream-allegory, extending to over 2,000 lines in nine-lined stanzas. The poem carries on the literary traditions of the courts of love, as shown especially in the "Romaunt of the Rose" and "The House of Fame." It is dedicated to James IV. No ms. of the poem is extant. The earliest known edition (c. 1553) was printed at London by William Copland, an Edinburgh edition, from the press of Henry Charters, followed in 1579.

2. *King Hart* described King Heart in his castle, surrounded by his five servants (the senses), Queen Plesance, Foresight and other courtiers. The poem runs to over 600 lines and is written in eight-lined stanzas. The text is preserved in the Maitland folio ms. in the Pepysian library, Cambridge. It is not known to have been printed before 1786, when it appeared in Pinkerton's *Ancient Scottish Poems*.

3. *Conscience* is in four seven-lined stanzas. Its subject is the "conceit" that men first clipped away the "con" from "conscience" and left "science" and "na mair." They then lost "sci," and had nothing but "ens" ("that schrew, Riches and gear").

4. Douglas's longest, last, and in some respects most important work is his translation of the *Aeneid*, the first version of a great classic poet in any English dialect. The work includes the 13th book by Mapheus Vegus, and each of the 13 books is introduced by a prologue. The subjects and styles of these prologues show great variety, some have little or no connection with the books which they introduce, and were perhaps written earlier and for other purposes. In the first, or general, prologue, Douglas attacks Caxton for his inadequate rendering of a French translation of the *Aeneid*. That Douglas undertook this work and that he makes a plea for more accurate scholarship in the translation have been the basis of a prevalent notion that he is a Humanist in spirit and the first exponent of Renaissance doctrine in Scottish literature. Careful study of the text will not support this view. Douglas is in all important respects even more of a medievalist than his contemporaries, and, like Henryson and Dunbar, strictly a member of the allegorical school and a follower, in the most generous way, of Chaucer's art. There are several early mss. of the *Aeneid* extant: (a) in the library of Trinity College, Cambridge, c. 1525, (b) the Elphinstoun ms. in the library of the University of Edinburgh, c. 1525, (c) the Ruthven mss. in the same collection, c. 1535, (d) in the library of Lambeth Palace, 1545-46. The first printed edition appeared in London in 1553. An Edinburgh edition was

issued from the press of Thomas Ruddiman in 1710.

For Douglas's career see, in addition to the public records and general histories, Bishop Sma's *Life* in Ruddiman's edition, and that by John Smill in the first volume of his edition of the *Works of Gavin Douglas* (4 vols, 1874, the only collected edition of Douglas's works). A new edition of the texts is much to be desired. On Douglas's place in Scottish literature see SCOTTISH LITERATURE, also G. Gregory Smith's *Transition Period* (1900) and chapters in the *Cambridge History of English Literature* vol. II (1905). P. LANE's dissertation *Chaucer's Einfluss auf die Originaldichtung, den des Schotten Gavin Douglas* (Halle, 1885) draws attention to Douglas's indebtedness to Chaucer. Further discussion of the question of Douglas's alleged Homericism will be found in Courthope's *History of English Poetry*, I (1891), T. F. Henderson's *Scottish Renaissance Literature* (1898), and J. H. MILLER's *Literary History of Scotland* (1903). For the language of the poem see G. GREGORY SMITH'S *Specimens of Middle Scots* (1902).

DOUGLAS, SIR HOWARD, BART (1776-1861), British general, younger son of Admiral Sir Charles Douglas, was born at Gosport in 1776. He was commissioned second lieutenant in the Royal Artillery in 1794. In 1795 he was shipwrecked while in charge of a draft for Canada and lived with his men for a whole winter on the Labrador coast. In 1804 he was placed in charge of the senior department of the R.M.C. at High Wycombe, the forerunner of the Staff College. Douglas served in 1808-09 and again in 1812 in the Peninsula, but was recalled to the Royal Military College. In 1816 appeared his *Essay on the Principles and Construction of Military Bridges* (subsequent editions 1837, 1853), in 1819, *Observations on the Motives, Errors and Tendency of M. Carnot's System of Defence* and in 1820 his *Treatise on Naval Gunnery*, which became a standard text book, and indeed first drew attention to the subject of which it treated. From 1823 to 1831 Sir Howard Douglas was governor of New Brunswick, and had to deal with the Maine boundary dispute of 1828. He also founded Fredericton college. On his return to Europe he published *Naval Evolutions*, a controversial work dealing with the question of 'breaking the line' (1822). Douglas was lord high commissioner of the Ionian islands (1835-40), and sat in Parliament from 1842 to 1847. His later works included *Observations on the Modern System of Fortification*, etc. (1859) and *Naval Warfare Under Steam* (1858 and 1860). He died on Nov. 9, 1861, at Tunbridge Wells. Douglas was a F.R.S., one of the founders of the R.G.S., held many honours. He was created full general in 1851.

See S. W. FULLON, *Life of Sir Howard Douglas* (1862), and *Gentleman's Magazine*, 3rd series, xii 90-92.

DOUGLAS, SIR JAMES (1803-1877), Canadian administrator, was born on June 5, 1803, in Lanarkshire, Scotland where he was educated. In 1820 he went to Canada, and four years later became the organizer of the property of the Hudson's Bay company west of the Rockies. In 1830 he was transferred to Ft. Vancouver in the Oregon Territory, where he extended the company's forts. In 1843 he made Camosun, the place where Victoria now stands, the chief northern centre of the fur trade. After the north-west Boundary Treaty of 1846, which moved the British frontier back to the 49th parallel, Douglas was appointed senior officer of the western department, and in 1851 became governor of Vancouver. In 1859 his statesmanship made possible the joint occupation of the island of San Juan by an equal number of British and American troops. When British Columbia was made a Crown colony in 1858, Sir James Douglas held its governorship with that of Vancouver until 1863. He died at Victoria on Aug. 1, 1877.

See COATS and GOSNELL, *Sir James Douglas* (Makers of Canada Series, vol. IV, 1926).

DOUGLAS, SIR ROBERT KENNAWAY (1838-1913) English orientalist, was born in Devon. In 1858 he became attached to the Chinese Consular Service. Seven years later he returned to England and was made assistant in charge of the Chinese library in the British Museum and, in 1893, keeper of the Oriental books in the British Museum. He was also professor of Chinese in London. He died at Chippenham on May 20, 1913. His chief publications are *Life of Yen-chiu K'iao* (trans. from Chinese, 1877), *Confucianism and Taoism* (1879), *China* (1882), *Society in China* (1894), *Li Hung Chang* (1895), and *Europe and the*

Far East (1904).

DOUGLAS, STEPHEN ARNOLD (1813-1861), American political leader, was born in Brandon, Vt., on April 23, 1813. Left in infancy to the care of a widowed mother and a bachelor uncle, he became a cabinet maker's apprentice in Middlebury and Brandon. He attended schools at Brandon and Canandaigua, N.Y., and began the study of law. In 1833 he went west and finally settled in Jacksonville, Ill., where he was admitted to the bar in March 1834. From the first he took an active interest in politics and his rise was remarkably rapid. In Feb. 1835 he was elected public prosecutor of the first judicial circuit, in Dec. 1836 he became a member of the State legislature. In 1837 he was appointed by President Van Buren registrar of the land office at Springfield, which had just become the State capital. In 1840 he did much to carry the State for Van Buren, and for a few months he was secretary of State of Illinois. He was a judge of the supreme court of Illinois from 1841 to 1843. In 1843 he was elected to the national House of Representatives.

In Congress, though one of the youngest members, he at once sprang into prominence by his clever defence of Jackson for alleged contempt of court in New Orleans. He was soon recognized as one of the ablest and most energetic of the Democratic leaders. An enthusiastic believer in the destiny of his country and more especially of the West, and a thorough going expansionist, he heartily favoured the measures which resulted in the annexation of Texas and in the Mexican War—in the discussion of the former foreshadowing his doctrine of "popular sovereignty." Taking an active share in the Oregon controversy, he opposed yielding "one inch" of the territory to Great Britain and advocated extending United States settlements under military protection. He was an advocate of the construction, by the aid of Government land grants, of a trans-continental railway, and the chief promoter (1850) of the Illinois Central. As chairman of the committee on territories, at first in the House, and then in the Senate, of which he became a member in Dec. 1847, he introduced the bills for admitting Texas, Florida, Iowa, Wisconsin, Minnesota, California and Oregon into the Union, and for organizing the Territories of Minnesota, Oregon, New Mexico, Utah, Washington, Kansas and Nebraska.

In the bitter debates concerning the keenly disputed question of slavery in the Territories, Douglas was particularly prominent. Against slavery itself he seems never to have had any moral antipathy, and his first wife and children were by inheritance the owners of slaves, though he himself never was. He did more, probably, than any other one man, except Henry Clay, to secure the adoption of the Compromise Measures of 1850. Nevertheless the bill for organizing the Territories of Kansas and Nebraska, which Douglas reported in Jan., 1854, and which in amended form was signed by the president on May 30, reopened the whole slavery dispute—wintonly, his enemies charged, for the purpose of securing Southern support—and caused great popular excitement. It repealed the Missouri Compromise, and declared the people of "any State or Territory" "free to form and regulate their domestic institutions in their own way, subject only to the Constitution of the United States", that is, "popular sovereignty" or "squatter sovereignty" would determine the admission of slavery. The passage of this Kansas Nebraska bill, one of the most momentous in its consequences ever passed by the Federal Congress, was largely a personal triumph for Douglas, who showed marvelous energy, adroitness and resourcefulness, and a genius for leadership but was universally condemned in the free States. His hostility to "know-nothingism" and his plea for religious toleration also caused him trouble, but in 1852 and again in 1856 he was a strong candidate for the presidential nomination in the National Democratic Convention.

In 1857 he broke with President Buchanan and the "administration" Democrats and lost much of his prestige in the South, but partially restored himself to favour in the North, and especially in Illinois, by his vigorous opposition to the method of voting on the Lecompton constitution, which he maintained to be fraudulent and (in 1858) to the admission of Kansas into the Union under this constitution. In 1858, when the Supreme Court, after

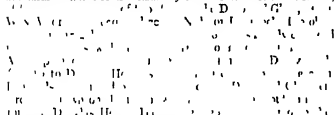
the vote of Kansas against the Lecompton constitution, had decided that Kansas was a "slave" territory, thus quashing Douglas's theory of "popular sovereignty," he engaged in Illinois in a close contest for the senatorship with Abraham Lincoln, the Republican candidate, whom he met in a series of debates. Although in Illinois his followers did not poll so large a vote as Lincoln's, Douglas won the senatorship by a vote in the legislature of 54 to 46. In the senate he was not reappointed chairman of the committee on territories.

In 1860, in the Democratic national convention in Charleston, the adoption of Douglas's platform brought about the withdrawal from the convention of Alabama, Mississippi, Louisiana, South Carolina, Florida, Texas and Arkansas. The convention adjourned to Baltimore, where the Virginia, North Carolina, Tennessee, Kentucky and Maryland delegations left it, and where Douglas was nominated for the presidency by the northern Democrats. He campaigned vigorously but hopelessly, boldly attacking disunion, and in the election, though his popular vote was 1,376,957, he received an electoral vote of only 12, against Lincoln's 180. Douglas urged the south to acquiesce in Lincoln's election, and he and his second wife, Adele Cutts, were among the foremost to welcome the Lincolns to Washington. On the outbreak of the Civil War he denounced secession as criminal, and was one of the strongest advocates of maintaining the integrity of the union at all hazards. At Lincoln's request he undertook a mission to the border states and the northwest to rouse the spirit of unionism; he spoke in West Virginia, Ohio and Illinois. He died on June 3, 1861, at Chicago, where he was buried on the shore of Lake Michigan.

In person Douglas was conspicuously small, being hardly five feet in height, but his large head and massive chest and shoulders gave him the popular sobriquet "The Little Giant." As a resourceful political leader, and an adroit, ready, skilful tactician in debate, he has had few equals in American history. His generosity in defeat, his courage and his capacity for inspiring warm personal friendships are among his most attractive qualities. It was regretted that his death came just when a new and great era of usefulness seemed opening before him.

One of the most sympathetic biographies is that by Allen Johnson (1860). Other biographies are by H. M. Flint (1860), J. W. Sheahan (1860), W. G. Brown (1902), Wm. Gardner (1905), C. E. Carr (1909), H. P. Willis (1910), and Louis Howland (1910). See also P. O. Ray, *Repeal of the Missouri Compromise* (1900), and an autobiographical sketch in the Ill. State Hist. Soc. Journal (vol. v, Oct., 1912).

DOUGLAS, capital of the Isle of Man, municipal borough and favourite watering place. Pop. (1939) 20,014. Area, 1.9 sq mi. It stands on a fine semicircular bay on the east coast of the island,



immediately north of this, vessels drawing 9 ft may enter it during neap tides, and those drawing 13 ft during spring tides. A castellated building (Tower of Refuge, 1832), marks the dangerous Conister rocks, north of the harbour entrance. The harbour is protected by three piers, the Battery pier, the Red pier and the Victoria pier (at which passengers can load and embark at all tides). There is regular daily communication with Liverpool, and during the season there are connections with Fleetwood, Heysham, Barrow, Dublin, Belfast and Glasgow. Douglas is connected by electric tramway northward with Laxey, the summit of the mountain of Snaefell and Ramsey, and southward with Port Soderick; while the Isle of Man railway runs to Peel in the west, and Castletown and Port Erin in the southwest. The various popular attractions include theatres, dancing halls, a racecourse and two golf links. The shore of the bay is of firm sand, and the sea bathing is good. Among buildings and institutions are the legislative buildings (1893), the town hall (1899), the free library,

the courthouse and the Isle of Man hospital. St. George's church, oldest in Douglas, dates from 1780. Douglas was incorporated in 1805.

DOUGLAS, a civil parish, Lanarkshire, Scotland. Pop. (1931) 2,948. It is on Douglas water, 4 mi. from Douglas station and 1½ mi. from Douglas West station, on the branch line of the LMSR from Cirstaurs to Av. SSW of Lanark. It is the original home of the Douglas family. Of the old castle, Scott's *Castle Dangerous*, only a tower exists, it repeatedly changed hands during the wars of Edward I. The modern castle is the seat of the Earl of Home. Only choir and spire remain of the 12th century church of St. Brude, patron saint of the Douglases. The vault beneath the choir was, until 1761, the burial place of the family, and it contains a silver case said to hold the ashes of the heart of the "good Sir James" (1286-1330). In 1879 the choir was restored and the tombs (including that of Sir James Douglas) repaired. On the hill of Auchenshugh, 2½ mi. SE, the Cameronians assembled in 1712 to renew the Solemn League and Covenant.

DOUGLAS, a city of Cochise county, Arizona, U.S.A., 25 mi. SE of Bisbee, on the Mexican border line. It is on federal highway 80 and the Southern Pacific railway and is served by air and bus lines. The population was 9,393 in 1950 and 8,623 in 1940 by the federal census. Cattle raising and copper smelting are the main occupations of this part of Arizona, and the Sonora mining region of Mexico lies directly south. The city has immense copper smelters, to which carloads of ore are brought daily from the mines at Bisbee and other points in Arizona and in Mexico. There was formerly a U.S. army post (Camp Harry J. Jones) at Douglas. The Coronado National forest, within which is the Chiricahua National monument, is 55 mi. north. Douglas was settled about 1904 and incorporated as a city in 1905.

DOUGLAS-FIR (*Pseudotsuga taxifolia*), an important North American timber tree of the pine family (Pinaceae), called also red fir, yellow-fir and Douglas spruce. Botanically it exhibits some of the characteristics of the firs and the hemlock, although it most closely resembles the spruces. It is found from South Dakota to British Columbia and southward to Texas and Mexico, but attains its maximum development in Washington and Oregon, where it forms immense forests, furnishing the valuable structural timber known also as the lumber trade as yellow fir, Oregon-fir or Oregon-pine. In the forests of Washington it commonly reaches a height of 180 ft or 190 ft with a trunk diameter of 3½ ft to 6 ft and sometimes attains a height of 250 ft and a trunk diameter of 10 ft or 12 ft. Among North American trees it is exceeded in height and massiveness only by the giant sequoias of California. According to the U.S. department of agriculture, the lumber cut of Douglas-fir in 1940 amounted to 7,121,000,000 bd ft, with a value at the mill exceeding \$140,000,000, in footage more than one-fourth of the total lumber cut of the United States during that year. Of this production of Douglas fir lumber the states of Washington and Oregon contributed more than 90%. The closely related bigcone-spruce (*P. macrocarpa*) a much smaller tree, native to southern California, with large cones sometimes 3 in. thick and 7 in. long, hanging from the widely spreading branches, is of value chiefly as cover on arid mountain slopes. (E. S. Hk.)

DOUGLASS, FREDERICK (1817-1895), American orator and journalist, was born in Tuckahoe, Md., probably in 1817. His mother was a Negro slave of exceptional intelligence, and his father was a white man. Until nearly eight years of age, he was under the care of his grandmother, then he lived for a year on the plantation of Col. Edward Lloyd, of whose vast estate his master, Capt. Aaron Anthony, was manager. After a year he was sent to Baltimore where he lived in the family of Hugh Auld, whose brother, Thomas, had married the daughter of Capt. Anthony. Mrs. Auld treated him with marked kindness and without her husband's knowledge began teaching him to read. With money secretly earned by blacking boots he purchased his first book, *The Columbian Orator*, he soon learned to write "free passes" for runaway slaves. Upon the death of Capt. Anthony in 1833, he was sent back to the plantation to serve Thomas Auld, who hired him out for a year to one Edward Covey, who had a

wide reputation for disciplining slaves, but who did not break Frederick's spirit. Although a new master, William Ireland, who owned a large plantation near St. Michael's, Md., treated him with much kindness, he attempted to escape in 1836, but his plans were suspected, and he was put in gaol. For lack of evidence he was soon released, and was then sent to Hugh Auld in Baltimore, where he was apprenticed as a ship caulker. He learned his trade in one year, and in Sept. 1838, masquerading as a sailor, he escaped by railway train from Baltimore to New York city. For the sake of greater safety he soon removed to New Bedford, Mass., where he changed his name from Frederick Augustus Washington Bailey to Frederick Douglass, "Douglass" being adopted at the suggestion of a friend who greatly admired Scott's *Lady of the Lake*. For three years he worked as a day labourer in New Bedford. An extempore speech made by him before an anti-slavery meeting at Nantucket, Mass., in Aug. 1841 led to his being appointed one of the agents of the Massachusetts Anti-Slavery Society, and in this capacity he delivered during the next four years numerous addresses against slavery, chiefly in the New England and middle states. To quiet the suspicion that he was an impostor, in 1845 he published the *Narrative of the Life of Frederick Douglass, an American Slave*. Learning his capture, his friends persuaded him to go to England, and in 1845-47 he lectured in Ireland, Scotland and England, and did much to enlist the sympathy of the British public with the Abolitionists in America. Before his return a sum of £150 was raised by subscription to secure his legal manumission, thus relieving him from the fear of being returned to slavery in pursuance of the Fugitive Slave law. From 1847 to 1866 he conducted an anti-slavery weekly journal known as *The North Star*, and later as *Frederick Douglass's Paper*, at Rochester, N.Y., and, during this time, also was a frequent speaker at anti-slavery meetings. At first a follower of Garrison and a disunionist, he allied himself after 1851 with the more conservative political abolitionists, who, under the leadership of James C. Birney, adhered to the national Constitution and endeavoured to make slavery a dominant political issue. He disapproved of John Brown's attack upon Harper's Ferry in 1859, and declined to take any part in it. During the Civil War he was among the first to suggest the employment of negro troops by the United States Government, and two of his sons served in the Union army. After the war he was for several years a popular public lecturer. In 1871 he was assistant secretary of the Santo Domingo commission, appointed by President Grant. He was marshal of the District of Columbia in 1877-81, was recorder of deeds for the district in 1881-86, and from 1889 to 1891 was the American minister resident and consul general in the Republic of Haiti. Douglass was widely known for his eloquence, and was one of the most effective orators whom the negro race has produced in America. He died in Anacostia Heights, D.C., on Feb. 20, 1895.

His autobiography appeared, after two revisions, as *The Life and Times of Frederick Douglass* (1882). See F. M. Holland, *Frederick Douglass, the Colored Orator* (1891), C. W. Chesnut, *Frederick Douglass* (Boston, 1899), and Booker T. Washington, *Frederick Douglass* (Philadelphia, 1907), in the series of American Crisis Biographies.

DOUKHOBORS, a name given by the Russian Orthodox clergy to a community of nonconformist peasants. The word signifies "spirit-fighters," and was intended by the priesthood to convey that they fight against the Spirit of God, but the Doukhobors themselves accepted it as signifying that they fight, not against, but for and with the Spirit, though later they decided to give up this name and call themselves "Christians of the Universal Brotherhood." The community was first heard of in the middle of the 18th century, by the beginning of the 19th their doctrine had become so clearly defined, and the number of their members had so greatly increased, that the Russian government and Church, considering the sect to be peculiarly obnoxious, started an energetic campaign against it. The foundation of the Doukhobors' teaching consists in the belief that the Spirit of God is present in the soul of man, and directs him by its word within him. They understand the coming of Christ in the flesh, His works, teaching and sufferings, in a spiritual sense. The object of the sufferings of Christ, in their view, was to give an example of suffering for truth

Christ continues to suffer in us even now when we do not live in accordance with the behests and spirit of His teaching. The whole teaching of the Doukhobors is penetrated with the Gospel spirit of love, worshipping God in the spirit, they affirm that the outward Church and all that is performed in it and concerns it has no importance for them, the Church is where two or three are gathered together, *i.e.*, united in the name of Christ. They pray inwardly at all times, on fixed days they assemble for prayer-meetings, at which they greet each other fraternally with low bows, thereby acknowledging every man as a bearer of the Divine Spirit. Their teaching is founded on tradition, which is called among them the "Book of Life," because it lives in their memory and hearts. It consists of sacred songs or chants, partly composed independently, partly formed out of the contents of the Bible, which, however, has evidently been gathered by them orally, as until lately they were almost entirely illiterate and did not possess any written book. They found alike their mutual relations and their relations to other people and to all living creatures exclusively on love, and therefore they hold all people equal and brethren. They extend this idea of equality also to the government authorities, obedience to whom they do not consider binding upon them in those cases when the demands of these authorities are in conflict with their conscience, while in all that does not infringe what they regard as the will of God they willingly fulfil the desire of the authorities. They consider killing, violence, and in general all relations to living beings not based on love as opposed to their conscience and to the will of God. They are industrious and abstemious in their lives, and when living up to the standard of their faith present one of the nearest approaches to the realization of the Christian ideal which has ever been attained. In many ways they have a close resemblance to the Quakers.

For these beliefs and practices the Doukhobors long endured cruel persecution. Under Nicholas I, in 1840 and 1850, when, on religious grounds, they refused to participate in military service, they were banished from the government of Tauris—whither they had been previously deported from various parts of Russia by Alexander I—to Transcaucasia, near the Turkish frontier. But neither the severe climate nor the neighbourhood of wild and warlike hillmen shook their faith, and in the course of half a century, in one of the most unhealthy and unfertile localities in the Caucasus, they transformed a wilderness into flourishing colonies, and continued to live a Christian and laborious life, making friends with, instead of fighting, the hillmen. But the wealth to which they attained in the Caucasus weakened for a time their moral fervour, and little by little they began to depart somewhat from the requirements of their belief. As soon, however, as events happened among them which disturbed their outward tranquility, the religious spirit which had guided their fathers immediately revived within them. In 1887, in the reign of Alexander III, universal military service was introduced in the Caucasus, and even those for whom, as in the case of the Doukhobors, it had formerly been replaced with banishment, were called upon to serve. This measure took the Doukhobors unawares, and at first they outwardly submitted to it. About the same time, by the decision of certain government officials, the right to the possession of the public property of the Doukhobors (valued at about £50,000) passed from the community to one of their members, who had formed out of the more demoralized Doukhobors a group of his own personal adherents, which was henceforth called the "Small Party." Soon afterwards several of the most respected representatives of the community were banished to the government of Archangel. This series of calamities was accepted by the Doukhobors as a punishment from God, and a spiritual awakening of a most energetic character ensued. The majority (about 12,000) resolved to revive in practice the traditions left them by their fathers, which they had departed from during the period of opulence. They again renounced tobacco, wine, meat and every kind of excess, many of them dividing up all their property in order to supply the needs of those who were in want, and they collected a new public fund. They also renounced all participation in acts of violence, and therefore refused military service. In confirmation of their sincerity, in the summer of 1895 the Doukhobors of the

"Great Party," as they were called in distinction from the "Small Party," burnt all the arms which they, like other inhabitants of the Caucasus, had taken up for their protection from wild animals, and those who were in the army refused to continue service. At the commencement of the reign of Nicholas II, in 1895, the Doukhobors became the victims of a series of persecutions, Cossack soldiers plundering, insulting, beating and maltreating both men and women in every way. More than 400 families living in the province of Tiflis were ruined and banished to Georgian villages, of 4,000 thus exiled, over 1,000 died in the course of the first two years from exhaustion and disease, and more would have perished had not information reached Tolstoy, and through him the Society of Friends in England, and funds were immediately raised for alleviating their sufferings. At the same time an appeal, written by Tolstoy and some of his friends, requesting the help of public opinion in favour of the oppressed Doukhobors, was circulated in St Petersburg and sent to the emperor and higher government officials. The Doukhobors themselves asked for permission to emigrate, and the Society of Friends petitioned the emperor to the same effect. In March 1898 the desired permission was granted, and the first party (1,136) in the summer were able to sail for Cyprus, which was originally chosen for their settlement because at that time funds were not sufficient for transferring them to any other British territory. Later it was found possible to send two parties of over 4,000 to Canada, whither they arrived in Jan. 1899. They were joined in the spring of the same year by the Cyprus party, and some 2,000 from the Caucasus, and in all about 7,500 Doukhobor immigrants arrived in Canada, the government allotting them land in the provinces of Assiniboia near Yorktown and of Saskatchewan near Thunder Hill and Prince Albert. They were very cordially received by the population of the Canadian port towns. In April 1901, in the Canadian House of Commons, the minister of justice made a statement about them in which he said that "not a single offence had been committed by the Doukhobors, they were law abiding, and if good conduct was a recommendation, they were good immigrants. The large tracts of land demanded population, and if they were not given to crime, the conclusion was that they would make good citizens." Nevertheless the Canadian government has had difficulties with the sect owing to their objection to acknowledge any allegiance except to their leader Verigin, who, however, proved himself an eminently practical man.

See V. Tcherikoff, *Christian Martyrdom in Russia* (1897), Aylmer Maude, *A Peculiar People* (N.Y., 1904), and ref. in article "Doukhobors," by A. A. Stambouli, in Hastings, *Encyclopaedia of Religion and Ethics*.

DOULLENS, a town of northern France, capital of an *arrondissement* in the department of Somme on the Authie, 27 mi N. of Amiens by rail. Pop. (1936) 4,429. Doullens, the ancient *Dulincum*, was an important stronghold in the middle ages. In 1475 it was burnt by Louis XI for openly siding with the Spaniards, but was restored to France by the treaty of Vervins (1598). It was an important British centre in the war of 1914-18. It has a citadel of the 15th and 16th centuries, now a girls' school. The old hotel de ville has a fine belfry and dates from the 15th to the 17th century. The town is the seat of a subprefect and has a tribunal of first instance, it has trade in phosphates, of which there are workings in the vicinity, and carries on cotton-spinning and the manufacture of leather and paper.

DOULTON, SIR HENRY (1820-1897), English inventor and manufacturer of pottery, was born in Vauxhall on July 25, 1820, and died in London on Nov. 18, 1897. From the age of 15 he was employed in the pottery works of his father, John Doulton, at Lambeth. One of the first results of his experiments was the production of good enamel glazes. In 1846 he initiated in Lambeth the pipe works for the manufacture of the drainage and sanitary appliances which have helped to make the firm of Doulton famous. In 1870 the manufacture of "Art pottery" was begun at Lambeth, and in 1877 works were opened at Burslem, and later at Rowley Regis, Smethwick, St. Helens, Paisley and Paris. After the Paris exhibition of 1878 Henry Doulton was

made a chevalier of the Legion of Honour. In 1872 the "Art department" was instituted in the Doulton works, giving employment to both male and female artists, amongst whom George Tinworth and the Misses Barlow obtained a reputation outside their immediate sphere. In 1885 Doulton was awarded the Albert medal by the Society of Arts, and was knighted in 1887.

DOUMER, PAUL (1857-1932), French statesman, was born at Aurillac on March 22, 1857, and entered the Chamber of Deputies in 1888. As minister of finance in the Bourgeois cabinet (Nov. 3, 1895, to April 21, 1896), he tried without success to introduce an income tax. In Jan. 1897 he became governor of Indo China, where he carried out important public works. In 1902 he returned to France and to the Chamber of Deputies. He refused to support the Combes ministry, and formed a Radical dissident group, which eventually caused the fall of the ministry. Doumer was elected president of the chamber in Jan. 1905, being re-elected in Jan. 1906. Senator in 1921, he was minister without portfolio in the Poincaré Government, and in 1921-22 and 1925-26 was minister of finance. In 1932, shortly after his election as president of the Republic, he was assassinated by a Russian. Doumer wrote *L'Indo-Chine française* (1903).

DOUMERGUE, GASTON (1863-1937), 12th president of the Third French Republic, was born at Aiguës-Vives on Aug. 1, 1863, and was educated at the Lycée at Nîmes. He studied law, became a barrister, and, after holding magisterial appointments in Cochinchina and Algiers, was elected deputy for Nîmes in 1893. In the Chamber he spoke with authority on colonial questions and was minister for the colonies in the Combes Government, 1902-05, being elected vice-president of the Chamber when this administration fell. In 1906 he was minister of commerce in the Sarraute cabinet, retaining his portfolio in the succeeding Clemenceau Government. When M. Clemenceau reconstituted his cabinet, M. Doumergue became minister of education and held the same post in the Brand ministry (July 1909 to Nov. 1910). In the latter year he became senator for the Gard Department and strongly advocated the Three Years' Military Service Bill.

On the fall of M. Barthou's administration in Dec. 1913, M. Doumergue formed a cabinet in which he himself took charge of foreign affairs. He was forced to resign, however, after the general elections of May 1914, which resulted in a majority in the Chamber opposed to the Three Years' Military Service law. On the outbreak of the World War he again became minister for the colonies in the Viviani Government of national defence. In 1917 he left the Government, and was sent on a mission of inquiry into conditions in Russia. On his return he re-entered the senate. After the resignation of M. Léon Bourgeois on Feb. 22, 1923, M. Doumergue was elected to succeed him as president of the senate. He supported the policy of M. Poincaré with regard to Germany and the Ruhr. On June 13, 1924, he was elected president, and remained in office until 1931. He was prime minister of a National Government from February to November, 1934.

DOUMIC, RENÉ (1860-1937), French critic and Academician, was born in Paris, and after a distinguished career at the Ecole Normale began to teach rhetoric at the Collège Stanislas. He was a contributor to the *Monteur*, the *Journal des Débats* and the *Revue bleue*, but was best known as the independent and uncompromising literary critic of the *Revue des Deux Mondes*. Many of his critical essays are reprinted in *Études sur la littérature française* (5 vols., 1896-1905), *Les Hommes et les idées du XIX^e siècle* (1903), etc. He died in Paris, Dec. 2, 1937.

DOUNE, a small burgh, Perthshire, Scotland, 8½ mi N.W. of Stirling by the L.M.S.R. Pop. (1938) 841. It is on the left bank of the Teith, here crossed by the bridge built in 1535 by Robert Spittal, tailor to James IV. The town was once famous for pistols and sporrans. Doune castle, in a commanding position on the Teith, is believed to have been built by Murdoch, 2nd duke of Albany (d. 1425). A nephew of Rob Roy held it for Prince Charlie, and it figures in Scott's *Waverley*. It belongs to the earl of Moray (Murray). The bres of Doune lie to the north-west of the town and extend towards Uam Var Deansdon, 1 mi S.W. of Doune, on the right bank of the Teith, has cotton mills, and was the scene of James Smith's (1789-1850) agricultural experi-

ments in deep ploughing and machine design

DOURO (Span. *Duero*, Port. *Douro*, anc. *Durnus*) a river of the Iberian peninsula. The Douro rises south of the Sierra de la Demanda in the Pico de Urbiön, an isolated mass 389 ft. high. It curves past Soria and then flows westward across Old Castile. It passes south of Valladolid and proceeds westward to the Portuguese frontier. The numerous tributaries have been most important influences in the growth of Castile's power in the middle ages. The northern tributaries, especially the Pisuegra, Valdeira duey and Esia, come from the region of heavy rainfall. The tributaries from the south, of which the Adaja, Tormes and Veltes are the most important, come from the drier Meseta.

From the great highland basin the Douro turns south-west, forming from a point east of Paradelia to Barca d'Alva a section of the boundary between Spain and Portugal. This marked north-east to south-west line of the middle Douro has some relation to the general direction of the old mountain ribs of the Meseta. The river leaves the ancient plateau in a series of deep gorges in the difficult country of northern Portugal. In this country it receives the Ageda, Cõa and Pava from the left, and the Sabor, Tusa and Tamega from the right. The river enters the Atlantic 3 m. below Oporto at São João da Foz. The probable length of the river is about 485 m., and the area of its basin upwards of 37,500 sq. miles. The rapids (*portos*) and gorges of the Portuguese section of the river seriously impede navigation. The lower reaches of the river are also liable to heavy floods. The difficulty of navigation is compensated for by the railway that follows the valley through most of the Portuguese section. The mouth of the river is partly blocked by a sand bar, which only allows small ships to enter. The large vessels have to be accommodated at Lervões, an artificial harbour to the north of the estuary. The Douro is the outlet for the important wine-producing region of the Pais do Vinho. The Douro yields an abundance of fish.

DOUROCOULI, the native name of a small group of American monkeys ranging from Nicaragua to Amazonia and eastern Peru, and forming the genus *Aotus*. In addition to the absence of prehensile power in their tails, dourocoulis are distinguished by their large eyes. The ears are short, and the hair round the eyes forms a disc. Dourocoulis live in parties and are nocturnal. They feed on insects and fruit and, when excited, utter piercing screams.

DOUSA, JANUS (JAN VAN DER DOES), lord of Noordwyck (1545–1604), Dutch statesman and scholar, was born at Noordwyck on Dec. 6, 1545, and studied at Delft, Louvain, Douai and Paris. His name stood first on the list of nobles who in 1565 formed a league against Philip II. of Spain. He was living at Leyden at the time of the famous siege, and took a gallant and leading part in the defence against the Spaniards. William the Silent made him first curator of the new university in Leyden, a post which he held for nearly 30 years. After the assassination of William, Dousa went to England to persuade Queen Elizabeth to support the cause of the States. The rest of his life was devoted to literary work. His position of keeper of the State archives put within his reach the materials for his valuable *Annals of Holland*. He also wrote commentaries on Horace, Plautus and Catullus. He died at Noordwyck on Oct. 8, 1604.

DOUVILLE, JEAN BAPTISTE (1794?–1837), French traveller, was born at Hambye (Maauche), and is said to have been murdered in 1837 on the banks of the São Francisco in Brazil. He received the gold medal of the Paris Société de Géographie for his *Voyage au Congo* (1832), but his account of his travels was proved to be fictitious and there is no evidence that he went beyond the coast. His narrative was based on unpublished Portuguese sources.

DOUW (or Dow), **GERRIT** (GERARD) (1613–1675), Dutch painter, was born at Leyden on April 7, 1613. His first instructor was Bartholomew Doelendo, an engraver, and he afterwards learned the art of glass painting under Peter Couwenhorn. In 1658 he became a pupil of Rembrandt, from whom he acquired his skill in colouring, and in the more subtle effects of lighting, and the style of Rembrandt is reflected in several of his earlier pictures, notably in a portrait of himself at the age of 22, in the Bridge-

water House gallery, London, and in the "Blind Tobit going to meet his Son," at Wardour castle, Wiltshire. England. His more mature manner was in some respects antagonistic to that of his master. He cultivated a minute treatment of his subjects, but notwithstanding his meticulous style, the general effect was harmonious and free from stiffness, and his colour was always admirably fresh and transparent. He was fond of representing subjects in lantern or candle light, the effects of which he reproduced with a fidelity and skill which no other master has equalled. He frequently painted by the aid of a concave mirror, and to obtain exactness looked at his subject through a frame crossed with squares of silk thread. His practice as a portrait painter, which was at first considerable, gradually declined, sitters being unwilling to give him the time that he thought necessary. His pictures were always small in size, and represented chiefly subjects in still life. Upwards of 200 are attributed to him, and specimens are to be found in most of the great public collections of Europe. Among his more famous works are the "Woman sick of the Dropsy," in the Louvre, the "Evening School," in the Amsterdam gallery, the "Poulterer's Shop," and a portrait of himself in the National Gallery, London. Douw's pictures brought high prices, and it is said that President Van Spring of The Hague paid him 1,000 florins a year simply for the right of pre-emption. Douw died in Leyden in Feb. 1675. His most celebrated pupil was Francis Miens.

See W. Martin, *Het leven en de werken van Gerrit Douw* (1901).

DOVE, ALFRED (1844–1916), German historian, was born on April 4, 1844, in Berlin, and studied medicine and science at Heidelberg and Berlin. From 1870 he edited *Grenzboten* and then *Im Neuen Reich*. In 1874 he became professor of history at Breslau and in 1884 at Bonn. In 1890 he edited the *Samtliche Werke* of von Ranke, whose posthumous manuscript, completing the *Weltgeschichte* he had already published and in 1891 the final volumes of Bismarck's speeches. Dove also wrote *Deutsche Gesch. im Zeitalter Friedrichs des Grossen u. Joseph II.* (1883), *Kaiser Wilhelms Geschichte* (1888), *Grossherzog Friedrich von Baden als Landesherren und deutscher Fürst* (1902). He died at Freiburg on Jan. 19, 1916.

DOVE, HEINRICH WILHELM (1803–1879), German meteorologist, was born at Lignitz, Silesia, on Oct. 6, 1803. He studied mathematics and physics at Berlin and Breslau. He was professor of physics at Königsberg (1836–39), supplementary professor (1839–45), and finally, professor of physics at Berlin. He made an exhaustive and exact study of the distribution of temperature over the surface of the earth, giving many of his results in carefully drawn maps. This work has been of great importance to geographers and geologists. He also carried out a series of investigations on winds and phenomena allied with winds, he was considerably hampered in this work by the fact that the barometers in use at the time did not give reliable readings. Dove was a foreign member of the Royal Society. He died at Berlin on April 6, 1879. Among his publications were *Über Mass und Messen* (1835), *Meteorologische Untersuchungen* (1837), and *Klimatologische Beiträge* (1857–69).

See H. Neumann, *H. W. Dove* (1925).

DOVE, a river of England, tributary to the Trent, rising in the Edg., Derbyshire, and through almost its entire course forming the boundary of that county with Staffordshire. In its upper course it traverses a fine narrow valley, where the limestone hills exhibit many picturesque cliffs, gullies and caves. Doveclade, that part between Dove Holes and Thropes Cloud, is especially famous. Below Thropes Cloud the Dove receives on the west the Manifold, which, like it, tributary, the Hamps, and other streams in the limestone district, has part of its course below ground. Near the village of Rocester the Churnet joins the Dove on the west, and then its course, hitherto southerly, bends nearly easterly on passing Uttoxeter, and, winding through a widening valley, joins the Trent below Burton-on-Trent at Newton Solney. The length of the valley is about 40 m. and the total fall of the river about 1,450 feet. The Dove is well known for trout-fishing, and Beresford Dale, below Hartington, has a special interest for fishermen through its associations with Isaac Walton and Charles Cotton, whose fishing house stands near the Pike Pool.

DOVE, a name applied to the smaller members of the order Columbidae, but no sharp distinction can be drawn between pigeons (*q.v.*) and doves

The English ring dove or wood pigeon (*Columba palumbus*) is a common bird in most parts of Europe, where it is the largest species. It may be recognized by the large white patches on the wings and the white spot (sometimes absent, however) on either side of the neck, whence it gets its name. Its familiar cooing song is remarkable for its abrupt close. It makes a slight platform of stick on the horizontal bough of a tree and thereon lays two white eggs. In the wild state, it is very wary and the flight is strong and rapid.

The stock dove (*C. oenas*) is smaller and breeds in hollow trees or rabbit holes. It is darker than the ring-dove, lacking the white on the wings and neck, and is locally distributed.

The rock-dove (*C. livia*) is the parent stock of our domestic pigeons. In the wild state it haunts the rocky coasts of Europe. Domestic pigeons have been classified by Darwin (*Variation of Animals and Plants under Domestication*) in four groups.

I The "Pouters," having the gullet of great size, barely separated from the crop and capable of inflation.

II Three races (1) "Carriers," with a long bill and eyes surrounded by bare skin (2) "Runts," with a long massive bill and large body (3) "Barbs," with a short bill and bare skin round the eyes. There are numerous sub races.

III An artificial group, comprising five races (1) "Fan-tails," whose tail may consist of 42 rectrices, instead of the normal 12 (2) "Turbits" and "Owls" with the feathers of the throat diverging and a short thick bill (3) "Tumblers," which tumble backwards during flight (4) "Frill backs," in which the feathers are reversed (5) "Jacobins," with the neck feathers forming a hood.

IV Resembling the normal form and including two races (1) "Trumpeters," with a tuft of feathers at the base of the neck, curling forward, and a peculiar voice (2) Pigeons scarcely differing from the wild stock.

The differences extend to every part of the body. Doves have from time immemorial been employed as messengers (*cf. Gen. viii. 8-12*).

The headquarters of the Columbidae are the Papuan sub region (see PIGEON).

The turtle dove of Europe (*Streptopelia turtur*) is a summer visitor to the northern parts of the Continent. The collared or Barbary dove (*S. decacotta*) is distinguished by its cream coloured plumage and black necklace.

In North America the name is given to the very widely distributed mourning dove (*Zenaidura macroura*), the white-fronted dove (*Leptotila verreauxi angelica*), from southern Texas to Guatemala, the ground dove (*Columbigalina passerina*), and the Inca dove (*Scardafella inca*) of Texas and Mexico.

DOVEKIE, the common name in North America for the little auk (*Plautus alle*) 8 in long breeding on rocky coasts and islands of the North Atlantic (See AUKS). The name is applied by sailors to the black gullie-mot (*See GULLIE-MOT*).

DOVER, GEORGE JAMES WELBORE AGAR-ELLIS, BARON (1797-1833), English man of letters, was the only son of the 2nd Viscount Clifden. He secured the grant of £57,000 to purchase John Julius Angerstein's collection of pictures, which formed the foundation of the National Gallery. He was president (1832) of the Royal Society of Literature, a trustee of the British Museum and of the National Gallery, and a commissioner of public records.

Lord Dover edited the *Ellis Correspondence* (1829) and *Walpole's Letters to Sir Horace Mann* (1833), and he was the author of some historical works.

DOVER, ROBERT (1575-1641), English captain and attorney, is known as the founder and director for many years of the "Cotswold Games," which he originated as a protest against the growing Puritanism of the day. These sports, which were referred to by contemporary writers as "Mr Robert Dover's Olympic Games upon the Cotswold Hills," consisted of cudgeling, wrestling, running at the quintain, juggling, casting the

bar and hammer, hand-ball, gymnastics, rural dances and games and horse racing, the winners in which received valuable prizes. They continued from about the year 1604 until three years after the death of Dover, which took place in 1641. They were revived for a brief period in the reign of Charles II.

DOVER, a seaport and municipal borough in the Dover Parliamentary division of Kent, England, one of the Cinque Ports, 76 mi. ESE of London by the Southern railway. Pop. (est. 1938) 39,950. Area, 5.7 sq. mi. It is situated at the mouth of a small stream, the Dour, whose valley here breaches the high chalk cliffs which fringe the coast on either hand. The dominant object is the castle, on the east height, 375 ft. above sea level. Within its precincts are a Roman pharos or lighthouse, still exhibiting the Roman masonry, the ancient fortress church (St. Mary in Castro), some remains of the Saxon fort, and the massive keep and subsidiary defenses (such as the Constable's, Avranche's, and other towers) of the Norman building. The church, substantially unaltered, forms an almost unique Christian relic. It has been called Roman, but is later. It is cruciform in shape, and the walls are built mainly of flint, but jambs and arches are formed of Roman bricks. At the end of the 12th century it was remodelled and given an Early English character. In the beginning of the 18th century it was dismantled and turned into a storehouse, and so continued until 1863, when, having been restored by Sir G. G. Scott, it was again opened for divine service, and is now the chapel of the castle garrison.

The castle is probably of extremely early origin. The earthworks on the line of the outer curtain may be British, or even Roman, or may possibly represent the Saxon "burg" which Harold is said to have constructed. To these early banks and ditches, with perhaps stockades and wooden towers the conqueror added according to William of Potters, such additional "firmamenta" as were needful. This probably means a Norman "motte and bailey," and a moat, and in part a bailey, still remain inside the earlier castrum. The moat is unusually big, and the bailey, south of it, had an unusual loop to the southeast apparently to include the already extant church and pharos. Henry II is responsible for the first stone fortification. He encircled the Norman moat with a wall and crowned it with a keep. Finally the outer rampart was translated into stone, with a line of at least 17 towers at intervals in the time of Henry III, perhaps by Hubert de Burgh. The small inner ward, on the moat, has an area of about two acres, the Norman bailey about four, the whole castrum enclosing about 34 acres. Though the castle has suffered many alterations for modern military requirements, especially during the scare of a Napoleonic invasion, which have much obliterated the walls of the middle ward, the remainder of the castle stands substantially as it stood in the time of Henry III. With the exception of the Tower of London, it is probably at once the largest, most complete and most complex example of mediaeval fortification. Nine wards named in a list of Dover wards and their fees, dated 1211-12, in the Red Book of the exchequer, are all reproduced in names still attached to towers. These names had become fixed probably not later than the reign of Henry II. The constableness was attached to the honour of Haughley, known in consequence as the honour of the constable. It reverted to the crown on the forfeiture of Henry of Essex in 1163. At the time of Domesday it was held by Hugh de Montfort. The constableness later was held jointly with the lord wardenship of the Cinque Ports.

Remains were discovered in 1854 of a round church of the Templars (Holy Sepulchre), 32 ft. in diameter, which has been restored, the church, doubtless, in which King John made his submission to the papal nuncio in 1213. Archcliffe fort lies to the southwest of old Dover. There is a remnant of the Saxon collegiate church of the canons of St. Martin. The remains of the splendid foundation of St. Martin's priory, of the 12th century, include the great gate, the house refectory, with campanile, and the spacious strangers' refectory, now incorporated in Dover college. The college of St. Martin for 22 secular canons, which had been established in the castle before 640, was removed to the church of St. Martin in the town in 696, and in 1736 became a Bene-

dictine priory under the jurisdiction of that at Canterbury, to which see the lands are still attached. The interior of the refectory is very fine and on its east wall are remains of a 12th century mural painting of the Last Supper, some of the nimbi surrounding the heads may still be made out. King Stephen is said to have died in the priory guesthouse, which is the chapel of the modern college. The gatehouse, now the library of the college is a good piece of Decorated work, and has a fine open fireplace. In high street may be seen the noble hall and truncated fabric of the Maison Dieu founded by Hubert de Burgh in the 13th century for the reception of pilgrims of all nations. From the time of Henry VIII to 1830 it was used as a crown victualling office, but was subsequently purchased by the corporation and adapted as a town hall. The new town hall adjoining the old hall of the Maison Dieu was opened in 1883. The museum (1849) contains an interesting collection of local antiquities and a natural history collection. A bell taken from Antwerp by the Germans during World War I and used as an air raid warning at Zeebrugge was presented to Dover by the king of the Belgians and hung in a turret outside the town hall.

During World War II Dover suffered from constant "hit and run" air raiding, as well as shelling from Cape Gris Nez. To the end of 1941 about 9,000 houses had been damaged, also the parish church of St. Mary the Virgin (rebuilt and enlarged in 1843-44, but preserving the three bays of the Saxon church with its western narthex, on which was superimposed the Norman tower, whose rich front faced the street, the rest of the building was Norman and Early English), and the churches of St. James-the-Less (originally Norman, but vigorously restored) and St. Barnabas.

Among various charitable institutions are the National Sailors' home and the Gordon Boys' and Victoria Seaside orphanages. Among educational establishments is Dover college, occupying the site and remaining buildings of St. Martin's priory, with additional modern buildings. It was instituted in 1871, and educates about 220 boys. There is a separate junior school.

Dover is the only one of the Cinque Ports which is still a great port. It is one of the principal ports for passenger communications across the channel, steamers connecting it with Calais and Ostend. The Admiralty pier was completed to a length of about 2,000 ft. in 1871. The construction of a new commercial harbour was begun in 1893. The works included the east pier ("Prince of Wales's pier" completed, 1902), running parallel to the general direction of the Admiralty pier, and in conjunction with it enclosing an area of sheltered water of 75 ac. The Admiralty harbour, begun in 1896, has an area of 610 ac. of which 322 ac. have a depth of not less than 30 ft. at low water. It comprises three enclosing breakwaters—on the west an extension of the Admiralty pier in a southeasterly direction for 4,000 ft., on the south an isolated breakwater, 4,200 ft. long, curving round shoreward at its eastern end to accord with the direction of the third breakwater, on the east, which runs out from the shore in a southerly direction for 3,350 ac. These three breakwaters, with a united length of more than 12½ mi., are each built of massive concrete blocks in the form of a practically vertical wall rising to a quay level of 10 ft. above high water. There are two entrances, one 800 ft. and

Saxon shore (*Latus Saxonum*). As a Cinque Port, Dover (*Dofra, Dovorra*) contributed 20 of the quota of ships furnished by those ports. A charter of liberties was granted to the ports as a body by Edward I in 1278, confirming charters of Henry II and John, which in the case of Dover had confirmed privileges enjoyed by the town in the time of Edward the Confessor and later kings. Edward I's charter was confirmed by subsequent kings with additions, down to James II. During the middle ages Dover castle was an object of contention both in civil wars and foreign invasions, and was considered the key to England. It was successfully defended in 1216 against the French under the dauphin Louis by Hubert de Burgh. In 1659 Charles II confirmed to the inhabitants of Dover a fair beginning on Nov. 11, which had been held of old in the town, and granted two others on April 23 and 24 and on Sept. 25 and 26. After the decay of Richborough harbour the passage from Dover to Whitland, and later to Calais, became the accustomed route to France, and by a statute of 1465 no one might ship for Calais except at Dover. The guardians of the harbour were incorporated by James I in 1607.

See S. P. H. Statham, *History of the Castle, Town and Port of Dover* (1899), and *Dover Charters and Other Documents* (1902).

Battle of Dover—This famous and important naval victory was won off the town of Dover by the ships of the Cinque Ports on Aug. 21, 1217, during the minority of King Henry III. The barons, who were in arms against his father King John had called Louis, son of Philip Augustus, king of the French, to their aid. Having been recently defeated in Lincoln, they were hard pressed, and reinforcements were sent to them from Calais in a fleet commanded by a pirate and mercenary soldier called Eustace the Monk. He passed the Straits of Dover with a numerous flotilla laden with military machines and stores, and also carrying many knights and soldiers. The Monk's fleet was seen from Dover where the regent, Hubert de Burgh, lay with the naval force of the Cinque Ports, said to have been very small. Sixteen vessels, large for that time, and a number of smaller craft, is said to have been their total strength. It put to sea, and by hugging the wind gained the weather gage of the French adventurer.

Eustace is said to have been under the impression that they meant to attack Calais in his absence, and to have denied them because he had left the town well guarded. When they were to windward of his fleet the Cinque Port ships bore down on the enemy. As they approached they threw unslaked lime in the air and the wind blew it in the faces of the French. This form of attack, and the flights of arrows discharged by the English (which flew with the wind), produced confusion in the crowded benches of the French vessels, which in most cases must have been little more than open boats. The Monk was defeated, and his fleet was entirely scattered, sunk or taken. His own vessel was captured. Eustace, who had concealed himself in the bilge, was dragged out. In answer to his appeals for quarter and promises to pay ransom, he was told by Richard, the bastard son of King John, that he was a traitor who would not be allowed to deceive more men. His head was struck off by Richard, and was sent round the ports on a pike. The Cinque Port seamen returned in triumph, towing their prizes, after throwing the common soldiers overboard, and taking the knights to ransom according to the

age. The political importance of the battle was to give the deathblow to the cause of the barons who had rebelled against, and it secured Henry III on his throne. But the death of the Monk was widely regarded as in a victory over the powers of evil. The man became a hero after his death the hero of many legends.

fact is less picturesque, but enough is known of Eustace the Monk that he was an adventurous and unscrupulous scoundrel. He was a monk, and left the cloister to claim an inheritance in the count of Boulogne. Not having received the inheritance he became a freebooter on land and sea, and merited his name. He is frequently mentioned in the Pipe, Patent and Close Rolls. For a time he served King John, but when the king made friends with the count of Boulogne, he fled abroad and entered the service of the French prince Louis and his father

Dover (*Dubris*) was one of the ports for continental traffic in Roman times. In the 4th century it was guarded by a fort lying down near the harbour, and forming part of the defenses of the

Philip Augustus. Chroniclers lavish on him the titles of "*achi prout*," "*vir flagitiosissimus et nequissimus*," and poets made him an associate of the devil.

The evidence concerning Eustace is collected by Herren Wendelin Forster and Johann Trost, in their edition of the French poem "*Wistasse le moine*" (Halle, 1891). See for the battle Sir N Harris Nicolas, *History of the Royal Navy* (London, 1847).

The Dover Patrol—Dover harbour provided the headquarters of the Dover Patrol during World War I. The area of the Patrol extended roughly from the North Foreland to Beachy Head, including both sides of the Channel. The functions of the Patrol were, primarily, to keep the narrows of the Channel open to traffic. London could not be by rail alone. Had sea traffic to London been stopped it would have been necessary at once to transport one third of the population to the west coast. The traffic had to be protected from mines, submarine boats and destroyer attacks. On an average 66 trawlers were used for mine sweeping and traffic duties, approximately 100,000 merchant vessels passed during 1915-17 inclusive, and of these only 48 were mined and 7 torpedoed, the percentage loss for the three years was 0.55, 0.8 and 0.66 respectively. 5,614,500 troops were transported between Folkestone and Boulogne without a single casualty or accident. Nine and a half million mail bags were sent without the loss of a single letter or parcel.

The next important duty of the Patrol was hunting submarines. At first these vessels passed down the straits on the surface, diving only when they were sighted. It was then simple to attack them. After 1915 they dived when well to the eastward and passed the narrows entirely submerged. Many schemes were tried to defeat them, and as soon as mines became available a barrage of mines moored at various depths was laid between Folkestone and Gris Nez. This was nearly completed by January 1918 and the first submarine was destroyed in it in December 1917. This in the end completely stopped the passage of submarines and destroyed a considerable number of them.

At the commencement of the war the Dover Patrol force operated with the army in checking the German advance through Belgium by their gun fire and made the shore road difficult for the Germans to use. Subsequently the Patrol was called on to defend the sea flank of the army and by means of landings to draw troops from the main offensive to the coast. To assist in the advance which was contemplated in 1917 three 12 in guns, seven 9.2 and eight 7.5 in guns were landed and mounted, at the same time arrangements were made for landing 20,000 men on the coast between Ostend and Westend. Pontoons 55 feet long loaded with men and accessories were constructed to be pushed ahead of the monitors on to the beach. This landing was never carried out, as the commander-in-chief did not consider it advantageous to land troops until the army had reached Roulers. It never pushed on beyond the Paschendale Ridge. The only attacks by the enemy prior to 1918 on the Dover defences were those made by destroyers at night. Darkness and surprise coupled with the meagre allowance of destroyers for Dover made these raids very difficult to cope with, but the damage done was insignificant, the total losses being two merchant vessels (one empty), two destroyers and six drifters. During the fourth raid the *Broke* and *Sunfi* sank two German destroyers, and for a time the raids ceased. During 1918 a last raid was made on the vessels protecting the mine barrage and several were sunk.

An examination service for the detection of contraband was established in the Downs. All North and South going traffic had to anchor and be examined. This work was largely undertaken by Naval Reserve officers under a post captain. In 1917, when raids by German destroyers threatened the safety of the vessels in the Downs, the Northern examination service was moved inside the Thames shoals.

Vessels at Dover were also called on to undertake bombardments of the dockyard at Ostend and the submarine base at Zeebrugge. The result of these operations was that the dockyard was made untenable and the destroyers and submarines forced up the canal to Bruges. In 1916 the aircraft were used for spotting with successful results, several of the bombardments being carried out without the Belgian coast being sighted by the

ships. The force of destroyers available at Dover before 1917 was very small having regard to the duties they were called on to perform, only six mounted 4-in guns. During the latter year they were augmented. Of the 12 Tribal class half were mined or torpedoed. A constant patrol was kept up eight miles off the Belgian coast during the summer months of 1916-17. This was made possible by first laying down the barrage of mines and mined nets seven miles from the coast to protect the ships from attack on the shore side. The only ship damaged while on patrol was the monitor *Terror* which was struck by a boat controlled electrically from the shore.

Blocking operations were carried out during 1918 when Zeebrugge was attacked and blocking ships skillfully sunk in the Channel which however owing to its physical formation was not, and could not be, effectively blocked. A similar attempt on Ostend failed, though attempted with great gallantry. The drifters like the trawlers were invaluable in the English Channel, first drifting nets to entangle submarines, then watching the barrages. On the Belgian coast they laid 12 miles of armoured mine nets for two years in succession. The motor launches also were of considerable value for sundry services, especially burning smoke screens to hide the ships bombarding. These screens were necessary since the effective range of the monitors' guns was only about 75% that of the shore batteries. The French naval armaments on the north coast of France were under the orders of the Admiral of the Dover Patrol and did excellent service throughout the war. The air service at Dunkirk was also one of the arms of the Patrol and was invaluable both on the coast and also in assisting the army, notably at the battle of the Somme when the army was very deficient in aircraft. Without the breakwater and harbour facilities at Dover the protection of the straits would have been impossible, and the evacuation of the wounded most difficult. Almost all wounded at the front were safely landed at Admiralty pier and from there despatched to various hospitals.

DOVER, the capital city of Delaware, U.S.A., and the county seat of Kent county, on the St. Jones river, in the central part of the state. It is on federal highway 13, and is served by the Pennsylvania railroad. The population was 6,223 in 1950 and 5,517 in 1940 by the federal census. The state house, built about 1722 for a courthouse and remodelled in 1791 for its present purpose, is a beautiful building of dignified colonial architecture, set in a spacious green. Near Dover still stands the home of Caesar Rodney (1728-84), who rode to Philadelphia through the night of July 3, 1776, in order to be present at the roll call on the Declaration of Independence, and thus made possible a unanimous vote of the 13 Colonies in favour of its adoption. Dover is a shipping point for the strawberries, apples, peaches, grapes, poultry, vegetables and other products of the fertile surrounding country, and has many canneries and packing plants, including one of the oldest and largest in the country (established 1855). The state college for Negro students (1892) is located there. Dover was laid out in 1717, by order of William Penn. In 1777 it replaced New Castle as the capital of the state. It was incorporated as a town in 1829, and reincorporated as a city in 1925 with an area almost double its former size.

DOVER, a city of southeastern New Hampshire, on the Cochecho river, 20 mi. NW of Portsmouth, the county seat of Strafford county. It is served by the Boston and Maine Railroad and motorbus lines. The population was 15,911 in 1950 and 14,990 in 1940 by the federal census. It has abundant water power and large manufacturing industries. Leading products are woollen and worsted goods, printing presses, leather belting, shoes, window frames, chemicals, television parts, lumber, cement blocks, optical goods, cameras and films. A settlement was established in 1623 by Edward Hilton on Dover point, 5 mi. SE of the Cochecho falls, and in 1633 several families under Capt Thomas Wiggan settled on Dover neck (on the Piscataqua river, 1 mi. above Dover point) which for the first century, while shipbuilding was the important occupation, was the business centre of the town. With the development of manufacturing, business and population shifted to the Cochecho river, which is now the centre. For nearly half a century after 1641 the plantation (by will of the majority) was

under the jurisdiction of Massachusetts. Between 1675 and 1725 the town suffered greatly from attacks by the Indians, notably on June 28, 1689. Dover was chartered as a city in 1855. At Durham, 5 mi SW, is the University of New Hampshire, established as an agricultural college in 1866, at Hanover, moved to Durham in 1893, following the death of Benjamin Thompson, a farmer of that town, who left to the college almost his entire estate, and incorporated as a university in 1923.

DOVER, a town of Morris county, N.J., on the Rockaway river, 40 mi WNW of Jersey City, at an altitude of 570 ft. It is served by the Lackawanna railway. The population was 11,210 in 1950, in 1940, 10,491. Iron is mined in the vicinity, and the town has large railroad shops and important manufactures, including hosiery, silk, bar iron, furnaces and ranges, boilers, bridges, drills and air compressors. Dover was founded in 1722, when Joseph Jackson started an iron forge where the modern Hurd Park is located. Dover's progress was closely associated with the iron industry, and its iron products became known throughout the world.

DOVER, a city of Tuscarawas county, O. U.S., on the Tuscarawas river, 82 mi SE of Cleveland. It is on federal highways 21 and 250, and is served by the Baltimore and Ohio and the Pennsylvania railroads. The population was 9,787 in 1950 and 9,691 in 1940 by the federal census. The city lies on a plateau 884 ft above sea level, commanding diversified views. Iron ore, coal, freclay and limestone abound in the vicinity. The manufactures include electric irons, sweepers, stearic acid, bronze tubes, steel, buckets, tubs, stoves, tungsten wire, floor and wall tile. A town was laid out in 1807. It was on the Ohio canal (opened 1832) and was formerly called Canal Dover, but "Canal" was dropped in 1915.

Dover was incorporated as a village in 1842, reincorporated in 1867 and became a city in 1903.

DOVER, TREATY OF A secret treaty concluded on May 22, 1670 between Charles II of England and Louis XIV of France, whereby Charles II agreed to embrace the Roman Catholic faith and try to restore Catholicism in England. The King of France was to assist him in restoration with a large sum of money and the use of 6,000 troops. It was agreed that the two countries should declare war jointly on the United Provinces, and also that England should support the claim of Louis, should he "acquire new titles and rights to the Spanish Monarchy." The treaty was negotiated through Henrietta, Duchess of Orleans and sister of Charles II (See CHARLES II).

The treaty did not however become operative as such owing to the religious controversy involved, in a later version (Dec 1670) the proposed conversion of the English king was omitted in order to deceive the ministers who were not in the Catholic plot and a date fixed for the declaration of war against the United Provinces.

DOVERCOURT, a watermill place and parish in the borough of Haverhill, N.H., England, and with a station on the N.E.R. 20 mi N.E. from London. The estate and village are well from the North and there is a fine example of a mill. Much attention has been given to laying out public walks and gardens and providing recreation facilities. There is also a car park and a scenery of the neighbouring Orwell and Stour is fine. The church, which stands inland in the old village, is a fine building. As Upper Dovercourt is a fine English house formerly possessed a marvellous road which became an object of pilgrimage. It is said to have been stolen and burnt in 1532, three of the four thieves being subsequently taken and hanged.

DOW, NEAL (1804-1897), American temperance reformer, was born at Portland, Me., March 20, 1804. He drafted the Maine prohibitory law of 1851. He was mayor of Portland, 1831, 1855, a member of the Maine legislature, 1835-39, and in the Civil War colonel of the 13th Maine Volunteer Infantry.

He served in General B. F. Butler's New Orleans expedition, was commissioned brigadier general of volunteers in April 1863, and commanded for a time the department of Florida. After the war he devoted a great part of his time to the extension of prohibition in America and England. Through his exertions the prohibitory amendment was added to the Maine Constitution in

1884. He died at Portland, Oct. 2, 1897.

His *Reminiscences* were published at Portland in 1808.

DOWAGER, strictly, a widow in the enjoyment of dower. "Dowager" is also applied to widows of high rank to distinguish them from the wives of their sons, as queen dowager, dowager-duchess, etc. The title was first used in England of Catherine of Aragon, widow of Arthur, prince of Wales, who was styled princess dowager till her marriage with Henry VIII. By transference the word is used of an elderly lady.

DOWAGIAC, a city of Cass county, Mich., in the southwestern part of the state, on the Michigan Central railroad. The population was 6,534 in 1950 and was 5,007 in 1940 by the federal census. It is in a fertile region of many lakes. The city manufactures furnaces and fish bait, ships wheat, corn, fruit, celery, pepper mint and other agricultural products, and is a summer resort and touring centre. It was founded about 1838 and incorporated in 1852.

DOWDEN, EDWARD (1843-1913), Irish critic and poet, was born at Cork and educated at Queen's college, Cork, and Trinity college, Dublin. He became professor of English literature at Trinity college in 1867. His first book, *Shakespeare, his Mind and Art* (1875), a revision of a course of lectures, was translated into German and Russian, and his *Poems* (1876) went into a second edition. His *Shakespeare Primer* (1877) was also translated into Italian and German. Later works by him in Shakespearean criticism were his *Shakespeare's Sonnets* (1881), *Passionate Pilgrims* (1883), *Introduction to Shakespeare* (1893), and editions of *Hamlet* (1899), *Romeo and Juliet* (1900) and *Cymbeline* (1903). His *Studies in Literature* (1878), *Transcripts and Studies* (1885), *New Studies in Literature* (1895), and other works, many of them biographical, showed a profound knowledge of the currents and tendencies of thought in various ages and countries, but it was his *Life of Shelley* (1886) that made him best known to the public at large. In 1900 he edited an edition of Shelley's works. In 1889 he became the first Tylor lecturer at Oxford, and from 1892 to 1896 was Clark lecturer at Trinity college, Cambridge.

DOWER, in law, the life interest of the widow in a third part of her husband's lands. There were originally five kinds of dower: (1) at common law, (2) by custom, (3) *ad ostium ecclesiae*, or at the church porch, (4) *ex assensu patris*, (5) *de la plus belle*. The last was a conveyance of tenure by knight service, and was abolished in 1606, by the act which did away with old tenures. Dower *ad ostium ecclesiae*, by which the bride was dowered at the church porch (where all marriages used formerly to take place), and dower *ex assensu patris*, by the father of the bridegroom, though long obsolete, were formally abolished by the Dower act 1834. Dower was governed in Great Britain, so far as women married after Jan. 1, 1834 were concerned, by the Dower act 1834, and under it only attached on the husband's death to the lands which he actually possessed for an estate of inheritance at the time of his death. It did not attach to any land actually disposed of by him in his lifetime or by his will, or to any land from which he declared by deed or will his wife should not be entitled to dower. Dower was finally abolished by the Administration of Estates act 1925. The right to dower still obtains in some colonies, while in others it has been superseded by Homestead acts, or the acts dealing with devolution of property (see *Burge's For and Col Laws*, vol. IV pt. II Wyndham A. Bewes ed.).

In the United States, in such States as have not enacted statutes to the contrary, dower continues as at common law. Some statutes are in effect which declare the principles of the common law. In most States, however, the common law doctrines of dower have been very greatly modified by statute. In some States dower either has been abolished or a different right or interest has been substituted therefor. Even where it has been abolished, the term often popularly is used. Where dower is abolished the interest substituted may be in one of several forms, perhaps a certain portion of the husband's property or of the community property of both or of a life estate in a portion of his realty.

DOWIE, JOHN ALEXANDER (1847-1907), founder of the "Christian Catholic Apostolic Church in Zion," born in Edin-

burgh, and went as a boy to Australia with his parents. He returned in 1868 to study for the Congregationalist ministry at Edinburgh University, and subsequently became pastor of a church near Sydney, Australia. Imbued with belief in his powers as a healer of disease by prayer, he moved to Melbourne, where he founded "The Divine Healing Association of Australia and New Zealand." In 1888 he went to America, preaching and "healing," and in spite of opposition and ridicule attracted a number of adherents. In 1896 he established "The Christian Catholic Apostolic Church in Zion," with himself as "First Apostle"; and in 1901, with money liberally contributed by his followers, he founded Zion City, on a site covering about 10 sq mi on the west shore of Lake Michigan, with a central Zion Temple. In 1903 and 1904, in the course of a visit to the branches of the Christian Catholic Church throughout the world, he appeared in London, but was mobbed. In April 1906 a revolt against his domination took place in Zion City. He was charged with peculation and with practising polygamy, and was deposed, with the assent of his own wife and son. Downe was now broken in health, he was struck with paralysis and died in Zion City in March 1907. Downe was succeeded by Wilbur Glenn Voliva.

DOWLAS, plain cloth, similar to sheeting, but usually coarser. It is made in several qualities, from line warp and weft to two warp and weft, and is used chiefly for aprons, pocketing, soldiers' gaiters, linings and overalls. The finer makes are some times made into shirts for workmen, and occasionally used for heavy pillow cases. The word is spelt in many different ways, but the above is the common way of spelling adopted in factories, and it appears in the same form in the first part of Shakespeare's *Henry IV*, Act III scene 3. The modern dowlas is a good strong and closely woven linen fabric.

DOWN, a maritime county of Northern Ireland, occupying the most easterly part of the island, bounded N by Co. Antrim and Belfast Lough, E and S by the Irish sea, and W by Co. Armagh. The land area is 952 sq mi. Pop. (1937) 210,687.

The foundation of this county is Silurian rock throughout, the slates and sandstones striking as a whole north east, but giving rise to a country of abundant small hills. The granite that appears along the same axis in Armagh continues from Newry to Slieve Croob, furnishing an excellent building stone. South of it, the Eocene granite of the Mourne forms a group of rocky summits, set with scarps and tors, and divided by valleys, which are not yet choked by the detritus of these comparatively youthful mountains (Slieve Donard 2,796 ft.). Lower lands occupy the east, north and large portions of the west of the county. Basalt dykes abound, being well seen along the coast south of Newcastle. At the head of Strangford Lough, the basalt, possibly as intrusive sheets, has protected Triassic sandstone, which is quarried at Scrabo hill. A strip of marine Permian occurs on the shore at Holywood. The north west of the county includes, at Moura, a part of the great basaltic plateaus, with Chalk and Trias protected by them. The chief drainage is to the river Lagan in the north, and to the Bann and the Newry on the west. The period at which Down was constituted a county is not certain. A district, however, appears to have borne this name before the beginning of the 14th century, but little is known of it even later than this.

On the summit of a hill near the borders of Antrim. This altar is in the centre of an enclosure about a third of a mile in circumference, formed of a rampart about 15 ft. high, and broad enough on the top to permit two persons to ride abreast. Near Down

patrick is a rath, or encampment, three quarters of a mile in circumference. In its vicinity are the ruins of Saul abbey, an Augustinian friary founded about 1130 on the site of St. Patrick's first church, and Inch abbey, founded by Sir John de Courcy in 1180. The number of monastic ruins is also considerable. The most ancient and celebrated is the abbey or cathedral of Downpatrick. Dundrum castle attributed to the de Courcy family, stands above that town, and affords an unusual example (for Ireland) of a donjon keep. The castle of Hillsborough, seat of the marquesses of Downshire is of Carolean date. There are three round towers in the county, but all are fragmentary.

The predominating soil is a loam of little depth, in some places intermixed with considerable quantities of stones of various sizes, but differing materially in character according to the nature of the subsoil. Clay is mostly confined to the eastern coast, and to the northern parts of Castlerough. Of sandy soil the quantity is small, it occurs chiefly near Dundrum. Moor grounds are mostly confined to the skirts of the mountains. Bogs, though frequent, are scarcely sufficient to furnish a supply of fuel to the population. Agriculture is in a fairly satisfactory condition. The bulk of the labouring population dwells in reasonably good circumstances. Tillage land declines somewhat in favour of pasture land. Oats, potatoes and turnips are the principal crops, flax, formerly important, is almost neglected. Some of the best race-horses in Ireland have been bred in this county. The native breed of sheep is confined to the mountains. The various other kinds of sheep have been much improved. Pigs are reared in great numbers, chiefly for the Belfast market. Poultry farming is a growing industry. The fisheries, of less value than formerly, are centred at Donaghadee, Newcastle, Strangford and Ardglass. The chief industries in the county generally are linen manufacture and bleaching, and brewing.

The haematite of Deshommed, near Banbridge, is well spoken of. Topaz and aquamarine occur in hollows in the granite of the Mourne. The Mourne granite is quarried above Annalong, and an ornamental dolerite is worked at Rosstrevor.

The Great Northern railway has an alternative branch to its main line by Portadown, from Lisburn through Banbridge to Scarva, with a branch from Banbridge to Ballyronney and Newcastle. Newry is on a branch from the Dublin Belfast line to Warrenpoint on Carlingford Lough. The main line between Lisburn and Portadown touches the north western extremity of the county. The eastern part of the county is served by the Belfast and County Down railway with its main line from Belfast to Newcastle, and branches from Belfast to Bangor, Comber to Newtownards and Donaghadee, Ballynahinch Junction to Ballynahinch, and Downpatrick to Ardglass and Killybegs. The Newry Canal skirts the west of the county, and the Lagan Canal intersects the rich lands in the Lagan valley to the north.

Bangor is the largest town, though Downpatrick is the county town. Bangor and Newtownards are municipal boroughs and there are nine urban and eight rural districts in the county and eight Poor Law unions. There are several watering places on the coast. Co. Down returns eight members to the parliament of Northern Ireland and two members to the United Kingdom parliament.

DOWN, an expanse of high rolling ground destitute of trees occasionally used for a smooth rounded hill. The system of chalk hills in England is known as "The Downs" (see **DOWNES**). The usual English word "dune" is taken directly from the French. Low sandy tracts north and south of Yarmouth, Norfolk, are known as the "Dunes." The adverb "down," meaning, from above, had an earlier form "adown," i.e., off the hill.

DOWNES (D[ɔ]UNAUS), **ANDREW** (c. 1549–1628), English classical scholar, was born in Shropshire. He did much to revive the study of Greek at St. John's college, Cambridge, and was elected fellow in 1571. In 1585 he was appointed regius professor of Greek. According to Simonds d'Ewes (*Autobiography*, ed. J. O. Halliwell, i. pp. 139, 141), who attended his lectures, Downes was accounted "the ablest Grecian of Christendom." He edited Lysias *Pro caede Erasthenis* (1593), *Prædicationes in Philippiam de pace Demosthenis* (1621), dedicated to King James I, some letters (in Greek) to Isaac Casaubon

printed in the *Epistolae* of the latter, and notes to St Chrysostom, in Sir Henry Savile's edition. Downes was also one of the seven translators of the *Apoecrypha* for the "authorized" version of the Bible, and one of the six learned men appointed to revise the new version after its completion.

DOWNING, SIR GEORGE, BART (c 1624–1684), English soldier and diplomatist, son of Emmanuel Downing, barrister, and of Lucy, sister of Governor John Winthrop, was born in England. His family joined Winthrop in America in 1638, settling in Salem, Mass., and Downing studied at Harvard. In 1645 he sailed for the West Indies as a preacher and instructor of the seamen, and arrived in England some time afterwards, becoming chaplain to Colonel John Okey's regiment. In 1650 he was scout-master general of Cromwell's forces in Scotland, in Cromwell's parliament of 1654 he represented Edinburgh, and Carlisle in those of 1656 and 1659. In 1655 he was sent to France to remonstrate on the massacre of the Protestant Vaudois. Later in 1657 he was appointed resident at The Hague, to effect a union of the Protestant European powers, to mediate between Portugal and Holland and between Sweden and Denmark, to defend the interests of the English traders against the Dutch, and to inform the government concerning exiled royalists.

He was maintained in his post during the interregnum after the fall of Richard Cromwell, and in April 1660 made his peace with Charles II, to whom he communicated Thurloe's despatches, and declared his abandonment of "principles sucked in" in New England, of which he now "saw the error." Downing was knighted in 1660. He showed immense zeal in restoring in Holland and handing over for execution the regicides Barkstead, Corbet and Okey. In 1663, he was created a baronet. Downing had from the first been hostile to the Dutch as the commercial rivals of England. He had strongly supported the Navigation Act of 1660, and he now deliberately drew on the fatal and disastrous war. During its continuance he took part in the management of the treasury, introduced the appropriation of supplies, and in May 1667 was made secretary to the commissioners, his appointment being welcomed by Pepys. He sat in parliament for Morpeth from 1660 till his death, and spoke with ability on financial and commercial questions. He was appointed a commissioner of the customs in 1671. The same year he was sent to Holland to replace Sir William Temple, to break up the policy of the Triple Alliance and incite another war between Holland and England in furtherance of the French policy. After three months' residence Downing fled to England, in fear of the fury of the mob. For this unauthorized step he was sent to the Tower for some weeks. Downing Street, London, is named after him, while Downing College, Cambridge, derived its name from his grandson, the 3rd baronet. The title became extinct when the 4th baronet, Sir Jacob G. Downing, died in 1764.

Downing's great talents were rarely employed for the advantage of his country and his character was marked by treachery, servility and ingratitude. "A George Downing" became a proverbial expression in New England to denote a false man who betrayed his trust. He published many declarations and discourses, mostly in Dutch, enumerated in Sibley's biography, and wrote also "A True Relation of the Progress of the Parliament's Forces in Scotland" (1652), *Thomasian Tracts*, Brit. Mus., E. 640 (5).

See J. L. Sibley, *Biographical Sketches of Harvard vol. 1* (Cambridge, 1873), J. Beresford, *The Godfather of Downing Street*, Sir G. Downing (1847).

DOWNINGTOWN, a borough of Chester county, Pa., U.S.A. on Brandywine creek, 35 m. W. of Phila. It is one of the largest cities in the State, and is one of the most important manufacturing centers. It is situated on the Schuylkill river, and is one of the most important manufacturing centers. It is situated on the Schuylkill river, and is one of the most important manufacturing centers. It is situated on the Schuylkill river, and is one of the most important manufacturing centers.

DOWNMAN, JOHN (1800–1843), English painter and engraver, was born in London. He was a pupil of Sir John Lubbock, and was one of the most important painters of the day. He was a pupil of Sir John Lubbock, and was one of the most important painters of the day. He was a pupil of Sir John Lubbock, and was one of the most important painters of the day.

Downman is believed to have been "pressed" for the navy as a young man, and on his escape settled down for a while in Cambridge, eventually coming to London, and later (1804) going to reside in Kent in the village of West Malling. He afterwards spent some time in the west of England, especially in Exeter, and then travelled all over the country painting his dainty portraits.

See G. C. Williamson, *John Downman, his Life and Works* (1907).

DOWNPATRICK, market town, urban district and county town of Co. Down, Northern Ireland, 28 m. S.E. of Belfast by rail. Pop. (1937) 3,373. Area, 4 sq. m. It stands near the S.W. extremity of Strangford Lough. It is the seat of the Roman Catholic and Protestant dioceses of Down. St. Patrick founded the seat about 440, but the present Protestant cathedral dates from 1790, the old structure having been in ruins for 250 years. A round tower adjoining it was destroyed in 1790. The Rath or dun, from which the town is named, remains as one of the finest in Ireland. It is known as the Mound of Down and covers 10 acres. In the vicinity are remnants of the monastery of Saul, a foundation ascribed to St. Patrick, and where he died, and of Inch abbey (1180), founded by Sir John de Courcy. Three miles south is a stone circle and to the S.E. are the wells of Struill. The town was called *dun-leth-plas*, the fort of the broken fetters, from the deliverance from bondage of two sons of Dichu, prince of Leale, and the first convent of St. Patrick. It is the Dunum of Ptolemy and was the residence of the kings of Ulster. It was already incorporated early in the 15th century. A small trade is carried on at Strangford Lough, the quay being below the town. Industries are linen manufacture, brewing, tanning and soap-making.

DOWNS, the name of a system of chalk hills in the south east of England. It is most familiar in its application to the two ranges of the North and South Downs. Of these the North Downs are in the counties of Surrey and Kent, and the South in Sussex. Each forms a well-defined long range springing from the chalk area of Dorsetshire and Hampshire, to which latter the general name of the Western Downs is given. The Downs enclose the rich district of the Weald (q.v.).

The North Downs extend for 95 m. from Farnham to the English channel between Dover and Folkestone. The crest is not continuous, as the hills are breached by a series of deep gaps, through which northward flowing rivers, roads and railways pass. The entrances to these gaps are the locations of important town sites. The South Downs show similar characteristics, the rivers flowing southward. The river system of the Weald is an excellent example of a drainage system consequent upon an anticlinal structure. The western end of the North Downs is the Hog's Back, a narrow ridge, altitude 489 ft., a quarter of a mile broad on the top and sloping sharply north and south. At the west end is a depression, once occupied by the Blackwater, the head-waters of which have been captured by the Wey. In this depression lies Farnham. The Wey, flowing south of the Hog's Back, breaches the Downs at the Guildford gap. The next gap is that of the Mole, in which Dorking lies. Between Guildford and Dorking the main line of the Downs reaches 712 ft., but a lateral depression, followed by the railway, marks off on the south a loftier range of lower Greensand, in which Leth hill is 965 ft. in height. East of the Mole the northward slope of the Downs is deeply cut by narrow valleys and the depression between Redhill and Croydon was once traversed by a stream subsequently beheaded by the Mole. A height of 868 ft. is attained east of Caterham. The next river to break through is the Darent, but here another lateral depression marks off the Ragstone ridge, south of Sevenoaks, reaching 800 feet. The lateral depression is continued eastward, so that as far as Ashford the Downs consist of two parallel ranges, but the Medway itself breaches both, Maidstone lying in the gap. The elevation now begins to decrease, and 682 ft. is the extreme height east of the Medway. The final breach is made by the Great Ouse, between Ashford and Canterbury, but the valley of the Little Ouse offers a well-marked pass followed by the Folkestone-Canterbury railway. The North Downs end in the white cliffs between Dover and Folkestone.

The South Downs present similar characteristics on a minor

scale. Springing from the main mass of the chalk, south of Peters field, they have their greatest elevation (889 ft in Butser hill), and extend for 65 m to the English channel at Beachy Head. Here also a succession of rivers breach the hills, and towns mark the gaps. These are, from east to west, the Arun, with the town of Arundel, the Adur, with Shoreham, the Ouse, with Lewes and Newhaven and the Cuckmere, with no considerable town. The steep slope of the South Downs is northward. The southern slopes reach the coast east of Brighton, but west of this town a flat coastal belt, the Hampshire basin, intervenes, widening westward. Apart from the complete breaches, the South Downs, scored on the south with many deep vales, are generally more easily penetrable than the North Downs, and the coast is less continuous.

Smooth convex curves are characteristic of the Downs, their graceful and striking outline gives them an importance in the landscape in excess of their actual height, their flanks are well wooded, their summits covered with close springy turf.

"THE DOWNS" is also the name of a roadstead in the English Channel off Deal between the North and the South Foreland. It forms a favourite anchorage during heavy weather, protected, except during severe southerly gales, by the Goodwin Sands. It has depths down to 12 fathoms.

DOWNSHIRE, WILLIS HILL, 1ST MARQUESS OF (1718-1793), son of Trevor Hill, 1st Viscount Hillsborough, was born at Fairford in Gloucestershire on May 30, 1718. He became a member of parliament in 1741. In 1751 he was created earl of Hillsborough in the Irish peerage, and in 1756 a peer of Great Britain as Baron Harwich. For nearly two years he was president of the Board of Trade and Plantations under George Grenville, and after a brief period of retirement he filled the same position, and then that of joint postmaster general, under the earl of Chatham. From 1768 to 1772 Hillsborough was secretary of State for the Colonies and also president of the Board of Trade, becoming an English earl on his retirement, in 1779 he was made secretary of State for the northern department, and he was created marquess of Downshire seven years after his final retirement in 1782. Both in and out of office he opposed all concessions to the American colonists, but he favoured the project for a union between England and Ireland. He died on Oct. 7, 1793.

DOWRY, the property which a woman brings with her or is given to her at her marriage, a wife's marriage portion (see SETTLEMENT).

DOWSER and **DOWSING**, one who uses, or the art of using, the dowsing rod or "striking-rod" to find subterranean minerals or water (from the Cornish "dowse," ME *duchen*, to strike or fall. See DIVINING-ROD). More commonly with the spelling "douse" the verb is also used, especially in nautical parlance, with the meaning to lower or strike salt suddenly, as well as to quench or extinguish, as a light, or to close, as a port hole.

DOWSON GAS PRODUCER. See GAS MANUFACTURE.

DOXOLOGY, an ascription of glory to God (Gr *doxologia*, a praising). The name is applied specially to the *Gloria in excelsis Deo* (known as the Greater Doxology) and the *Gloria Patri* (the Lesser Doxology, usually called "the doxology" simple), but also, more generally, to the *Tersanctus* ("Holy, Holy, Holy," often called *Trisagion*, though that is strictly the name of the Greek invocation beginning "Αγιος ὁ θεός"), to the *Allélua* of Rev. xix and of many of the Psalms, to the last passage of the Lord's Prayer as found in Matt. vi. 13, and to such passages of glorification as Rom. vii. 27, Eph. iii. 21, etc.

The Greater Doxology, in a slightly different form from that now used in the Greek Church, is given in the 4th century *Apostolical Constitutions* (vii. 47), and a very similar form is found in the *Alexandrine Codex* (5th century). The translation into Latin is traditionally attributed to St. Hilary of Poitiers (d. 367). The date of its introduction into the public services of the church cannot be determined precisely. In the Eastern Church it was used in the morning office apparently as early as the 4th century, but has never formed part of the Liturgy. In the West, where it is used in the Mass, Pope Symmachus (498-514) is said in the *Liber Pontificalis* to have ordered it to be sung on Sundays and festival days, it is mentioned in the Gregorian Sacramentary, but not

in the *Gelasian*. Until the 11th century its use was confined to bishops, and to priests at Easter and on their installation. In the English prayer book it comes near the end of the communion of fice, but is not in either the morning or evening service. It is also used in the Protestant Episcopal and Methodist Episcopal churches of America, as indeed in most Protestant churches at the Eucharist.

The Lesser Doxology, or *Gloria Patri*, in its present form, is the result of the Anan controversies concerning the nature of Christ. There is no trace of its use in the first three centuries, and the second clause, "As it was in the beginning," etc., first appears in A.D. 529, when the 2nd council of Vaison asserted its use as already established in the East *propter haereticorum astutiam*, and ordered its adoption throughout the West. In the Western Church the *Gloria Patri* is repeated at the close of every psalm, in the Eastern Church at the close of the last psalm. This last is the optional rule of the American Episcopal Church.

Metrical doxologies are often sung at the end of hymns, and the term has become especially associated with the stanza beginning "Praise God from whom all blessings flow," with which Thomas Ken, bishop of Bath and Wells, concluded his morning and evening hymns.

See J. Bingham, *Biog. eccles.* xiv. 2, Siegel, *Christl. Alterthümer*, i. 515, etc., F. Procter, *Book of Common Prayer*, p. 112, W. Palmer, *Orig. Liturg.* iv. § 23, art. "Liturgische Formeln" (by Drews) in Hauck Herzog, *Realencyclopädie für Theol.* xi. 547, *Cath. Encycl.*

DOYEN, GABRIEL FRANÇOIS (1726-1806), French painter, was born at Paris in 1726. He became in his 12th year a pupil of Vanloo, obtained at 20 the Grand Prix, and in 1748 set out for Rome. Among his greatest works are counted the "Miracle des Ardents," painted for the church of Ste. Geneviève at St. Roch (1773), the "Triumph of Thetis," for the chapel of the Invalides, and the "Death of St. Louis," for the chapel of the Military School. In 1776 he was appointed professor at the Academy of Painting. Soon after the beginning of the Revolution he accepted the invitation of Catherine II and settled at St. Petersburg, where he died on June 5, 1806.

DOYLE, SIR ARTHUR CONAN (1859-1930), English novelist, knighted in 1902, eldest son of the artist Charles Doyle, was born on May 22, 1859. He was educated at Stonyhurst College, in Germany, and at Edinburgh University where he graduated M.B. in 1881 and M.D. in 1885. He was practising as a doctor in Southsea when he published *A Study in Scarlet* in 1887. *Micah Clarke* (1888), a tale of Monmouth's rebellion, *The Sign of Four* (1889), and *The White Company* (1891), a romance of Du Guesclin's time, followed. In *Rodney Stone* (1896) he drew an admirable sketch of the prince regent, and he collected a popular series of stories of the Napoleonic wars in *The Exploits of Brigadier Gerard* (1896). In 1891 he attained immense popularity by *The Adventures of Sherlock Holmes*, which first appeared in *The Strand Magazine*. These ingenious stories of the success of the imperturbable Sherlock Holmes, who had made his first appearance in *A Study in Scarlet* (1887), in detecting crime and disentangling mystery, found a host of imitators. The novelist himself returned to his hero in *The Memoirs of Sherlock Holmes* (1893), *The Hound of the Baskervilles* (1902), and *The Return of Sherlock Holmes* (1905). Other books by him include numerous novels, plays, *The Story of Waterloo* (1894), in which Sir Henry Irving played the leading part, *The Fires of Fate* (1909), *The House of Temperley* (1909), *The Poison Belt* (1913), two books in defence of the British army in South Africa—*The Great Boer War* (1900) and *The War in South Africa, its Causes and Conduct* (1902). During World War I Doyle wrote propaganda for the Allies. His *Cause and Conduct of the World War* appeared in 12 languages besides English. In his later years Doyle was a convinced spiritualist and a lecturer and writer on spiritualism. He died on July 7, 1930.

Among his later works were *History of the British Campaign in France and Flanders* (vols. 1 to vi, 1915-20), *A New Revelation* (1918), *History of Spiritualism* (2 vols., 1926), and *My Memories and Adventures* (1924).

DOYLE, RICHARD (1824-1883), Anglo-Irish caricaturist, water colourist and illustrator, was born in London in Sept.

DRACHMANN, HOLGER HENRIK HERBOLDT (1846-1908) Danish poet and dramatist son of A. G. Drachmann, a physician of Copenhagen, whose family was of German extraction, was born in Copenhagen on Oct. 9, 1846. At various periods he travelled very extensively in England, Scotland, France, Spain and Italy, and his literary career began by his sending letters about his journeys to the Danish newspapers. After returning home, he settled for some time in the island of Bornholm painting seascapes. He then issued his earliest volume of poems, *Digte* (1872), and joined the group of young Radical writers who gathered under the banner of Georg Brandes. By this time he had enjoyed a surprising experience of life, especially among sailors, fishermen, students and artists and the issues of the Franco-German War and the French Commune had persuaded him that a new and glorious era was at hand. His volume of lyrics, *Dæmpede Melodier* ('Muffled Melodies,' 1875) proved that Drachmann was a poet with a real vocation, and he began to produce books in prose and verse with great rapidity. *Ungt Blod* ('Young Blood,' 1876) contained three realistic stories of contemporary life. But he returned to his true field in his magnificent *Sange udvædt, Venezia* ('Songs of the Sea, Venice,' 1877), and won the passionate admiration of his countrymen by his prose work, with interludes in verse called *Derovre fra Grænsten* ('Over the Frontier There' 1877), a series of impressions made on Drachmann by a visit to the scenes of the war with Germany. During the succeeding years he visited most of the principal countries of the world, and familiarized himself by protracted voyages with the sea and with the life of man in maritime places. In 1879 he published *Ranker og Roser* ('Tendrils and Roses'), love lyrics in which he showed a great advance in technical art. To the same period belongs *Paa Sommars Tro og Love* ('On the Faith and Honour of a Sailor,' 1878), a volume of short stories in prose. About this time Drachmann broke with Brandes and the Radicals, and led a 'nationalist' or popular Conservative party in Denmark. He continued to celebrate the life of the fishermen and sailors in books, whether in prose or verse, which were the most popular of their day. *Paul og Virginie* and *Lars Kruse* (both 1879), *Østen for Sol og vesten for Maane* ('East of the Sun and West of the Moon,' 1880), *Puppe og Sommerjule* ('Chrysalis and Butterfly,' 1882), and *Strandby Folk* (1883) were among these. In 1882 Drachmann published his fine translation, or paraphrase, of Byron's *Don Juan*. In 1885 his romantic play called *Der var en Gang* ('Once Upon a Time') had a great success on the boards of the Royal theatre, Copenhagen, and his tragedies of *Volund Smed* ('Wayland the Smith') and *Brav Karl* (1897) made him the most popular playwright of Denmark. He published in 1894 a volume of exquisitely fantastic *Melodramas* in rhymed verse, a collection which contains some of Drachmann's most perfect

of which were: (1) extension of franchise, to all who could provide themselves with a suit of armour, (2) the institution of a property qualification for office (archon 10 minae strategus 100 minae), (3) a council of 401 members (*sc.* Boule), (4) magistrates and councillors to be chosen by lot. Further, the four Solonian classes are said to be already in existence.

But the passage is now generally considered spurious on the following grounds: (1) It is ignored by every other ancient authority, except in admittedly spurious passage in Plato,¹ whereas Aristotle says of his laws 'they are laws but he added the laws to an existing constitution' (Pol. ii, 9, 9). (2) It is inconsistent with other passages in the *Constitution of Athens*. It embodies some of the most advanced features of Solon's constitution, yet according to ch. vii, Solon repealed all laws of Draco except those relating to murder. (3) Its ideas are alien to the 7th century. That the qualification of the strategus should be ten times that of the archon is reasonable in the 5th but preposterous in the 7th century. Again it is unlikely that, had a wealth qualification for citizenship been established, Solon, a democratic reformer, would have reverted to an aristocratic birth qualification. (4) The terminology of Draco's constitution is that of the 5th century, whereas the chief difficulty of Solon's laws is the obsolete 6th century phraseology. (5) Lastly, the 'Draconian constitution' (hoplite census, nobody to hold office a second time until all duly qualified persons had been entrusted, fine for nonattendance in boule), embodies the ideals of Theramenes and the moderate oligarchs, which they expressed by the phrase *ἡ τάξις πολιτεία*.

Criticism of the text supports the hypothesis that ch. iv is an interpolation. Ch. iv breaks the connection of thought between iii and v. Moreover, an interpolator has inserted phrases to remove obvious contradictions: thus (1) in ch. vii, where we are told that Solon divided the citizens into four classes the interpolator adds "according to the division formerly existing," which was necessary in view of the statement that Draco gave the franchise to the Zeugitae, (2) in ch. xli, the words "the Draconian" (*ἡ ἐν Δράκωντος*) are inserted in the list of constitutions, though the subsequent figures are not accommodated to the change. Solon is also here spoken of as the founder of democracy, whereas the Draconian constitution of ch. iv contains several democratic innovations. Two further points may be added, namely, that whereas Aristotle's account mentions a money fine, Pollux quotes a law of Draco in which fines are assessed at so many oxen, secondly, that though the treatise was widely read in antiquity there is no reference to Draco's constitution except the two quoted above. In any case, whatever were Draco's laws, Solon abolished all of them (Plut., *Solon*) except those dealing with homicide.

See J. E. Sandys, *Aristotle's Constitution of Athens*, 2nd ed. (1912), G. Gilbert, *Constitutional Antiquities*, Eng. trans. (1895), and works, quoted in article CONSTITUTION or ATHENS, Grote, *Hist. of Greece*, pp. 9-11 (1907 ed.), with references, and histories of Greece published after 1894.

DRAÇO (the Dragon), in astronomy, a constellation of the northern hemisphere. The Greeks had many fables concerning this constellation, one is that when Heracles killed the dragon guarding the Hesperian fruit, Hera transferred the creature to heaven as reward for its services. The star γ Draconis has acquired historic interest because from his observations of it James Bradley discovered the phenomenon of aberration of light (see ABBERRATION or LIGHT). It enjoyed this distinction because it is the brightest star that passes close to the zenith of Greenwich, so that errors of observation arising from refraction are minimized.

DRACONTIUS, BLOSSIUS AEMILIUS, of Carthage (according to the early tradition, of Spanish origin), Christian poet, flourished in the latter part of the 5th century A.D. He belonged to a family of landed proprietors and practised as an advocate in his native place. After the conquest of the country by the Vandals, Dracontius was at first allowed to retain his

DRACO (DRACON) (7th century B.C.), Athenian statesman, was archon eponymos (but see J. E. Sandys, *Const. of Athens*, p. 12, note) in 621 B.C. He codified the laws, which had previously been unwritten and administered arbitrarily by the eupatrids. The fixing of the law was a great boon to the people, although later ages regarded Draco's code, in which "for nearly all crimes there was the same penalty of death" (Plut., *Solon*), as barbarously severe. For the institution of the 51 epithetae and their relation to the Areopagus in criminal jurisdiction, see GREEK LAW.

But in 1891 appeared Aristotle's treatise on the constitution of Athens, the fourth chapter of which credits to Draco the construction of an entirely new constitution for Athens, the main features

¹A passage (long overlooked) in Cicero, *De republica*, shows that by the 1st century B.C. the interpolation had already been made, the quotation is evidently taken from the list in ch. xli of the *Constitution*, which it reproduces.

estates but was later thrown into prison by the Vandal king. He addressed an elegiac poem to the king, asking pardon and pleading for release. It is supposed that Dracontius obtained his liberty and migrated to northern Italy. This is consistent with the discovery at Bobbio of a 15th century ms., in the Museo Borbonico at Naples, containing a number of poems by Dracontius (the *Carmina minora*). The most important of his works is the *De laudibus Dei* or *De Deo* in three books, wrongly attributed by tradition to St. Augustine. The account of the Creation, which occupies the greater part of the first book, was at an early date edited separately under the title of *Hexameron*, and it was not till 1791 that the three books were edited by Cardinal Arevalo. The apology (*Satisfactio*) consists of 158 elegiac couplets; it is supposed that the king addressed is Gunthamund (484-496). The *Carmina minora*, nearly all in hexameter verse, are school exercises and rhetorical declamations. It is also probable that Dracontius was the author of the *Orestes tragoedia*, a poem of some 1,000 hexameters, which in language, metre and general treatment resembles the other works of Dracontius. His works show considerable vigour of expression and a remarkable knowledge of the Bible and of Roman classical literature.

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DRAFT A written order drawn on a banker or other holder of funds for the payment of money to a third person, thus a cheque (*q.v.*) is a draft. A special form of draft is a banker's draft, an instruction by one bank to another bank, or to a branch of the bank making the instruction, to pay a sum of money to the order of a certain specified person. (See also **BILL OF EXCHANGE**, in **PRACTICE**.)

The term is also used to describe an outline, plan or sketch, or a preliminary drawing up of an instrument, measure, document, etc., which, after alteration and amendment, will be embodied in a final or formal shape, an allowance made by merchants or importers to those who sell by retail, to make up a loss incurred in weighing or measuring, and a detachment or body of troops "drawn off" for a specific purpose, usually a reinforcement from the depot or reserve units to those abroad or in the field. For draft in compulsory military service, see **CONSCRIPTION**.

DRAFTED MASONRY, in architecture, masonry formed of large stones dressed or cut round the edge to a single plane, with the face between left as it came from the quarry. Many notable Roman examples exist, such as that of the Porta Maggiore, at Rome (period of the emperor Claudius, c. A.D. 50). It was also particularly common in the Near East, being found from the time of Cyrus, in the platform at Pasargadae (c. 530 B.C.), up to the time of the castles built by the crusaders. In the Renaissance drafted masonry was used occasionally for decorative purposes, as in the Rucellai palace at Florence by Michelozzi (c. 1430). When so used it is sometimes loosely termed "rustication."

DRAQ. The term is applied to a harrow for breaking up clods of earth, or to an apparatus, such as a grapple, net or dredge, used for searching water for drowned bodies or other objects. As a name of a vehicle, "drag" is sometimes used as equivalent to "break," a heavy carriage without a body used for tramping horses, and also a large kind of wagonette, but is more usually applied to a privately-owned four-horse coach for four m-hand driving. The word is also given to the "shoe" of wood or iron placed under the wheel to act as a brake, and also to the "drift" or "sea anchor," usually made of spars and sails, employed for checking the lee-way of a ship when drifting. In fox-hunting, the "drag" is the line of scent left by the fox, but more particularly the term is given to a substitute for the hunting of a fox by hounds, an artificial line of scent being laid by the dragging of a bag of amseod or other strong smelling substance which a pack will follow.

DRAGASHANI (Rumanian *Drăgășani*), a town of Rumania, near the right bank of the river Olt, and on the railway between Caracal and Ramnicu Valcea.

The vineyards on the neighbouring hills produce some of the best Walachian wines. Dragashani stands on the site of the Roman Rusudava. In 1821 the Turks routed the troops of Ypsilanti near the town.

DRAGO DOCTRINE. The government of every state, declared Lord Palmerston in 1848, is entitled by diplomatic methods to take up the complaint of any of its subjects against the government of another state, and if well founded, to demand redress. It has been the policy of the British Government not to encourage its subjects to hazard their capital by investing in foreign loans, and consequently it has usually refused to interfere when foreign governments have failed to meet their obligations. Lord Palmerston, however, added that in certain circumstances the Government might be prepared to go to the length of using force. To this statement Lord Salisbury subsequently gave his assent in 1880. In 1902 Venezuela having failed to comply with the demands made by Great Britain, Germany and Italy to make good its default in respect of its external loans, was called upon by these Powers to honour its obligations. Failing to obtain satisfaction, a blockade of certain Venezuelan ports was instituted. This led to the despatch of a note from Dr. Drago, foreign minister of the Argentine Republic, to the Argentine minister at Washington declaring that the principle should be accepted that for the common safety of the South American Republics, just as the Monroe doctrine is a principle enforced by the United States for the preservation of the territorial status quo throughout the American Continent against European aggression, the collection of pecuniary claims of citizens of any country against the Government of any South American Republic should not be effected by armed force. This proposal, however, did not find general acceptance, but by the Hague Convention (1907), the contracting Powers agreed not to have recourse to armed force for the recovery of contract debts claimed from the Government of one state by the Government of another state as due to its nationals. This agreement, however, does not apply if the debtor state refuses or neglects to accept an offer of arbitration, or after accepting the offer, prevents any compromise being reached, or after an award, fails to carry it out. See Sir T. Barclay, *Problems of International Law and Diplomacy* (1907), Phillimore, *International Law*, vol. II (1854-61).

(H. H. L.)



A COURTIER OF A V. NOBIL DRAGOMAN OF CAIRO EGYPT WHO ACTS AS AN INTERPRETER AND GUIDE

DRAGOMAN, a comprehensive designation applied to anyone who acts as an intermediary between Europeans and Orientals, whether as hotel tout or travellers' guide, or as the chief dragoman of a foreign embassy whose functions may include the carrying on of important political negotiations. (Ar. *terjuman*, an interpreter, cf. Heb. *targum*.)

The original employment of dragomans by the Turkish government arose from its religious scruples to use the language of any peoples which had not adopted Islam, while its political relations compelled the sultan's ministers to make use of interpreters, who rapidly acquired considerable influence. The first chief dragoman of the Porte was Panayot Nikoussa, who held his office from 1665 to 1673. His successor, Alexander Mavrocordato (*q.v.*), Examporitos, was charged by the Turkish government with the delicate and arduous negotiation of the treaty of Carlowitz, and succeeded in becoming the factotum of Ottoman policy. From that time until 1821 the Greeks monopolized the management of Turkey's foreign relations, and soon established the regular system whereby the chief dragoman passed on as a matter of course to the dignity of hospodar (*q.v.*) of one of the Danubian principalities.

In the same way, the foreign representatives accredited to the

former sultan of Turkey, found it necessary, in the absence of duly qualified countrymen of their own, to engage the services of natives, Greek, Armenian or Levantine, more or less thoroughly acquainted with the language, laws and administration of the country, who became the confidential go-betweens of the foreign missions and the Porte. But the disadvantages of the system soon became apparent, and as early as 1869 the French government decided on the foundation of a school for French dragomans at Constantinople, for which in later years was substituted the *École des langues orientales* in Paris, most of the great powers even finally took some similar step, England also adopting in 1877 a system, since modified, for the selection and tuition of a corps of British born dragomans.

The functions of the first dragoman are mainly political and connected with diplomatic negotiations, while the subordinate dragomans transact the less important business comprising in general all the various matters in which the interests of foreign subjects may be concerned. The high estimation in which the dragomans are held by most foreign powers is shown by the fact that they are promoted to the most important diplomatic posts. In the Russian, Austrian and German services more than one ambassador began his career as a junior dragoman, and the French chief dragoman usually attains the rank of minister plenipotentiary. The more important consulates in the provinces of Turkey are also provided with one or more dragomans, whose duties, *mutatis mutandis*, are of a similar though less important nature. In the same way banks, railway companies and financial institutions employ dragomans for facilitating their business relations with Turkish officials.

DRAGOMIROV, MICHAEL IVANOVICH (1830-1905), Russian general and military writer, was born on Nov. 8, 1830. He entered the Guards in 1849 and from 1854 to 1859 studied military science first at the Russian staff college (Nicholas Academy) and then abroad. On his return to Russia he became professor of tactics at the staff college. He played a leading part in the reorganization of the educational system of the army, and acted as instructor to several princes of the imperial family. He took part in the suppression of the Polish insurrection of 1863-64. During the Austro-Prussian War of 1866, Dragomirov was attached to the headquarters of the II Prussian army. He was present at the battles on the upper Elbe and at Königgratz, and his comments on the operations which he witnessed are of the greatest value to the student of tactics and of the war of 1866.

In the Russo-Turkish war of 1877-78 he commanded the 14th division, which led the way at the crossing of the Danube at Zimnitsa. Later, after the reverses before Plevna, he, with the tsarevich and Generals Todeleben and Milutine, strenuously opposed the suggestion of the Grand Duke Nicholas that the Russian army should retreat into Rumania, and the demoralization of the greater part of the army was not permitted to spread to Dragomirov's division. He was wounded at the Shipka pass, and further disabled for active service. For 11 years thereafter General Dragomirov was chief of the Nicholas Academy. He collated and introduced into the Russian army all the best military literature of Europe, and improved the morale and technical efficiency of the Russian officer-corps, especially of the staff officer. In 1889 Dragomirov became commander in chief of the Kiev military district, and governor general of Kiev, Podolsk and Volhynia, retaining this post until 1903. He was promoted to the rank of general of infantry in 1891. During the Russo-Japanese War of 1904-05 he was conserved by the general headquarters at St. Petersburg (Leningrad), and while he was in command with General Kuropatkin in many important questions of strategy and military policy, they both recommended a repetition of the strategy of 1812, even though the total annihilation of Port Arthur was involved. General Dragomirov died at Kootsook on Oct. 25, 1905.

His larger military works were mostly translated into French and German, and his occasional papers, extending over a period of nearly 50 years, appeared chiefly in the *Journal des Armées* and the *Revue militaire*, his later articles in the last named paper were like the general orders he issued to his own troops, attentively studied throughout the Russian army. His critique of Tolstoy's *War and*

Peace attracted even wider attention. Dragomirov was, in formal tactics, the head of the "orthodox" school. He inculcated the "offensive at all costs," and the combination of crushing short range fire and the bayonet charge. He carried out the ideas of Suvarov to the fullest extent, and many thought that he pressed them to a theoretical extreme unattainable in practice.

DRAGON, a fabulous monster, usually conceived as a huge-winged, fire-breathing lizard or snake. The word is derived through the French and Latin from the Greek *δράκων*, connected with *δρακω* "see," and interpreted as "sharp sighted." The equivalent English word "drake" or "fire drake" is derived from Anglo-Saxon *draca*. In Greece the word *δράκων* was used originally of any large serpent, and the dragon of mythology, whatever shape it may have assumed, remains essentially a snake. For the part it has played in the myths and cults of various peoples and ages see the article *Serpent Cults*. Here it may be said, in general, that in the East, where snakes are large and deadly (Chaldaea, Assyria, Phoenicia, to a less degree in Egypt), the serpent or dragon was symbolic of the principle of evil. Thus Apophis, in the Egyptian religion, was the great serpent of the world of darkness vanquished by Ra, while in Chaldaea the goddess Tiamat, the female principle of primeval Chaos, took the form of a dragon. Thus, too, in the Hebrew sacred books the serpent or dragon is the source of death and sin, a conception which was adopted in the New Testament and so passed into Christian mythology. In Greece and Rome, on the other hand, while the oriental idea of the serpent as an evil power found an entrance and gave birth to a plentiful brood of terrors (the serpents of the Gorgons, Hydra, Chimaera and the like), the *dracones* were also at times conceived as beneficent powers—sharp-eyed dwellers in the inner parts of the earth, wise to discover its secrets and utter them in oracles, or powerful to invoke as guardian genii. Such were the sacred snakes in the temples of Aesculapius and the *sacri dracones* in that of the Bona Dea at Rome, or, as guardians, the Python at Delphi and the dragon of the Hesperides.

In general, however, the evil reputation of dragons was the stronger, and in Europe it outlived the other Christianity, of course, confused the benevolent and malevolent serpent deities of the ancient cults in a common condemnation. The very "wisdom of the serpent" made him suspect, "the devil," said St. Augustine, "is a lion and a dragon, a lion because of his rage and a dragon because of his wiles." The dragon myths of the pagan East took new shapes in the legends of the victories of St. Michael and St. George, and the kindly snakes of the "good goddess" lived on in the *immanissimus draco* whose baneful activity in a cave of the Capitol was cut short by the intervention of the saintly pope Silverster I. In this respect indeed Christian mythology agreed with that of the pagan north. The similarity of the northern and oriental snake myths seems to point to a common origin in remote antiquity. Whatever be the origin of the northern dragon, the myths, when they first appear, show him to be in all essentials the same as that of the south and east. He is a power of evil, guardian of hoards, the greedy withholder of good things from men, and the slaying of a dragon is the crowning achievement of heroes—of Siegmund, of Beowulf, of Sigurd, of Arthur, of Tristram—even of Lancelot, the *beau idéal* of mediaeval chivalry. Nor were these dragons anything but very real terrors. In the works of the older naturalists, even in the great *Historia animalium* of Conrad Gesner (d. 1564), they still figure as part of the fauna known to science.

As to their form, this varied from the beginning. The Chaldaean dragon Tiamat had four legs, a scaly body, and wings. The Egyptian Apophis was a monstrous snake, as were also, originally at least, the Greek *dracones*. The dragon of the Apocalypse (Rev. xii. 3), "the old serpent," is many headed, like the Greek Hydra. The dragon slain by Beowulf is a snake (worm), for it "buckles like a bow," but that done to death by Sigurd, though its motions are heavy and snake-like, has legs, for he wounds it "behind the shoulder." On the other hand, the dragon seen by King Arthur in his dreams is, according to Malory, winged and active, for it "swoogs" down from the sky. The belief in dragons

seems to have arisen without the slightest knowledge on the part of the ancients of the gigantic and astonishingly dragonlike extinct reptiles of past ages.

The qualities of dragons being protective and terror inspiring, and their effluvia decorative, they were early used as warlike emblems. Thus, in Homer (*Iliad* vi 36 seq.) Agamemnon has on his shield, besides the Gorgon's head, a blue three-headed snake just as ages afterwards the Norse warriors painted dragons on their shields and curved dragons' heads on the prows of their ships. From the conquered Danes, too, the Romans in Trajan's time borrowed the dragon ensign which became the standard of the cohort as the eagle was that of the legion, whence, by a long descent the modern dragon. Under the later east Roman emperors the purple dragon ensign became the ceremonial standard of the emperors, under the name of the *δρακόντιον*. In England before the Conquest the dragon was chief among the royal ensigns. Its origin, according to the legend preserved in the *Floris historiarum* was as follows: Uther Pen dragon, father of King Arthur, had a vision of a flaming dragon in the sky, which his seers interpreted as meaning that he should come to the kingdom. When this happened, after the death of his brother Aurelius, "he ordered two golden dragons to be fashioned, like to those he had seen in the circle of the star, one of which he dedicated in the cathedral of Winchester, the other he kept by him to be carried into battle." From Uther Dragon-head, is the English called him, the Anglo-Saxon kings borrowed the ensign, their custom being, according to the *Floris*, to stand in battle between the dragon and the standard. The dragon ensign which was borne before Richard I in 1191, when on crusade, "to the terror of the heathen beyond the sea" was that of the dukes of Normandy, but even after the loss of Normandy the dragon was the battle standard of English kings, and was displayed, e.g., by Henry III in 1245 when he went to war against the Welsh. Not till the 20th century was the dragon officially restored as proper only to the British race of Uther Pen dragon, by its incorporation in the armorial bearings of the prince of Wales. Thus the dragon and wyvern (i.e., a two-legged snake, M.E. *awere*, viper) took their place as heraldic symbols (see *HERALDRY*).

In the east the dragon is the national symbol of China and the badge of the imperial family, and as such plays a large part in Chinese art. Chinese and Japanese dragons, though regarded as powers of the air, are wingless. They are among the deified forces of nature of the Taoist religion, and the shrines of the dragon kings, who dwell partly in water and partly on land, are set along the banks of rivers. (See also *DRACO*.)

See J. B. Panthot, *Histoire des dragons et des escarboucles* (Lyons, 1691); C. V. Darlombert and F. Saglio, *Dictionnaire des antiquités grecques et romaines* (1886, etc.), s.v. "Draco"; Pausanias, *Presque-Islande*, s.v. "Drakon"; Du Cange, *Glossarium*, s.v. "Draco"; *La Grande Encyclopédie*, s.v. "Dragon". See also the article BABYLONIAN AND ASSYRIAN RELIGION (W. A. P., 2.).

The term "dragon" has no zoological meaning, but it has been applied in the Latin generic name *Draco* to a number of species of small lizards, found in the Indo-Malayan region, characterized by the possession of winglike folds of skin projecting from the sides of the body and supported by the greatly elongated ribs. These structures do not involve the legs and cannot be used as actual wings for flight, they serve merely as gliding planes which extend the distance over which the animal can leap from one to another of the trees in which it lives. The largest form is only about 10 in. in length.

Another lizard to which the name is popularly applied is the giant monitor, *Varanus komodoensis*, discovered in Komodo, one of the Netherlands Indies. It is a heavily built lizard that reaches a length of at least 10 ft., thus greatly exceeding all other living lizards, although the extinct *Varanus priscus* of Australia attained perhaps twice the length.

In military use the name was applied to the musket—ornamented with the head of a dragon—from which the dragons derive their name, and later it was applied to a mechanical tractor for drawing guns, propelled by an internal combustion engine and running on caterpillar tracks. This machine, a variant of the steam

tractor for heavy guns in use in most European armies before and during World War I, and of the wartime tank, replaced teams of horses for the traction of guns and limbers in certain British field artillery brigades. (See further *ARTILLERY*.)

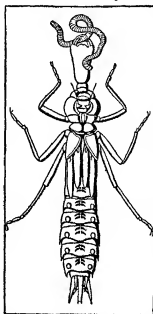
DRAGONET (*Callionymus lyra*), a small marine fish of the coasts of Europe, with slender naked body and large eyes close together on top of the flattish triangular head. The male is larger and more ornamented than the female, the body and the large dorsal fins having blue spots and bands on an orange ground. There is courtship and pairing, the male and female swimming upwards in an embrace.

DRAGONETTI, DOMENICO (1763-1846), Italian double bass player, was born in Venice on April 7, 1763, and died in London on April 16, 1846. Dragonetti was a virtuoso of the first rank, and one of the best known figures in the musical life of his day. His first appearance in London was in 1794. In London he met Lindley, with whom he played regularly from that time. In 1798 he visited Haydn at Vienna, and in 1808-09, on another visit to Vienna, he met Beethoven whom he worshipped. In 1845, at the age of 82, he led the double basses in the Beethoven Festival at Bonn.

DRAGONFLY, the common name applied to insects of the order Odonata. Dragonflies are graceful, acroplanlike insects which patrol the edges of ponds and streams. In the hand they are harmless and can be recognized by the great jewelled eyes, the two pairs of similar, narrow transparent wings, the long usually slender abdomen or "tail" and the fact that the six similar legs are far forward. Many are brilliant with spots and stripes of red, blue, green or yellow on a dark ground colour.

Habits and Structure—Above that of all other insects is the design of the dragonfly attuned to life on the wing. Some (*Ephedrus* princeps) seldom alight from dawn to dusk though the group has its loafers (*Neurocordulia*, *Gynacantha*) which sleep around the clock except for short flights at dawn and again at dusk. Dragonflies are content and at home in the air. All have speed, acrobatic ability and that most difficult manoeuvre of all, hovering, a flight skill possessed by few insects.

The eyes, occupying over half of the head surface, give both casual monocular and range-finding binocular vision as well as vision up, down and quartering to the rear. The dragonfly's life is encompassed and guided by vision. However, it is a mosaic vision, the sum of images seen by 2,000 or more individual cameras that compose the insect's compound eye. Such an eye is acutely sensitive to moving objects. The antennae, the main organs of smell in insects, are reduced to mere bristles with probably little use. The two pairs of jaws, with crushing and needle teeth, arm him well. The six legs placed far forward on the body are directed forward in hunting where the six feet form a spiny basket below the mouth in which hapless gnats are caught.



BY COURTESY OF W. J. LUCAS

FIG. 1—DRAGONFLY NYMPH WITH MARK EXTENDED, SEIZING ITS PREY. The female lays its eggs near or below the water, and after they are hatched, the nymphs spend their lives in the water until full development.

The wings are thin tough membranes stretched on an elaborate frame of veins. It is a rich basic plan for adaptation of wing structure to the flight habits of each species. Those living in low dense vegetation (Coenagruidae, Lestidae) and of small size (1½ in. expanse) have paddlike wings by which they flutter across the short distances between sedges and reeds. For concealment they can fold their wings against the body. The species (Agruidae) of narrow wooded streams, full of flight obstructions, have broad

wings with rounded tips by which the dragonfly can suddenly stop and change direction. The great rivers of the world have coursing over their unobstructed surfaces at top speed (20 to 60 m.p.h.) the giant dragonflies (Macromiinae) with stiff, sharp pointed wings. Collectors procure them with bird guns and dust shot. Such can bounce out of a net before the net opening can be twisted shut. The most graceful fliers (certain tropical Libellulinae), which can twist and spiral within the confines of a swarm of gnats, have the tip of the slender abdomen broadened into a thin horizontal steering fin. Such are aerial acrobats.

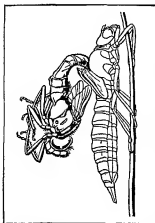


FIG 2—METAMORPHOSIS FROM NYMPH TO DRAGONFLY

On leaving the water, the final change takes place, the anterior portion of the dragonfly being liberated through the nymph-outlet as shown in the drawing.

The thorax, to which legs and wings are attached, houses the great wing muscles, the motor of these insectan planes. The wing muscles in other insects are short and vertical but in the dragonfly they are skewed forward in a thorax lengthened forward in some tropical species to thrice the usual length. The long muscles are an adjustment to the slow beat necessitated by long wings.

The slender abdomen of ten bamboo-like segments has at the tip in the male 24 claspers by which he seizes the head or thorax of the female when they fly tandem during mating manoeuvres.

On the second and third abdominal segments of the male is a complex copulatory organ to which he transfers sperm from the sex opening near the tip of his abdomen. While flying or resting in tandem the female loops her abdomen forward and places its tip at the male organ. No other insects have a similarly complex mating, one adapted to fast flight. The females of many species with an ovipositor place eggs in soft plant tissues, while other species without, scatter eggs during flight over the water's surface.

With such structures adapted to speedy graceful life on the wing, various fine points of streamlining occur. The large eyes round the forward end. In many species the forward three segments of the abdomen form a bulbous trailer to the large thorax, easing air eddies behind the latter. The abdomen then becomes a slender trailer. In flight the legs are pulled up under the thorax. Even the wings in section are thickened along the leading edge by a series of vein-formed ridges. The speedier species even have the usual microscopic hairs eliminated.

Classification—Dragonflies in general fall into two groups, the suborder Anisoptera and the suborder Zygoptera.

The Anisoptera are usually larger, heavier-bodied and have the hind wings broader at the base than are the fore wings. At rest the wings are extended. There are seven families. Widespread northern genera are *Gomphus*, *Aeshna*, *Libellula* and *Sympetrum*.

The Zygoptera are slender and rest with the wings folded over the body (except Lestidae and some tropical species). Fore and hind wings are similar with narrow bases. There are nine families, common northern genera are *Coenagrion*, *Ischnura*, *Enallagma* and *Agrion*. In Japan and India live two species of *Epiplatia* of an otherwise extinct suborder, the Anisozygoptera.

Development—While the adult dragonfly is an aerial insect,

it is attached to a water environment for its food of mosquitoes and aquatic gnats. The young dragonfly is aquatic but is limited to fresh or brackish water and mud. None are truly marine. Eggs are round and laid in the water or mud, or are elongate and thrust into aquatic plants when the female is one with ovipositor. (Fig. 1 shows an aeshnine nymph or young with short wing pads and its elongate under lip (labium) with apical labial jaws shot forward and grasping a worm. Figs. 2 and 3 show the lip folded up under the head.) The nymph stalks its living prey by stealth and when in range shoots the lip to grab it. The food is chewed with jaws similar to those of the adult and in many species is regurgitated within a gizzard lined with teeth. The nymph can walk but swims by a sort of jet propulsion. Water is drawn into the large rectum and is then forcibly ejected. Descended from air-breathing land insects, the nymph has a complete tracheal or air-tube system which carries oxygen to all parts. In the water the openings to the air (spiracles) are closed, and oxygen is absorbed into the tracheal system, directly from that dissolved in water, osmosis takes place through the walls of the gills and through the walls of the rectum, which areas are supplied with microscopic tracheal branches (tracheoles). In the Anisoptera the tracheolar gills are in the rectum and are folds of the rectal walls. They are aerated by



FIG 4—METAMORPHOSIS FROM NYMPH TO DRAGONFLY

The third stage shows the whole body extruded from the nymph-outlet.

water drawn through the anus into the rectum. In the Zygoptera three leaf-shaped gills occur as three tails on the apex of the abdomen. If these are lost the Zygoptera nymph can still breathe by sucking water into the rectum. The minute newly-hatched nymph eats at first large protozoa, then Entomostira (*Cyclops*, *Daphnia*), and eventually in large species may attack and devour tadpoles and young fish. It attacks only moving prey as it is eye-minded as are the adults. After many moults (10 to 15) of the skin or exoskeleton it reaches full growth. For a week or so it sits stupid and without motion while within its body the larval organs change into those of the adult. The long lip is shortened, the wings develop as crumpled wads within the nymphal wing pads.

Eventually the urge to light and air comes and the aquatic nymph crawls slowly up a stem into the air and sunshine. The back of the nymphal skin splits and a much crumpled dragonfly crawls out to expand in an hour or so into the winged adult. (See Figs. 2-4.) It is a critical period, since martins and other birds rear their young largely on soft emerging dragonflies. Many aeshnine nymphs emerge at night and are smartly on the wing with the birds at dawn.

Geographic Distribution—Dragonflies form a small order, 2,700 species, as against some great orders, Coleoptera, Diptera, Hymenoptera above 100,000 each, Carnivores form small groups. Because they are adapted to sunshine they are most abundant in the tropics, with 500 species in British India and 40 species in England. Few species spread onto two continents.

Geological History—Dragonflies appear in the Palaeozoic where fossils occur in the Carboniferous at Coventry, France, next in the Permian of Kansas. These were of the order Protodonata, many large, some 2 ft. across the wings. In the Mesozoic great size is lost and early modern forms appear of the orders, Anisozygoptera, Zygoptera and Anisoptera, found in the Bavarian slates (Jurassic). Cenozoic dragonflies early modern occur in the U.S. Green river beds (Eocene), and Miocene beds in Colorado and at Oeningen (Switzerland). In the latter appear libellulid nymphs, the most modern type.

Some of the most intensely coloured insects known are Odonata *Chalcopteryx* (the golden-winged one), South American, has



FIG 3—METAMORPHOSIS FROM NYMPH TO DRAGONFLY

The second stage shows the tail being extruded from the nymph-outlet.

wings in glittering gold, metallic violets and glistening black. The jewels of the order are in *Rhinocypha*, the species of which are scattered down the islands from India to New Guinea. These have gaudy bodies but indescribably brilliant wings that glitter with iridescent pinks, greens, blues and violets. In tropical rain forests are many species which while aquatic avoid the water.

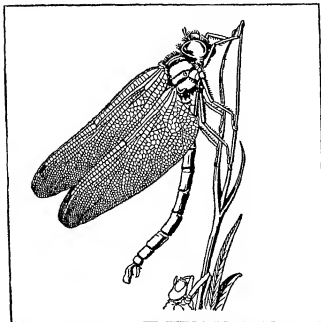


FIG. 8.—THE PERFECT DRAGONFLY ITS METAMORPHOSIS COMPLETE. The wings have acquired their full dimensions. The dragonfly is seen resting to dry itself, before the wings are horizontally extended.

Those (*Megalagrion*) in Hawaii have nymphs that live in the mud of the forest floor. In tropical America occur the giant Zygoptera of the *Pseudostigmatinae* with bodies 3.8 in. long, though slender, and 4-7 in. across the wings, the nymphs of which live in the mud at the bases of the broad leaves of tree-born epiphytes (Bromeliads) of the pineapple family.

Economic Importance.—All adult dragonflies catch mosquitoes while the nymphs feed on larvae and the active pupae. The nymphs are regular food for fish and diving ducks.

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DRAGON'S BLOOD. A red-coloured resin obtained from several species of plants *Daemonorops draco*, one of the rattan or rattan palms, which produces much of the dragon's blood of commerce, is a native of Further India and the Eastern Archipelago. The fruit is round, pointed, scaly, and the size of a large cherry, and when ripe is coated with the resinous exudation known as dragon's blood. The substance in commerce is dark red brown, nearly opaque and brittle, contains small shell like flakes, and gives when ground a fine red powder. It is soluble in alcohol, ether and fixed and volatile oils. If heated it gives off benzoic acid. In Europe it was once valued as a medicine on account of its astringent properties, and is now used for colouring varnishes and lacquers, in China, where it is mostly consumed, it is employed to give a red tinge to writing paper. The dragon's blood of commerce is still one of the products of Siam, and is obtained from *Dracaena cinnabari*. The dragon's blood of the Canary Islands is a resin procured from the surface of the leaves and from cracks in the trunk of *Dracaena draco*. The hardened juice of a euphorbiaceous tree, *Croton draco*, a resin resembling kino, is the "dragon's blood" of the Mexicans, used by them as a vulnerary and astringent.

DRAGON. originally a mounted soldier trained to fight on foot only (See CAVALRY and INFANTRY). This mounted infantryman of the late 16th and early 17th centuries, like his comrades of the infantry who were styled "pike" and "shot," took his name from his weapon, a species of carbine or short musket called the "dragon." Dragons were organized not in squadrons but in companies, like the foot, and their officers and non-commissioned officers bore infantry titles. The invariable tendency of the old-fashioned dragon, who was always at a disadvantage when engaged against true cavalry, was to improve his horsemanship and armament to the cavalry standard. Thus "dragon" came to mean medium cavalry, and this significance the word has normally retained since the early wars of Frederick the Great. The light cavalry of the British army in the 18th and early 19th centuries was for the most part called light dragons. The phrases "to dragon" and "dragonnade" bear witness to the mounted infantry period, this arm being the most efficient and economical form of cavalry for police work and guerrilla warfare. The "Dragonnades," properly so called, were the operations of the troops (chiefly mounted) engaged in enforcing Louis XIV's decrees against Protestants after the revocation of the edict of Nantes.

DRAGUIGNAN, the chief town of the department of the Var in S.E. France, 51 m. N.E. of Toulon, and 28½ m. N.W. of Fréjus by rail, 679 ft. above sea-level, at the southern foot of the wooded heights of Malmont, on the left bank of the Nartuby river, pop. (1946) 11,801. The buildings are mainly modern. There are manufactures of leather, soap and sparis and trade in olive oil and grapes.

DRAINAGE, HOUSE. see SANITATION OF BUILDINGS

DRAINAGE OF LAND. Drainage is the removal of unwanted water. When done over great areas of land, necessitating large engineering works, it is called arterial drainage (see below), but when done on farms to carry the water away from the fields to the nearest discharge point it is called agricultural or land drainage. It is needed because plant roots require oxygen and, if the pore spaces of the soil are blocked with water, air cannot enter nor can the carbon dioxide escape. Agricultural crops become enfeebled and their place is apt to be taken by weeds that tolerate the conditions. Drainage does not affect the water held by the powerful forces of suction in the finer pores on which the plant depends for its water supply and which may in a clay soil amount to about 30% of the weight of the dry soil.

In designing a drainage system the first problem is to ascertain if the superfluous water comes from a spring or by seepage from higher land or upthrow from an impervious subjacent layer, if so, some intercepting system is then required. But if it comes from rain it must either be led away by a water furrow or percolate through to the subsoil. On sandy or gravelly soils this happens easily, though a way out may still have to be found if the subsoil contains an impervious layer. On clays and heavy loams percolation is much more difficult and it is these that stand most in need of drainage. The method is to cut channels (formerly called "thoroughgs," meaning "through ways," hence the name "thorough drainage") into which the water can seep, and to link them with an exit into a ditch that will carry the water into the arterial system either by gravity or by aid of a pump. The ditch must be kept clean so that the water may flow away as rapidly as possible.

The siting of the channels, their depth and distance apart are largely empirical matters, but there are certain general rules. Usually the depth should not be more than about 2½ to 3 ft., and the distance between them about 30 or 40 ft., less on a heavy than on a lighter soil. They should be straight, parallel on a fairly level ground but running down the slope on sloping land, and be placed that every part of the field is served. The gradient must be uniform, and the more nearly level the ground the greater must be the care in ensuring this. These channels—the minors—run into a main, entering it if possible at a right angle though this may be impracticable on sloping land. The main leads to the exit point. On high grazing land the channels may be left open; they are then called sheep drains. But on more productive land open chan-

nels would interfere too much with agricultural operations. Unglazed clay pipes¹ are carefully laid at the bottom, the ends touching, and the channels are then filled up. The pipes on the minors are usually about 2½ or 3 in. in diameter, those on the main may be larger. The outlet to the ditch must be a solid brick or stone structure. A map of the system should be carefully prepared.

The channels can be made by a machine but the machine and the pipes are both expensive. A cheaper method available on heavy soils free from stones is to use a mole plough. This implement carries a strong steel blade at the end of which is a cylinder with a pointed end, this cuts a 2 or 3 in tunnel (mole) 15 to 25 ft below the surface into which the water can drain. The moles must be much closer together than the piped lines, about 10 or 12 ft is a suitable distance apart. They should not be too long—100 yd is a usual limit—and they should not discharge directly into the main but into a length of clay pipes. On stiff soils the moles may last 15 or 20 years, but since they can be redrawn over the same moles fairly cheaply they should not be left if they show signs of failing.

The water escapes from the soil into the drainage system by gravity through large pore spaces, cracks and other discontinuities, and the extent to which these persist determines the efficiency of the system. Good cultivation, dressings of lime and deep rooted crops all help to open up new passages and to promote stability of the soil crumbs and prevent their disintegration into fine particles which would block up the passages. Silty soils are particularly liable to this risk and are therefore the most difficult to drain, clay soils are much more stable.

The benefits of drainage are many. Cultivation becomes more effective, giving a better tilth and seed bed, germination is improved, plant growth can begin earlier in spring because the soil warms up much more quickly. The roots strike more deeply into the soil, they have a better oxygen supply—and oxygen for the plant roots is, in humid regions, as vitally important as is water in arid regions. A wider range of crops can be grown and the need for bare fallows is greatly diminished, fertilizers act much more efficiently. Grass land especially benefits from drainage because wild white clover can now be grown, greatly improving the grazing value, certain harmful parasites of the livestock are reduced and troubles like liver fluke and footrot in sheep considerably lessened. It should however be added that over considerable areas of the boulder clay in England the need for drainage arises from a dense mat of vegetation on the surface which holds up the rain water, if basic slag is applied the soil microorganisms become active and break up the mat, clover develops and its roots strike through into the underlying clay making a way for the water and so dispensing with the need for drainage.

Broadly speaking it is safe to say that drainage is one of the greatest and most vital improvements in humid countries. It has long been practised in England. Yet in the 1930s the National Farmers' union estimated that 7,000,000 ac. of farm land still needed drainage. More is being done today than after World War II, but the need is still great. The drainage of the United States is shown in the following table. The figures are in thousands of acres.

| Year | Drained | Not Drained | Total |
|------|---------|-------------|---------|
| 1930 | 10,000 | 100,000 | 110,000 |
| 1935 | 12,000 | 98,000 | 110,000 |
| 1940 | 14,000 | 96,000 | 110,000 |
| 1945 | 16,000 | 94,000 | 110,000 |
| 1950 | 18,000 | 92,000 | 110,000 |
| 1955 | 20,000 | 90,000 | 110,000 |
| 1960 | 22,000 | 88,000 | 110,000 |
| 1965 | 24,000 | 86,000 | 110,000 |
| 1970 | 26,000 | 84,000 | 110,000 |
| 1975 | 28,000 | 82,000 | 110,000 |
| 1980 | 30,000 | 80,000 | 110,000 |

Source: National Farmers' Union, *Drainage in the United States*, 1930-1980.

ARTERIAL DRAINAGE

The term arterial drainage embraces the whole drainage system of a catchment area, other than local field drainage systems, whereby surplus water is collected from the land and delivered finally into the sea. In lowlands such as the fens in England or the polders of Holland which have been reclaimed from marshes, the drainage system consists mainly of artificial channels. In such

reclaimed areas the land generally lies at such a low level that pumps have to be employed to lift the water into the main high-level system. In former times windmills were employed for this purpose, but with the invention of the steam engine and later the diesel engine and centrifugal pump, much more efficient and intensive drainage has been possible. Apart from lowlands, where the drainage system is mainly artificial and where it is vital to the continued existence of agricultural land, practically all agricultural land depends in some degree upon drainage to maintain its fertility.

In the Netherlands, the spheres of the arts of draining and embanking have created the very soul of the country, organized drainage authorities of one sort or another may be traced from the 11th century onward. In some provinces the administration of drainage was part of the functions of the local government authority, e.g., the count and his court or the local ecclesiastical body, in others there were organizations created exclusively for this purpose. By the 13th and 14th centuries the administration of draining and embanking enterprises was highly developed, and in some regions conducted on a broadly democratic basis. In 1954 there were in the Netherlands about 2,500 embankment and drainage bodies, of which about 500 dated back to the middle ages.

It is probable that the earliest drainage authority in England, viz the lords bailiff and jurats of Romney marsh, dating from the reign of Henry III (1232), was based on the example of the Netherlands and, in its turn, served as a model for later drainage bodies in England. The first general statute relating to commissioners of sewers ("sewer" then meaning a watercourse) was promulgated in 1427 under Henry VI, it declared that his majesty had ordained that for a period of ten years commissioners of sewers should be sent into all parts of the realm where needed. The practice of issuing such commissions became permanently established in the reign of Henry VIII under the Bill of Sewers, 1531. These commissioners were, however, temporary in character. Their powers were originally limited to a three year period, later extended to five years and subsequently to ten. The commissioners had no powers to carry out any work, but they could hold inquiries, order work to be done, assess responsibilities, appoint bailiffs to collect money, distraint for arrears, and so forth. The "laws and customs of Romney Marsh" were taken as precedents to be followed.

The act of 1531 has provided the basis of land drainage legislation up to modern times. Indeed, it is the rather obscure wording of this enactment which is held to establish the principle of obtaining benefit or avoiding danger as a basis for the liability to pay drainage rates, a principle reaffirmed, but with a wider interpretation of benefit, in the Land Drainage act, 1930. The Sewers act, 1833, and the Sewers Acts Amendment act, 1849, gave wider powers to commissioners, but under the Land Drainage act, 1861, the duties of commissioners were more clearly defined and their powers greatly extended. It was under this act that elective drainage boards were first established. Apart from the commissioners of sewers, many drainage authorities were set up under special acts, particularly in the fens in the 18th and 19th centuries, when numerous internal drainage boards were established. The Land Drainage act of 1918 enabled the ministry of agriculture and fisheries to constitute drainage boards and delegated certain powers to county councils, further powers being given to county councils under the Land Drainage act, 1926.

While the work done by internal drainage boards in fen areas established under various acts was effective enough, the natural drainage problem remained unsolved. The principle of "no benefit, no rates" resulted in limited rating areas which yielded insufficient funds to carry out the works required. The failure of the Ouse Drainage board, set up in 1920 to remedy the drainage difficulties on the Great Ouse, showed how impracticable was the limited benefit area for dealing with a large-scale problem. It was largely as a result of this that the royal commission on land drainage in England and Wales was set up in 1927. The commission's report states that "the administration of arterial drainage is conducted by a confused tangle of Authorities established by the piecemeal legislation of 500 years, and exercising a great variety of powers and functions. There is no uniformity of

²The pipes should not be too porous. In US experience concrete pipes served equally well, but they are too costly for use in Great Britain.

Statistics—According to the enterprises each serving 500 ac. In 30 states these enterprises tracts while in the other 10 the and technical supervision and arranged financing of community drainage works. The New England states, Pennsylvania and West Virginia reported no drainage enterprises.

In 1950, out of 1,158,000,000 ac in farms in the United States, 103,000,000 ac were included in drainage enterprises. This number compared with 87,000,000 in 1940 and 84,000,000 in 1930. Drainage enterprises reported 155,000 mi. of open ditches, 56,000 mi. of tile drains and 8,000 mi. of levees. These figures do not include the much greater length of open and closed drains provided by private landowners.

Despite the large area already improved, many millions of acres of land throughout the country still needed drainage at mid-20th century.

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DRAKE, SIR FRANCIS (c. 1545-1596), English admiral, was born near Tavistock, Devonshire, about 1545 according to most early authorities, but possibly as early as 1539 (see Corbett, vol. 1, Appendix A). His father, a yeoman and a zealous Protestant, took refuge in Kent during the reign of Queen Mary. Young Drake was educated at the expense and under the care of Sir John Hawkins, who was his kinsman, he was apprenticed on a coasting vessel, and at 18 was purser of a ship trading to Biscay. At twenty he made a voyage to Guinea, and at twenty-two he was made captain of the "Judith." He fought his ship gallantly in the Gulf of Mexico under Sir John Hawkins, and returned with him to England, having acquired great reputation, though with the loss of all the money which he had embarked in the expedition. In 1570 he obtained a regular privateering commission from Queen Elizabeth, and embarked on a cruise in the Spanish Main. He planned an attack against the Spaniards in the West Indies to indemnify himself for his former losses, and set sail in 1572, with two small ships named the "Pasha" and the "Swan." He was afterwards joined by another vessel, and with this small squadron he took and plundered the Spanish town of Nombre de Dios. He penetrated across the isthmus of Panama, and committed great havoc among the Spanish shipping. From the top of a tree on the isthmus he obtained his first view of the Pacific, and resolved "to sail an English ship in these seas." In these expeditions he was assisted by the Maroons, descendants of escaped negro slaves. Having filled his ships with plunder, he bore away for England, and arrived at Plymouth on Aug. 9, 1573.

Having fitted out three frigates at his own expense, he sailed to Ireland, and served as a volunteer, under Walter, earl of Essex. After his patron's death he returned to England, where he was well received by Queen Elizabeth. The first proposal he made to her was a voyage into the South Seas through the straits of Magellan, which no Englishman had hitherto ever attempted. The queen furnished him with means, and his own fame quickly attracted the men. The fleet with which he sailed consisted of only five small vessels, manned in all by 166 men. Starting on Dec. 13, 1577, he laid his course by the west coast of Morocco and the Cape Verde Islands. He reached the coast of Brazil on April 6, and entered the Rio de la Plata, where he parted company with two of his ships, but having met them again, and taken out their provisions, he turned them adrift. On June 19 he entered the port of St. Julian's, where he remained two months,

US census for 1950 drainage or more, operated in 40 states were drainage or irrigation districts supplied administration



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE SAME MARSH AFTER BEING DRAINED BY CHANNELS

partly to lay in provisions, and partly delayed by the trial and execution of Thomas Doughty, who had plotted against him. On Aug. 21 he entered the Straits of Magellan. The passage of the straits took sixteen days, but then a storm carried the ships to the west, on Oct. 7, having made back for the mouth of the strait, Drake's ship and the two vessels under his vice-admiral Captain Wynter were separated, and the latter, missing the rendezvous, returned to England. Drake went on, and came to Mocha Island, off the coast of Chile, on Nov. 25. He thence continued his voyage along the coast of Chile and Peru, taking all opportunities of seizing Spanish ships, and attacking them on shore, till his men were satiated with plunder, and then coasted along the shores of America, as far as 48° N. lat., in an unsuccessful endeavour to discover a passage into the Atlantic. He named the country New Albion, and took possession of it in the name of Queen Elizabeth. He sailed on July 26, 1579, for the Moluccas. On Nov. 4 he got sight of those islands, and, arriving at Ternate, was extremely well received by the sultan. On Dec. 10 he made the Celebes, where his ship unfortunately struck upon a rock, but was taken off without much damage. On March 11 he arrived at Java, whence he intended to have directed his course to Malacca, but he found himself obliged to alter his purpose, and to think of returning home. On March 26, 1580, he again set sail, and on June 15 doubled the Cape of Good Hope, having then on board only 57 men and three casks of water. He passed the line on July 12 and on the 16th reached the coast of Guinea, where he watered. On Sept. 11 he made the Island of Terceira, and on Sept. 26 (?) he entered Plymouth harbour. This voyage round the world, the first accomplished by an Englishman, was thus performed in two years and about ten months.

The queen hesitated for some time whether to recognize his achievements or not, on the ground that such recognition might lead to complications with Spain, but she finally decided in his favour. She went on board his ship at Deptford and there conferred upon him the honour of knighthood. She likewise gave directions for the preservation of his ship, the "Golden Hind," that it might remain a monument of his own and his country's glory. After the lapse of a century it decayed and had to be broken up. Of the sound timber a chair was made, which was presented by Charles II. to the university of Oxford.

In 1581 Drake became mayor of Plymouth, and in 1585 he married a second time, his first wife having died in 1583. In 1585 hostilities having commenced with Spain, he again went to sea, sailing with a fleet to the West Indies, and taking the cities of Santiago (in the Cape Verde Islands), San Domingo, Cartagena and St. Augustine. In 1587 he went to Lisbon with a fleet of thirty sail, and having received intelligence of a great fleet being assembled in the bay of Cadiz, and destined to form part of the Armada, he entered the port on April 19, and there burnt upwards of 10,000 tons of shipping—a feat which he afterwards called "singeing the king of Spain's beard." In 1588, when the Spanish Armada was approaching England, Sir Francis Drake was appointed vice admiral under Lord Howard, and made prize of a very large galleon, commanded by Don Pedro de Valdez, who struck at once on learning his adversary's name.

In 1589 Drake commanded the fleet sent to restore Dom Antonio to the throne of Portugal. He sailed on Dec. 13, 1589, and on Jan. 28, 1590, he entered the bay of Rio de Janeiro, and on Feb. 28, 1590, he entered the bay of Santos. He then sailed for the West Indies, on Jan. 28, 1590.

The older Lives by Samuel Clarke (1671) and John Barrow, junr (1843), have been superseded by Julian Corbett's two admirable volumes on *Drake and the Tudor Navy* (1898), the best source of information on the subject, which were preceded by the same author's *Sir Francis Drake in the "English Men of Action"* series (1890). See also E. J. Payne's edition of *Voyages of the Elizabethan Seamen to America*. Thirteen original narratives from the collection.

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DRAKE, NATHAN (1766-1836), English essayist and physician, son of Nathan Drake, an artist, was born at York. He was apprenticed to a doctor in York in 1779, and in 1786 proceeded to Edinburgh university, where he took his degree as M.D. in 1789. In 1790 he set up as a general practitioner at Sudbury, Suff., where he found an intimate friend in Mason Good. In 1792 he removed to Hadleigh, Suff., where he died in 1836. His most important production was *Shakespeare and His Times, Including the Biography of the Poet, Criticisms on His Genius and Writings, a New Chronology of His Plays, a Disquisition on the Object of His Sonnets, and a History of the Manners, Customs and Amusements, Superstitions, Poetry and Elegant Literature of His Age* (1817).

DRAKENSBERG or QUATHLAMBA, the highest portion of the great eastern scarp of the South African plateau. It forms the eastern boundary of Basutoland and Orange Free State.

DRAM or DRACHM, a weight approximately equal to that of the ancient Greek coin, in apothecaries' weight one-eighth of an ounce, or 60 gr. (3.888 g.), in avoirdupois weight one sixteenth of an ounce, or 27.34375 gr. (1.772 g.). For short the term is used for a fluid dram (drachm), a measure of capacity equal to one-eighth of a fluid ounce. The U.S. *Pharmacopoeia* differs in usage from the British. The former uses apothecaries' weights, the latter the avoirdupois.

DRAMA is a transmutation of the Greek *δρᾶμα*, which means a thing done, theatre is a transmutation of the Greek *θεῖον*, which means a seeing place. The word audience, meaning those who listen, is derived from the Latin and therefore represents a later idea of playgoing. From this use of two Greek words and one Latin a useful hint is given as to the first dramatic values. Drama begins with action and spectacle, the deed comes before the word, the dance before the dialogue, the play of body before the play of mind. The audience is subsequent to the spectators. The history of drama is largely a history of changing dramatic values. Gradually the presentation of thought becomes as important as the representation of emotion, which was the main element of theatrical origins. Nowadays a person who talks about the drama may actually be thinking of a literary form and of something that will be read and discussed but will rarely or never live up to the original meaning of its name and be "done."

Modern drama includes work in which the discussion of ideas is the whole purpose of the play. Of the play it is sometimes permissible to observe that it is just as effective in book form as when "done." Indeed, in the first decade of the 20th century the drama of the intellectuals definitely revolted so far from the idea of "four boards and a passion" that H. G. Granville-Barker could describe it in this way: "Plays grew so austere, intellectual that their performance seemed a profanation, and we saw the actors moving apologetically through their parts as if they had been told that they were rather vulgar people with no right here at all." This was a paradoxical fate to befall the men of action in "the seeing place," but those who read or listen to the political and philosophical discussions in George Bernard Shaw's "metabological pentateuch" *Back to Methuselah* will appreciate the point of this and realize how great is the change from the simple conception of a drama as a thing done to the later use of "the seeing place" as a schoolroom for the continued instruction and entertainment of the adult who is hungry for ideas. If we are to find a definition of drama which will cover all theatrical manifestations from the wordless ritual and mummeries of primitive man to the actor's dialectic or a modern philosopher that definition will be so loose as to be almost useless. It is more profitable to ask and answer two simple questions about the thing which is done. They are: Why is it done, and how is it done?

The Laws of Aristotle.—To the query "Why?" the answers fall into two main groups. It is possible to reply from a psycho-

logical or a historical point of view. It is also possible to combine the two kinds of reply. Such a combination is made in the *Poetics* of Aristotle. Because of the classical domination over western thought which has prevailed since the Renaissance, Aristotle's *Poetics* has had an enormous influence on academic views of drama. He laid down laws of drama in general and of various types of drama in particular.

Horace presented the Aristotelian lore to Rome (whose theatre was almost entirely derivative from Greek models), and the French classicists carried on the tradition of a dramatic discipline expounded in Greek lecture rooms as a small part of Aristotle's encyclopaedic survey of all human problems. So diligent was the pursuit of the classic ideal that Aristotle's hints about observing the three unities of time, place and action are incorporated and strengthened in the great French curriculum, being expanded and expounded by Jean Chapelain, Richelieu, Corneille and N. Boileau Despreaux. A last echo of the Aristotelian authority was to be heard in the dramatic criticism of A. B. Walkley who used to complain of George Bernard Shaw that he did not keep to the familiar classical rules. The critic was twitted in turn by Shaw for his obedience to "the immortal Stagnite" (see *Fanny's First Play*, introduction). During the first decades of the 20th century the revolt against classical authority in the art of the theatre was finally driven home.

Imitation in Drama.—Aristotle gave both a brief historical explanation of the rise of Greek drama from ritual choruses and a psychological interpretation of the dramatic impulse. Of the latter he said (*Poetics*, 4), "Imitation is natural to man from childhood, one of his advantages over the lower animals being this, that he is the most imitative creature in the world, and learns at first by imitation. And it is also natural for all to delight in works of imitation." That is true. Man is a natural mimic as birds and beasts have been before him, and anthropologists who examine the origin of drama and seek all manner of esthetic causes for acting are seriously mistaken if they omit to allow also for the simple impulse to dress up and play at "let's pretend." But, however much the world's first player may have enjoyed his primitive masquerade or mischievous aping of a neighbour, as soon as the fun becomes regularized in a ritual a great change occurs. We soon discover that acting has become immensely serious and is directed by prudential considerations. Possibly the first "thing done" was done for a joke, as Aristotle suggested when he cited the universal delight in works of imitation. But, undeniably, when the things done became seasonal rites, they were carried on for serious and sacred purposes. The idea of going to the play as a form of relaxation or holiday treat belongs to the civilized and not to the primitive state. It is true that as early as Roman times Terence, an adroit adapter of the Greek new comedy, complained of the rivalry of jugglers and rope walkers in the Roman entertainment market, which shows how far the secular notion of playgoing had prevailed over the primeval concept of dramatic ritual. Comedy had naturally lost its religious significance before tragedy. But the essential fact about early drama, both comic and tragic, is that, all over the world, the primitive peoples have regarded it as a utility and an obligation. It is only after civilization has firmly established itself that the atmosphere of a religious service no longer surrounds the thing mimed and is replaced by the less strenuous air of an entertainment for an idle occasion. Thus the development of drama presents us with a double change. On the one hand physical action directed toward an emotional climax is no longer the supreme quality of drama, since the mind insists that the mental march may be movement of the dramatic kind, on the other hand, secularization sets in and what had been in its infancy a propitiation of gods and heroes becomes in its mellow years a popular show and source of mundane merriments and excitements. Drama did quite literally begin with song and dance and the most popular form of drama today is still mainly compact of song and dance. But the difference in purpose and temper of the old dithyramb as offered to the gods and the new musical comedy "number" as projected at the orchestra and gallery is, by its very immensity, indicative of a change that is fundamental. But by

no means is the change final, since it is continually the object of theatrical reformers to recapture the drama for the exalted social purposes toward which, in other circumstances, its child hood was directed

The Origin of Dramatic Rites—It is not necessary to discuss at this point the rival theories as to the origin of dramatic rites. These theories fall into two main groups. It is claimed by one party that the song and dance from which drama sprang were a celebration of the life force in the natural world and that the traditional dramatic conflict is a reputation or a restatement of the old battle between the New Year and the Old which is fought out with ubiquitous regularity in the folklore of races. The other party, of which Sir William Ridgway was an active and important protagonist, surveyed the primitive folk dances and mumblings of the world and found the significant common factor to be a tomb ritual. The "thing done" was inspired by a wish to honour the great departed and to help him to immortality in order that he might, from his place of influence in the next world, continue to guide and protect his kinsmen and his tribesmen in this world.

There is much evidence which both parties can fruitfully exploit. For the believers in a vegetation cult there are the old mummers' plays which have survived in many counties and in which a slaying of age or winter and a resurrection of youth or spring are constant features. For the other side there appears in the witness box the constant presence of the mask which is traditionally associated with the impersonation of departed spirits. The world-wide researches of anthropology have, as Ridgway demonstrated in his collection of far-fung testimony, proved a continual connection of early mumings, dances and choruses with the sites of tombs and occasions of remembrances. One cause of drama is certainly to be found in that pursuit of immortality which has been the devouring passion of man from his first rough struggles for existence down to the ceaseless quest of civilized thought into human origins and human destiny. Acting in the first form was a species of prayer. You imitate a thing in order that the gods may take the hint and do likewise. You leap round the growing corn that the corn may also leap in a large fertility, you pour out water as a sign to the god who controls the rain, you act the hero rising from the tomb or portray his sufferings and services that he may be strengthened in his immortality and pass on some of his grace and greatness and succour to mortals here below. From such ritual an art of drama was developed, from that art an entertainment.

A Birth in Holy Places—Thus, what we must conceive, if we wish to understand the vigour and variety of drama in the light of its history, is a birth in holy places. The performer was no playboy, but a priest or servant of the priests. He was also a social worker engaged, as much as any primate or politician, in saving the tribe. By sympathetic magic he might prevail for the common good, by his persuasive arts the sun might shine and the rain might fall in their proper seasons. Dionysus, to give the fertility god his Greek name, might leap amid the leapers and pour out his power in appropriate response to the dithyramb or vigorous incantation of his cult. Or else the rite at the tomb might save from a black oblivion the vanished leader and keep him in ghostly power to help the tribe amid its difficulties and dangers. So we pass from Dionysus, the god, to the Greek Dionysia, the festival for which the tragedian wrote, and so out on to that winding highway of secular art and amusement whose final tributaries and turnings are Broadway and Arny lane.

Along such lines as these the many replies must be made to the question "Why is there drama, why is there a thing done?" Naturally the answers will vary according to the particular circumstances of time and place. Civilizations make drama according to their needs and develop it according to their capacities. To the second question, "How?" the answers will be equally numerous and various. Drama may be purely communal or purely individual, poetical or prosaic, acted by individuals and by teams or presented through the medium of the puppet or the marionette. Here it borders on ballet, there it borrows from the library. Its literary form will be found to be conditioned by the

particular stage or platform for which it was written and the particular social object at which it was originally aimed. There are no inclusive theatrical formulas. Nor can a simple definition be found by use of the word "imitation." Many of the earliest forms of drama and some of the later are not representative in the sense that the players are trying to mimic the life they know. Instead of copying they are creating and their performance is a statement and not a simulation. It is true that some kind of imitation remains, but it is imitation tempered by traditional symbolism. The Greek actor, to take the most obvious instance, did not try to imitate a man, he attempted to present something larger than life. Accordingly he wore a mask, propped himself up on buskins, and was padded out to superhuman size. This made realistic acting, as we understand it, impossible, but created a suitable mouthpiece for the superb rhetoric of Greek tragedy and also assisted the atmosphere of religious ceremonial in which the play was produced. Similarly in the mystery plays of the middle ages the actor often wore the conventional symbol of his part as though that sufficed. The symbol announced what could not be imitated. A gilt beard, for example, was the traditional decoration of St. Peter, just as in the circus we may know the clown by his colour long before he has begun his antics. The clown is an actor, but he is not, in any close sense of the word, an imitator. He works in his own world of fancy free. The history of the theatre has contained every kind of presentation and representation from the purely fantastic and symbolic to the actualities of our modern stage on which producers will lavish infinities of care in order to get a trifling detail "correct", i.e., as closely imitative of life as possible.

Varieties of Drama—Accordingly, as our eyes range up and down the whole cycle of "things done," from the vast ritual of the resurrection play of Osiris, the god hero of Egypt, to the 20th-century comedy with its cynical chatter and realistic cocktails and cigarettes, we find it difficult indeed to lay down boundaries and to make exclusive or inclusive definitions. After the broad casting of plays had become a popular practice one could not even insist that drama must be a thing seen, and from its very beginning the silent mummery, the thing seen but not heard, has been an essential form of the theatre. But, if we rule out broadcasting, we can say that drama consists of emotions and opinions and occurrences presented in three dimensions with more or less approach to imitation by human agency. (It is true that one medium may be the marionette but that is controlled by the human hand and mind.)

There may be as much or as little music, as much or as little scene, and as much or as little mechanical aid as the circumstance offers. The acting company may be a civic community, as in a pageant, or a single individual, like a modern reciter or the first Greek *hrotophros* who answered the chorus and so originated dialogue. A great amount of human ingenuity has been wasted on laying down rules for drama as though it were a small and single thing. But such lawgiving either ends in academic and abstract formulas which are belied by the history and practice of the stage or else makes classifications which are so vague as to be valueless. The much discussed "dramatic conflict" is itself a widely inclusive term since the conflict may be of the mind as well as of the body, argument is simply mental action. In short, as we come to survey the various dramas of the various nations and cultures, we can only conclude that the techniques of drama are as widely divergent as the racial tendencies and individual qualities of mankind and that to lay down lists of rules and to impose conditions is only a vanity of the academic brain, against which all the diversity of performance stands in a complete and crushing defiance. (I Br.)

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GREEK DRAMA ORIGINS

Modern drama is confessedly an entertainment, its "intent is all for our delight," and it is generally a piece of free fiction with imaginary characters and an invented plot. In Greece and elsewhere, however, drama was in its origin a religious ritual, intended to secure the continued life of the community or to avert the consequences of unclean pollution or the wrath of the dead. In Rome, for instance, in 365 B.C., *ludi scaenici* were introduced from Etruria in order to stop a plague. Even in the great works of Attic drama some traces of the old ritual remain: a severely traditional form and diction, a preoccupation with religious or ethical problems and an adherence to what was regarded as true history.

Tragedy was never free fiction, and even comedy, though it uses fictitious characters, followed certain ritual forms.

Recent research has enabled scholars to understand more clearly the real nature of the ritual which took form in tragedy and comedy.

Dionysus—It is generally recognized that Dionysus was not one of Homer's aristocratic Olympians, but an "original Thracian or Thracio-Phrygian god, whose worship stole in early times into Greece and found response among the village populations. It also seems fairly sure, on lines initiated by Kretschmer, that the name, with its variants *Dios nysos* and *Deos nysos*, means either "Son of Zeus" or, more probably, "Young Zeus." *Dios* or *Deos* being the Thracio-Phrygian equivalent of *Zeus*. His mother is *Zemela* (Greek, *Semle*), which is simply Earth, the perpetual queen mother, and he himself the new god who is the rebirth of the world after the dead winter. An orchestra, or dancing ground, of Dionysus with a special *theatron*, or arrangement for spectators, was built in Athens early in the 6th century B.C. and evidently became the great centre for ritual drama, including many varieties not originally connected with Dionysus. They are all, however, absorbed by him. Drama in both its forms is produced at his festival, in his theatre, under the presidency of his priest, by performers in masks and hieratic dress who are technically known as *Διονυσίου χοροῖται*.

Drama (*δράμα*) means "a thing done" or "performed," and the drama is a performance in honour of Dionysus. One may compare the *δρῶματα* or "things done" and the *δελκύα*, "tableaux" or "things shown" in the mysteries at Eleusis and elsewhere (cf. C. A. Lobbeck, *Aglaophamus*, pp. 50, 688 et seq. [Berlin, 1829]), and even more helpfully the ecclesiastical plays of the middle ages. These were sometimes tableaux, sometimes extracts from the liturgy made dramatic and divided between performers, and sometimes they were developed into plays in the full sense, representing such subjects as the Passion or the Massacre of the Innocents. They sometimes included characters outside the Gospel, e.g., the *augustinarius* from whom Mary Magdalene buys cosmetics. Sometimes they left both the Bible and the liturgy aside and dealt with the adventures of saints,

Thus we see that the mediaeval religious plays were gradually extended both in subject and treatment far beyond the original limits, and the Greek proverb *ὁδὸς πρὸς τὸν Διόνυσον* ("nothing to do with Dionysus") seems to refer to a similar extension of the field of drama. Yet it would be rash to suppose that all Attic drama dealt originally with Dionysus and thence spread to other cults. It is more likely that *dramata* existed in many rituals of the Mediterranean religion from the earliest times.

Aristotle in his account of drama remarks that man is "by nature imitative," extremely ancient *xōpoi*, or dancing grounds, like those from which the drama developed, have been found in Thera, Crete, etc., they are assumed as an ordinary institution in the Homeric poems, while in the dialogue *Mēnos* (attributed to Plato) it is remarked that tragedy was "ancient in Athens." There is also sufficient evidence of the use of tableaux and acting in other cults besides the Dionysiac to justify this hypothesis. However, it remains certain that in classical Greek times the drama was the *sacer ludus* of Dionysus.

Tragedy and Comedy—Drama took two forms distinct and never combined, *αἰσώβια* and *τραγῳδία*, *hōmos* song and *tragōs*, respectively. The first name is transparent, a *hōmos* being a revel, and almost every extant comedy ending with a revel scene. The second is obscure, and must be considered more carefully below.

To begin with comedy, we find in it almost always a *hōmos* and associated therewith, as habitually on Greek drinking vases, a *γᾶμος* (*gamos*) or union of the sexes. Of the 12 plays of Aristophanes 8 end in a *gamos*. And we may note that in three of these (*Ach.*, 1, 178 et seq., *Egn.*, 1, 389 et seq., *Vesp.*, 1, 342 et seq.) it is dragged in and not naturally deduced from the plot. That is to say, it probably comes from the underlying ritual.

Also, all through the classical period, the chorus and the performers in comedy wear artificial *phallai* (i.e., representations of the male organ of generation), usually to some extent disguised in the 5th century, except in the bird or beast choruses. This feature also is usually (except, e.g., in the *Lysistrata*) quite irrelevant to the plot. It comes from the ritual, and the ritual is a well known fertility ritual connected with the *Emantos* or recurrent-year daemon.

Aristophanes boasts more than once how he has raised the tone of comedy (*Nub.*, 537 et seq., *Vesp.*, 1, 015 et seq., *Pax.*, 736 et seq.), but amid all refinements the ritual phallus was still retained, in inconspicuous form, even in plays like the *Frogs* and the *Birds*. By the time of Menander they had disappeared.

Thus comedy is a perfectly intelligible performance of *hōmos* and *gamos* in the ritual of the vegetation or fertility spirit, Dionysus. It represents, we may say, the triumph and marriage of the *Emantos* daemon.

Essentials of Tragedy—If we seek for some similar constant feature in tragedy, we find generally (a) an *αἰτίον* (*aition*), i.e., the origin or cause of some rate or custom. Thus the *Prometheus* trilogy explained the festival *Prometheia*, the *Ajax* explains the ritual of the Aiantidae, the *Zeumenides* explains the origin of the worship of the Eumenides at the Areopagus, the *Hippolytus* the worship of that hero by maidens, the *Iphigenia in Tauris* the curious ritual of Artemis at Brauron, the *Medea* the lamentation for Medea's children, etc. We find (b) that the *aition* is almost always a death, and the ritual to be explained a tomb worship, e.g., that of Alcestis, Hippolytus, Neoptolemus, Pelcus and Thetis (*Androm.*), Rhesus, etc. Some tragedies indeed seem to be taken more from the epic tradition than from any ritual. The *Septem* is a treatment of the old siege motive, found in very early Minoan paintings as well as in the *Iliad* and the *Thebais*, but the trilogy to which it belongs is based on the regular year-king sequence, in which the old king is killed by the young king with the queen mother as his accomplice. Some of the plays about Orestes (e.g., Sophocles' *Electra*) become epic rather than religious, but they also are rooted in the year-king ritual. And even the most definitely epic or heroic stories seem always to have in them a dirge or a sacred tomb, e.g., *Troades*, *Antigone*, *Persae*.

Thus it seems normal to tragedy to contain a dirge or a tomb story, and to act the *aition* of it. It is also notable that the

death of the hero or heroine is not enacted, but, as in the year ritual of Osiris, Adonis, Pan, etc., regularly related by a messenger

Death and Resurrection.—Thus, as comedy gives the *kósmogamos*, so tragedy gives the *ráthos-órthos* ("violent death and lamentation") of its hero or heroine

Now a marriage revel plus a slaying and lamentation is the content of the traditional pre-Christian religious drama once prevalent all over the Mediterranean world, and still not quite extinct under the name of the "mummers' play." It celebrates the birth and growth, the victorious battle and marriage, the lost battle and death and sometimes the resurrection of a hero representing the year, or the annual revivification of the world. And Dionysus, the "Young Zeus," was just such a being, akin, as Sir James Frazer has shown, to Attis, Adonis and Osiris

Thus comedy gives a triumph and marriage, tragedy a defeat and death, but in the death two lines of myth seem to be confused. In one we have simply the overthrow of the old year-king, doomed for his *hubris* and his pollutions. In the other we have the mourning for the young god, an Adonis, Osiris or Dionysus, torn in pieces at the harvest or the vintage, then sought for and at last rediscovered. A complication is added by the rule that the death of Dionysus is "unspeakable" (see below). As for his birth and growth, we have these described in the *Hymns to Hermes*, the satyric *Didymus* and *Ichneutae* and the *parados* of the *Bacchae*, and it is possible that this was properly the content of the dithyramb. At least Plato says that the dithyramb was *Διονύσου γένεσις, ολβία* ("the birth of Dionysus, I imagine") (*Lysis*, 700B)

There is one further element commonly, though not always, present in the mummers' play, viz, the resurrection of the slain hero. This resurrection or rejuvenescence occurs in many myths (A. B. Cook, *Zeus, a Study in Ancient Religion*, 3 vol., II, 270 et seq. [Cambridge, 1914-40]) and is common in comedy (*Knights*, *Tragedy*, *Amphitruos*, cf. *Clouds*, *Wasps*; see F. M. Cornford, *The Origin of Attic Comedy*, pp. 87-93 [London, 1914], cf. also *Bacchae*, 184 et seq., *Helios*, 786 et seq., *Andr.*, 548-765). It seems possible that this was represented in the satyr play, which normally followed the third tragedy, and represented the arrival of Dionysus with his attendant daemones (Jane Harrison, *Themis, a Study of the Social Origins of Greek Religion*, p. 344 et seq. [Cambridge, 1912, rev. 1927], Cook, *Zeus*, I, pp. 680, 696 et seq.). At any rate a trace of it seems to exist in the constantly recurring deification or heroization of the chief characters. Thus it seems that in dithyramb, comedy, tragedy and satyr play we have traces of the birth and growth, the marriage, the death and the resurrection of the year-daemon, which formed the subject of a complete ancient mummers' play

The Goat Song.—We have seen above that the *tragódia* or goat song, with its enigmatic name, describes the *ráthos* or violent death of the hero, generally by some form of ritual slaying and particularly by *sparagmos* or dismemberment. When we observe that a goat was the animal commonly sacrificed to Dionysus, and particularly was so at Icaria, where tragedy is said to have been invented by Thespis, it seems reasonable to suppose that the goat song was the song sung over the sacrificial goat. It is certain that in Graeco-Roman tradition generally the goat was especially associated with Dionysus, and almost certain that the dismembered kid or goat, of which we hear so often, was the representative or the embodiment of the god (L. R. Farnell, *The Cults of the Greek States*, v, pp. 105 et seq., 302e, 303 [Oxford, 1896-1909]). The *sparagmos* or *disarcasmos* of the kid, whose blood the worshippers sacramentally drank, tells its own tale. The goat song is the song of the dismembered goat, which is really the god (Cf. Eratosthenes, "The Icarians then first danced around a goat," and Farnell, *The Cults of the Greek States*, v, p. 303.)

When, therefore, Herodotus tells us (v, 67) that at Sicily they used to honour Adrastus instead of Dionysus, celebrating his "sufferings" (*πάθεα*) with tragic choruses, we may naturally suppose that other people in their tragic choruses celebrated the "sufferings" of Dionysus. What were these "sufferings"?

The Dismemberment.—We have the express testimony of He-

rodotus, a contemporary of the bloom of tragedy, that the characteristic worship of Dionysus was "in almost all respects the same" as that of Osiris (see Harrison, *Themis*, p. 342, Hdt., II, 48 *τὴν δὲ ἑλλὰν ἀνάγουσι ὁρτὴν τῷ Διονύσῳ ὁ Αἰγύπτῳ, πλὴν χορῶν, κατὰ ταυτὰ σχεδὸν πάντα Ἑλλήσιν*). Ordinarily Herodotus simply uses the name Dionysus for Osiris (as here, cf. II, 144, "Osiris is Dionysus in Greek", cf. II, 42, etc.). We know the ritual of Osiris, and must therefore conclude that the ritual of Dionysus also contained a *sparagmos*, mourning, search and discovery. It seems at first sight extraordinary that, if this were so, there is no mention of this ritual in classical times. The explanation is given by Herodotus. When there is mention of Osiris' death and lamentation he has a religious scruple against mentioning Dionysus' name in such a connection (II, 61, "They lament but whom they lament I must not say", cf. II, 132, "When the Egyptians lament the god whom I may not name in this connection," so II, 170, 86). It was forbidden to speak of the death of the god who was the life of the world. Consequently, in the manner of ancient religion, a surrogate took the god's place. We find a frequent *sparagmos* of beings who have committed some sin against Dionysus or other gods of Pentheus by Maenads, Orpheus by Maenads, Lycurgus by horses, Hippolytus by horses, Dirce by a bull, Actaeon by hounds, etc. This use of a surrogate was made easier by the fact that both at Eleusis (Lobeck, *Aglaophamus*, pp. 50, 688 et seq.) and in the Osiris rite (Hdt., II, 171) the myth was sometimes conveyed by tableaux, not words. The truth could be shown to the wise and at the same time veiled from the unknowing. Such facts help to explain the charge of "profaning the mysteries" which was brought against Aeschylus

Aristotle's two statements, that tragedy arose "from the *ἐξάρχοντες* of the dithyramb" and comedy "from those of the *ῥαλτικά*" are thus intelligible. The dithyramb (see above) is perhaps used for the whole birth and death story of Dionysus, the *exarchontes* develop into the actors as opposed to the chorus. The *ῥαλτικά* form that part of the year ritual which is concerned with the *gamos*, and perhaps also, as in the Osiris rite, with rebirth or resurrection

In the remains of tragedy that we possess a few plays, like the *Bacchae*, and Aeschylus' *Edom*, show the full Dionysus ritual almost unaltered, its influence is visible in others, such as the *Hippolytus* and *Andromache*, which have a sequence of scenes showing agon, pathos or *sparagmos*, messenger, threnos, theophany. But elsewhere we find that other rituals have left almost equally clear traces: the regular earth-and-year sequence in which the sky god marries the earth (Gaia, Semele, etc.) and is overthrown by his son, the virgin martyr rite, in which a king gives his daughter or son to save the city (*Macaria*, *Iphigenia*, *Polyxena*, *Menaiskeus*), the rite of supplication at an altar (the two *Suppliants* plays and frequently elsewhere), of atonement for a sin (for Medea's children, Heracles' children, for Oedipus' pollutions), of averting the wrath of the dead (*Eumenides*, many tomb rituals). One can see also great influence exerted by the idea of the theophany or resurrection

Most tragedies end with the quasi-deification of some hero or heroine, or at least the foundation of some worship. Less prominent but constantly influential among these ritual types is the figure of the *pharmakos*, the old polluted year, the sin bearer, who has to be stoned or cast out, to suffer for his people. Oedipus and Orestes are typical

Thus, while we must allow for the influence of epic legends and heroic sagas upon tragedy, and of mere stories upon comedy, in the main Greek drama grows from a dramatization of ritual, and mostly of some ritual connected with the cult of the year spirit or vegetation spirit. When drama was put specially under the charge of Dionysus the specific Dionysus ritual, resembling that of Osiris, with its *sparagmos* and search and discovery, became prominent, but it was not exclusive, and through the earlier part of the 5th century other themes were fully as common. It is the year religion in general which provides tragedy with its main scheme and exhibits life in the tragic pattern as a thing which, like the corn and flowers, like the young animals, like the sun and earth themselves, begins gentle and gracious, grows gradually

great and commits the sin of *hubris* (pride), and at last in payment of that sin must die and be replaced.

Development of the Modern View—The researches referred to above have, after much controversy, arrived at something like a firm and generally accepted result, which is really a restatement of the traditional doctrine better understood. That doctrine, as stated in old books like Max Müller and Sir James Donaldson's *History of Greek Literature* (1858), regarded tragedy as a performance developing from the cult of Dionysus, the god of wine, ecstasy and the forces of nature, especially the joy of the spring. It was obviously a little difficult to get from this god to tragedy, though to comedy the way was easy enough. In A. E. Haigh's *Tragic Drama of the Greeks* (Oxford, 1896) this difficulty is felt but not solved. The first hold stroke at a solution was made by Sir Willi m Ridgway, who simply denied the Dionysiac origin of drama, and explained tragedy as a funeral performance at the grave of a warrior ("Origin of Tragedy," in *Quarterly Review* [1908], also a book, same title [1910]). These were followed by *Dramas and Dramatic Dances of Non-European Races* [Cambridge, 1915]. Part of Ridgway's theory was obviously true. Tragedy is a *Transepitaph*, a ritual lamentation over a death, and almost every tragedy contains a sacred or "heroic" tomb. On the other hand, all the ancient testimony describes tragedy as a Dionysiac celebration, and no one had properly emphasized the words of Dionysius Halicarnassensis, *Roman Antiquities*, II, 19, about "black-robed festivals, with beatings of the breast and lamentation over the disappearance (or death) of gods, as for the rape of Persephone and the sufferings of Dionysus."

Meantime the real nature of Dionysus was made much clearer by Frantz's *Adonis, Attis, Osiris*, which emphasized the element of death and mourning in this type of cult, and Farnell's account of Dionysus in *The Cults of the Greek States*, vol. V. Farnell rightly (chap. 5) derived tragedy from the contest between the fair and the dark (i.e., day and night or summer and winter), using a hint of H. Usener's in the *Archiv für Religionswissenschaft* (pp. 303-313 [1904]), while A. Dietrich in a remarkable article in the same *Archiv* (1908) developed the conception of tragedy as a *sacer ludus*, for the purpose of averting the disasters which it portrayed. The connection between the Dionysus cult, dithyramb, tragedy, etc., and the wide-spread year celebration known as the mimes' play, with its sequence of birth, growth, victory, marriage, defeat, death and (sometimes) resurrection, was first brought out by Richard M. Dawkins, "A Modern Carnival in Thrace and the Cult of Dionysus," in *the Journ. Hell. Stud.* xvi (1906).

Gilbert Murray in a chapter contributed to Jane Harrison's book *Themis* pointed out the knowledge by Herodotus of a Dionysus cult practically identical with the mourning cult of Osiris, and the regular presence in tragedy of a ritual death, together with the traces in many tragedies of the complete sequence—agon, pathos, messenger, threnos, theophany. Finally, Cornford in *The Origin of Attic Comedy* combined with this conception of tragedy as the death and lamentation of the year-dæmon the observation that comedy represented his victory, revel and marriage. For Dionysus as Young Zeus see especially A. B. Cook (*Zeus*, II, 271-291), also the account of the marriage of the "very old wooden Dionysus" with the Basileia in A. Mommsen's *Feste der Stadt Athen* (p. 302, et seq. [Leipzig, 1898]) and L. Deubner's *Attische Feste* (p. 100 et seq. [Berlin, 1932]). The best negative criticism of these results is by A. W. Pickard-Cambridge, *Dithyramb, Tragedy, and Comedy* (Oxford, 1927).

GREEK DRAMA HISTORY

The beginning of tragedy may be put at the foundation of the Great Dionysia by Peisistratus (535 B.C.), when Thespis was the first victor. There were already festivals, presided over chiefly by Apollo and the muses, for music and for epic recitation, the new feast gave dignity to the Dionysiac dance and spectacle and perhaps began its separation from the wild play of the satyrs. The full Dionysiac celebration was a tetralogy, consisting of three *agon dramata* (performances) followed by a *drama* of satyrs, the *phallos* half god *daimon* forming the rout of Dionysus.

Aristotle's statement that tragedy arose from the *exarchontes*, or directors, of the dithyramb, is illustrated by the earliest tragedy we possess, Aeschylus' *Suppliants*, which has three choruses of 50 dressed with barbaric splendour and each directed by its *exarchon* the Danaids by their father, the Argive soldiers by their king, the Egyptians by the herald. The dancing, 603 lines out of 1,073, must have occupied fully three-quarters of the time, and the subject is simply the flight of suppliant virgins from black pursuers. There is no separate *drakopros*, or actor, unconnected with the chorus. Tradition, however, says that Thespis employed one actor and Aeschylus two. The satyr element faded away later, as in Euripides' protosyntactic *Alceste*, but of the two elder contemporaries who competed with tragedies against Aeschylus in 499 B.C., Choerilus is famed as "a king among satyrs" and Pratinas as "second only to Aeschylus" in the satyr play.

Phrynichus (first "victory" 511 B.C., another 476, with Themistocles as choragus) invented dance movements "as many as waves on a stormy sea" and wrote lyrics beloved by Aristophanes long afterward. Many of his plays started a tradition in tragedy, e.g., *Alceste* (cf. Euripides), *Suppliants*, followed by *Agamemnon* (cf. Aeschylus) and *Phoemissae* (celebrating the victory of Salamis, like Aeschylus' *Persae*). His *Capture of Miletus*, however, celebrating a disaster with political bearings, incurred a fine and was never imitated.

In early times each tragic drama probably concentrated on one situation, so that the three made up a loosely connected story, like some of the recorded trilogies of Aeschylus. His *Orestes*, however, the one trilogy we possess, was written toward the end of his life and is a magnificent unity. The element of epic story as opposed to Bacchic dance steadily increased. Aeschylus drew "slices from the great banquet of Homer" (not the *Iliad* and *Odyssey*, which belonged to the Panathenaea, but the rest of the epic tradition), and Sophocles was named "Ὀμηροκράτορ," "most Homeric" (In the *Oedipus* only 317 lines out of 1,530 are lyrical.) Sophocles particularly developed the "plot," i.e., the art of telling a story not by narrative but by action. He dropped the tetralogy and made each play a finished whole. The third actor, introduced by him, led the way to complex dramatic effects, as when a messenger brings the news of Orestes' death at the same time to Clytemnestra and Electra, throwing one into exultation, the other into despair, while the news itself is a lie. No such effect could be produced with the two actors of Aeschylus, whose genius liked to concentrate on one great situation, like the age-long martyrdom of Prometheus, or one problem, like the crime that can only be avenged by more crime (*Orestes*). Sophocles made his diction more natural, his character drawing more subtle and varied and his verse more fluent, often ending a line with no pause, and sometimes even with an elision. One may say he created the "well made play" admired by Aristotle.

Greek opinion, however, demanded, as may be seen from the *Progs* and from Plato, that a poet should be *σοφός*, "wise" or "enlightened," and Euripides particularly responded to the demand. In some ways he returned toward Aeschylus in his Dionysiac form (see above), his grand choral effects, his religious problems, even his revival of the obsolete long-trochaic metre, but in thought he belongs to the Sophistic age, being a friend of Anaxagoras and Protagoras and particularly admired by Socrates. He subjects to criticism both the traditions about the gods and the Socratic theory that virtue is knowledge (Hipp., 377-383). He was also an adept in *ῥητορικὴ*, not what we call "rhetoric" but the new "art of speech," aiming at order and lucidity. His plays generally start with a prologue, often spoken by a supernatural being, explaining the subject, and end with a divine judgment or prophecy. This produces both a ritual form and an artistic pattern: calm—passion and crisis—calm. The variety of his themes is remarkable, he has dramas of love (*Hippolytus*, *Medea*), of mystery (*Bacchae*) and realism (*Electra*), of adventure (*Telephus*, *Helena*), of epic fullness (*Phoemissae*) and of static Aeschylean tragedy (*Troades*).

He had only 5 victories, 1 of them after his death, as against 13 of Aeschylus and 18 of Sophocles. The ancient life says,

strangely, that he "had no ambition about the theatre." In later antiquity, however, he was far more acted and read than the other two. Aeschylus, though always respected, began to be obsolete even in the 4th century B.C., he is little noticed by Aristotle. Sophocles was not apparently much acted, and was less quoted and discussed than Euripides, though far more highly praised by the critics. He was something of a critic himself, remarking that Aeschylus "did what was right without knowing how," while Euripides presented people "as they are, not as they ought to be presented."

The three great writers towered above the rest, but others, like Ion and Agathon, were admired, and Philocles actually defeated the *Oedipus Rex* of Sophocles. The plays of the three were reproduced by their heirs, who also wrote tragedies of their own. Euphorion, son of Aeschylus, Iophon, son of Sophocles, and Euripides, nephew of his namesake. Later on, because of the conquests of Alexander, the interest in tragedy spread all over the Hellenistic world, but the art of Dionysus chiefly lived on in the so-called new comedy (see below).

Old Comedy—For its general nature see above. Popular revells and *phallos* were no doubt common and took the most varied forms. What is remarkable is their development in Athens into a brilliant art form, spirited and accomplished in language and verse, and often highly intellectual in subject. One may compare the history of the "mime," or humorous realistic conversation piece, which branched into philosophical discussions under Epicharmus and reached the very height of philosophy in Plato's dialogues. The old comedy had a fairly fixed traditional form: a prologue and preparation scene, an agon or contest, ending in a victory (cf. the mummer's play), a break in the action for the parabasis or "coming forward" of the chorus to address the spectators on behalf of the poet, and finally a number of more or less farcical scenes, showing the result of the victory, e.g., what happens when Dicaeopolis has made a private peace all by himself, or when the birds have founded their happy day city.

We know the old comedy only by 11 plays of Aristophanes, though other writers, such as Cratinus, Eupolis, Crates, Pherecrates and Magnes, are known by a few criticisms in Aristophanes (especially *Knights*, 1, 516-40) and by about 1,500 fragments. The subjects discussed are public and topical, whether political (*Acharnians*, *Knights*, *Lyssistrata*), philosophical (*Clouds*) or literary (*Frogs*, *Thesmophoriaeuzae*), and seem to be addressed to a very well read audience. As remains of the popular fertility revel we may note the frequently indecent language, the constant suggestion in the background of a better world to be attained in some new age, and the personal abuse of politicians, as in the cartoons in modern newspapers. These attacks were often violent, especially against the ultrademocratic war party, and were forbidden by law (414 B.C. and later) when that party was chiefly in power. In the general distress after 404 B.C. the old chorus, consisting of true Athenian citizens "taught" by the poet, seems to have been replaced by professional performers of higher training if less pure citizenship. In the latest extant plays of Aristophanes we find occasionally, instead of the actual lyric, the note "chorus," as is regular in the Menander papyrus. Indeed his last plays, except for some burlesques of tragedy, form a transition or middle stage leading toward the famous "new comedy" of Menander, Philemon, Diphilus and others.

New Comedy—It was a comedy of manners, with no coarse language and no mixture of the supernatural or heroic. "O Menander and life, which of you imitated the other?" asks one ancient critic. On the other hand it kept faithfully the Dionysiac new-year pattern. There is always a lost or mysterious baby who in the end is "recognized" and restored to his proper state in life. He is a replica of the unknown son of a god and an earth mother, who in so many tragedies is "recognized" and becomes the "new king" (cf. Menander's *Arbitration* with Euripides' *Alope*). Menander (c. 343-291/0 B.C.) was known only by numerous quotations (including St. Paul's "evil communications corrupt good manners") and Terence's Latin imitations until the discovery in 1905 of a papyrus containing a great part of three plays and fragments of four others. The plays fully confirm the ancient

praises of Menander's quietly witty style and delicate character drawing. The plays might well belong to the times of Congreve or Molière, except that the intrigue is never produced by marital infidelity but always by the exposure or loss of a child.

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ROMAN DRAMA

Early Dramatists—The art of the drama was at Rome a *res peregrina*, and, according to Livy (vii, 2), took its rise from the performance of the Etruscan *hudi* who were summoned to Rome in 364 B.C. to divert by their dancing and playing the wrath of the gods who had sent a plague. Livy is, no doubt, following the accepted antiquarian view of contemporary scholars, such as Varro, and too much reliance must not be placed upon his details, but that Roman drama came under Etruscan influence at an early stage is proved by the Etruscan origin of the words *hister* (player) and (probably) *persona* (a player's mask). Rome had been in contact with the Italian Greeks much earlier than the middle of the 4th century and must have been aware through them of the existence of dramatic exhibitions, and the "Fescennine verses" were germs out of which the art of dramatic representation might have been developed. Further, the Oscan town of Atella from an early time had possessed (possibly under Greek influence) a rude native drama, afterward developed at Rome into a distinctive form under the name of the *fabula Atellana*. Under the combined influence of the Etruscan *hudi* and the rudeness of the Fescennine verses there developed (according to Livy) a form of drama called the *satura*, with full musical accompaniment by a flute and an appropriate style of acting, but the details of the development are obscure and the very existence of the dramatic *satura* is doubtful.

It was not till the Punic Wars that Rome possessed a regular drama. Livius Andronicus, a Greek captured at Tarentum and afterward a schoolmaster at Rome, translated a Greek tragedy and comedy for production at the Roman games of 240 B.C. The titles of nine tragedies and three comedies of his survive, the skill with which Greek metres are handled in his extant fragments, and the success with which the Latin language is adapted to their use, are so remarkable as to cause hesitation in accepting the current view that he was absolutely the pioneer of verse translation from the Greek. His contemporary Gnaeus Naevius inclined more toward comedy than tragedy, we have the titles of 34 comedies of his as against 7 tragedies; he was the first to choose as subjects for tragedies traditional Roman legends (e.g., Romulus) or contemporary events such as the battle of Clastidium (222 B.C.), this type of tragedy was known as *fabula praetextata*. The fragments of his comedies contain references to contemporary life and manners worked into the framework of his Greek original. One of his most famous comedies was the *Tarenilla*, which turned upon the adventures of two young men detected by their fathers living with two girls in Tarentum and helmed back to respectability. Naevius thus pointed the way for the later type of comedy which found its subject matter in Roman (or Italian) life, the *fabula togata*. The work of the two pioneers was continued by Quintus Ennius who was born in Calabria in 239 and lived till 170 B.C. We know by name only two comedies of his, but there are fragments of 22 tragedies, and two *fabulae praetextatae*. He seems to have been especially attracted by Euripides, his translation of the *Medea* was famous and his *Andromache in Captivity* was well known and appreciated as late as the time of Cicero.

Plautus and Terence—After Ennius no one attempted both branches of the drama, indeed the practice had already been abandoned by his elder contemporary T. Maccius Plautus, a na-

tive of Sarsina in Umbria whose dramatic career began during the later years of the Second Punic War. Plautus confined himself to comedy, and is the great representative of the *fabula palliata*, the comedy translated or adapted from the Greek masters of the middle or new comedy, Menander, Philemon, Diphilus and their fellows. Of the poet himself we know next to nothing, the only certain dates in his career are those of his death (184 B.C.) and of the production of the *Stichus* (100 B.C.) and the *Pseudolus* (91 B.C.). The name Plautus may be a nick-name ('flatfoot') and Mucius may be derived from the name of one of the stock characters in the *fabula Atellan* in which he may have appeared during his youth. The details of his life given by later writers are either inventions or inferences or modelled upon forms in Greek biographies. The 10 complete comedies which we possess along with the *Fiduliana* (extant only in fragments) were all that Varro recognized as genuine of the 150 attributed to Plautus in his day (hence known as the *fabulae Varronianae*). Besides these we have insignificant fragments of 32 of the plays rejected by Varro. Of the prologues to the extant plays some are certainly (and all may be) post-Plautine.

Though Plautus immoderately adopted a Greek engine he preserved his independence, fitting in upon occasion scenes from other plays which served his purpose (a method known to subsequent critics as *contaminatio*). He introduced quite freely allusions to Roman legal procedure, manners and customs; he abandoned the previous convention with regard to the metres of dialogue, his hoarsest humorous break through the artistic restraint imposed by tradition upon his Greek masters. One of the greatest masters of the Latin language Plautus roils and gambols in dialogues in which everything is sacrificed to the desire to raise a laugh, but the numbness and appleness of his diction are extraordinary. His high spirits and his mastery of dialogue remained unique in Roman comedy.

Plautus' younger contemporary Titius Cicilius who died in 168 (or 166) B.C., with his comic later critics regarded as the chief of Roman comedians. Masters of plot and *gratuitus* were regarded as his principal merits, following the advice of his friend Ennius he avoided *contaminatio*. His chief model was Menander to whom he owed the plots of 16 of his 42 known comedies and his fragments show that (in spite of Cicero's *multis latinitatis auctor est*) he had caught something of Menander's happy brevity. A new movement which roused the hostility of the dominant school of comedy was represented by Publius Terentius Afer, who, coming to Rome from Carthage as a slave, became a literary friend of Scipio and his circle and died at an early age c. 159 B.C. Of Terence's six plays the first (the *Indira*) was produced in 166 B.C. and the last (the *Idelphi*) in 100 B.C. Terence avoided the boisterous mirth of his predecessors and lacks the rich vocabulary of Plautus; he excelled in the portrayal of character, his style is choicest and correct without formality, he avoids the anachronisms and carelessness of Plautus, and simplifies his medium by confining himself practically to two metres and by omitting the lyrical passages in irregular verse known as *canina*. His prologues were war upon the popular taste and the views of his critics. Without the strength and vigour of Plautus, Terence is superior to him in dramatic construction and definiteness of phrase, and became the acknowledged model of cultivated Latin speech. After Terence the comedy modelled upon Greek originals declined, and a number of writers (sexus Turpilius, who died in 103 B.C.) alone deserve mention. He represents the extreme reaction from the line of correctness of Terence to the vocabulary of the crowd. But the public taste was turning to other forms of comedy, though *palliatae* continued to be produced and earlier plays were revived and imitated. It is to this period that many of the plays afterward attributed to Plautus can be assigned, including (perhaps) the *Asinaria*.

Later Developments.—Roman tragedy after Ennius was continued by his nephew and pupil Marcus Pacuvius, born at Brundisium about the beginning of the Second Punic War. He was regarded down to the time of Quintilian as the chief Roman tragedian, though Cicero finds fault with his style. We possess fragments of one *praeetextata* and 13 tragedies modelled on the Greek.

His plays continued to be performed till the 1st century A.D., the most famous being the *Tencer*, the *Intopia* and the *Niptra* parts of which Cicero preferred to Sophocles' play on the same subject. Pacuvius' metre conformed closely to Greek models, and he was noted for his copious flowing style and his love for compounds and unusual grammatical forms. His technical competence was contrasted by later critics with the spirited and lofty genius of Lucius Accius (born 170 B.C.), whom Ovum seems to have rated higher than Pacuvius. Fragments survive of 43 of his tragedies and of two *praeetextatae*. His plays cover the whole of Greek mythology and his favourite master is Sophocles. His first tragedy the *Atrius*, was produced in 130 and though Pacuvius to whom it was read found it somewhat harsh and immature in spite of its stately and sonorous style, it remained a favourite acting piece. His style shows the influence of rhetoric and he provided models for more than one of Seneca's plays. Quintilian considered him a master of diction.

By the last century B.C. the comedy borrowed from Greece was supplanted by the *fabula togata*, the subject of which was the life of country towns and obscure people. Its chief writers were the plebeian Titius, a younger contemporary of Terence. I. Quintus Atta (d. 77 B.C.) and Lucius Afranius (b. about 150 B.C.). The first brought the *togatae* to the highest finish and his plays were popular till the Augustan age. Sulla's predilection for the *fabula Atellan* gave it a vogue during the same century. These forces originally dealt with stock characters (Macrus the simpleton, Pappus the old fellow, Dosennus the hunchback, etc.) but later were assimilated to the *fabula togata*. The same century witnessed the rise of the *mimus* which by the time of Cicero had ousted the *Atellana* as an *exodium*. The principal writers of these, generally licentious, plays were Decimus Laberius (105-143) and his contemporary Publilius Syrus, a liberated slave from Antioch, the fame of the latter rests mainly on the collections dating from the 2nd century A.D. of *sententiae*, or pithy sayings from his works.

During this century the tragedies of the earlier masters were frequently reproduced but there was no tragedian of repute until the reign of Nero when Seneca composed his tragedies whether for the theatre or not is uncertain. He borrowed freely from his predecessors, Greek and Latin, and produced nine tragedies, in which plot and character were subordinated to declamation and expositions of Stoic morality, but as models of tragic composition they long exercised great influence. The *praeetextata* entitled *Oedipus* which is included in the list of his plays is of later date.

Production of Plays.—The early Roman drama laboured under great restrictions, plays were produced only at the great festivals, such as the *ludi Romani*, the *Megalesia*, etc., or at funerals, triumphs and dedications of temples. The theatre was a temporary structure of wood and for long no seats were permitted. An attempt in 151 B.C. to build a stone theatre was prevented by the consul Scipio Nasica. Pompey's stone theatre was not built till 55 B.C. though wooden seats for the spectators had been provided a century before.

There were three stock changes of scene, and the only music was provided by a flute player (*hiberni*). At first authors acted in their own plays but later a manager (such as Ambivius Turpio, who produced for Terence) with a troupe of actors (*grece*) brought out the play, engaging their services to the magistrate who had charge of the festival. These actors were generally slaves, though the Atellan farces were for long produced by freeborn citizens, in course of time, however, great actors like Quintus Roscius Gyllus and Clodius Aesopus had a certain social position, though the actor in a mime (*plumpes*) was despised until imperial times.

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DOWNFALL OF THE CLASSICAL DRAMA

The end of the ancient classical drama has been already fore-shadowed. The elements of dance and song, never integrally united with the dialogue in Roman tragedy, were now altogether separated from it. While it became customary simply to recite tragedies to the small audiences who continued (or, as a matter of courtesy, affected) to appreciate them the *pantomimus* commended itself to the heterogeneous multitudes of the Roman theatre and to an effete upper class by continuing the performance of the actor to gesticulation and dancing, a chorus singing the accompanying text. The species was developed with extraordinary success under Augustus by Pylades and Bathyllus, and so popular were these entertainments that even eminent poets, such as Lucius (AD 39-65), wrote the librettos for these *fabulae salticae* (ballads), of which the subjects were generally mythological, only now and then historical, and chiefly of an amorous kind.

Comedy more easily lost itself in the cognate form of the *mimus*, which survived all other kinds of comic entertainments because of its more rudacious immorality and open obscenity. Women took part in these performances by means of which, as late as the 6th century, a *mima* acquired a celebrity which ultimately raised her to the imperial throne, and perhaps occasioned the removal of a disability which would have rendered her marriage with Justinian impossible.

Meanwhile, the regular drama had lugged on, enjoying in all its forms imperial patronage in the days of the literary revival under Hadrian (117-138), but the peccant taste for the spectacles of the amphitheatre, which was as strong at Byzantium as it was at Rome, and which reached its climax in the days of Constantine the Great (c. 288-337), under whom the reaction set in, determined the downfall of the dramatic art. It was not also utterly extinguished even by the irruptions of the northern barbarians, but a bitter adversary had by this time risen into power. The whole authority of the Christian church had, without usually caring to distinguish between the nobler and the looser elements in the drama, involved all its manifestations in a consistent condemnation (as in Tertullian's *De spectaculis*), comprehended them all in an uncompromising anathema. When the faith of that church was acknowledged as the religion of the Roman empire, the doom of the theatre was sealed.

At Rome the last mention of *spectacula* as still in existence seems to date from the sway of the Ostrogoths, in the earlier half of the 6th century. In the capital and provinces of the eastern empire the decline and fall of the stage cannot be similarly traced, but its end is authoritatively assigned to the period of Saracen invasions which began with the Omayyad dynasty in the 7th century. Gradually, however, as they lost all footing in the centres of civic life, the mimes and their fellows became a wandering fraternity, who doubtless appeared at festivals when their services were required, and vanished again into the depths of the obscurity which has ever covered the strollers' life. It was thus that these strange intermediaries of civilization carried down such traditions as survived of the acting drama of pagan antiquity into the succeeding ages.

CHINESE DRAMA

Chinese drama is deeply rooted in the tradition of the country and has many conventions which are not easily understood by the casual spectator. Even to this day when films and plays in plain dialogue compete so hard with the traditional drama, which is something of an opera, there is no sign that the latter has lost any of its popularity. It has colour in the gorgeous pre-17th-century costumes and it has well-trained actors to perform dancing, singing and mime, allowing just enough variation to give the imprint of the favourite actor's individuality, which reinterprets old themes and familiar songs and dances and livens up the conventions of the stage. In the miming and dancing, quick or slow, the movements of hands, feet, head or body are always in curves

and never in angles or straight lines, as, for instance, in Javanese dancing.

Sources.—The history of the traditional drama of China, like that of most dramas, goes back to the earliest rituals connected with sacrifices performed with song and dance by the *wu* (priests and their acolytes), and a very ancient pantomime is said to have originated from a symbolical dance in honour of the victory of Wu Wang, founder of the Chou dynasty, over the then known empire of China. Dancing and singing always accompanied celebrations at harvests and in connection with war and peace.

But the drama proper did not develop directly from religious ceremonies as, say, in Greece. Miming, dancing and singing continued to exist as such and Hsuan Tsung of Tang (8th century AD) personally trained actors in music and dancing in the part of his place called Pear garden. His patronage is cherished in the memory of this much despised profession to this day, so that actors still call themselves "disciples of the Pear garden." Meanwhile, independently, there grew up at court the tradition of persons offering counsel to their ruler under the cover of impersonation, to present a story or a situation which led to the remonstrance and this method often softened the blow so much that the ruler tolerated it, was often amused and could even see his own faults of omission or commission in a more reasonable light. Thus such persons were in the position of the clowns in Shakespearean plays. The rulers of Tang and Sung employed groups of actors to perform little one-act plays at court banquets besides the performance of dance, music and song, and it was greatly amusing when these actors satirized, chiefly with puns, on the most powerful ministers as well as the emperor and his lords, even at the risk of losing their heads. Wang Kuo wei in his *History of the Drama of Sung and Yuan* recorded many such plays or dialogues.

Side by side with such impersonation and dialogues between two or more actors there grew up in Tang times a rich body of short stories, *ch'uan-ch'ü*, historical, heroic, melodramatic or tragic, which became very popular, and from them professional storytellers could extract material for their own embellished interpretations to their special audiences in their various dialects. Competing with these in popularity were performances of Buddhist sutras and stories, *pien-wen*, which look more like a direct ancestor of the drama. These were originally stories from sutras woven in order to interpret to the laymen the ideas of Buddhist saints and sages. Large audiences flocked to the monasteries to hear the storyteller of the *pien wen*. These stories consisted of short prose passages, either direct quotations from a sutra or parts of a Buddhist story in prose, each is followed by a rhymed part to be chanted or sung and this embellishes the short and comparatively dry prose with something appealing to the audience, since it furnishes personal and familiar details, depicts characters, provides humour and diversion and in some cases good poetry. The singer of these *pien wen* must have employed facial expressions, his hands and change of voice to add vividness and poignancy to his story, but it was still told in the third person. Like religious drama in the west, this sort of entertainment became so popular that vulgarities crept in and caused embarrassment to the monasteries as well as to the Confucian government. The Sung emperor Chen Tsung (988-1022) issued an edict to forbid its performance, so that it disappeared from the sacred places, but its prototype with increasingly secular themes reappeared among the people in different areas by another name. In the *pien wen* narrative, song and mime were combined for the first time.

Meanwhile music and dance had experienced a great change in Tang times, as this period came after long foreign domination in the northern part of the empire and the great emperors of Tang times extended their influence to western Asia and continued the contact with the outside world. Exchange of cultures was bound to take place and in the sphere of music and dance foreign influence was so dominant that of the ten schools of music only two taught the native kind. Chinese poems were fitted to popular tunes, of either native or foreign origin, and these poems and tunes were seized upon by singers to be the medium for telling their stories.

Drama Proper—At the times of Sung and Chin (Khitans), 1115-1234 long acts of dancing and singing with a chorus incorporating popular tunes and representing some narrative were called *yuan-pên* or *isa chu*, but it was only in Yuan times (1280-1367) that the drama proper, again called *isa chu* or *pei ch'u*, actually appeared. It included singing of the poetic parts which were the popular tunes (*chu hung-tiao*), dialogues, mime and dancing when it could fit in, and for the first time the actor spoke in the first person. These dramas or operas or plays, whatever one chooses to call them, were in four acts with occasionally a *hsieh tsu* (wedge) taking the place of a prologue or epilogue, according to its position. They were necessarily short plays, seeing that at a banquet or celebration a play was only one feature of a variety of entertainment. When a longer story was told, it had to be done in more plays than one. A story like that of *Hsi-Hsiao-Chi* (The Western Chamber) took up the time of five plays of four acts each. The peculiar feature of these plays was that only one person did the singing throughout one play, and so hero and heroine never sang together. Later during the Ming dynasty in the 16th century the *k'un-ch'u* or music from the Wu district became the most popular and plays of this style abolished the earlier restrictions of the four-act rule as well as that of allowing only one person to sing throughout the play. The play probably then became independent as a complete entertainment with more than one singer and was able to be as long as its theme required, without the previous time limit. The construction of the play became freer after Yuan times.

The themes of Chinese plays range from historical plays about emperors, princes, ministers, popular strategists and successful generals down to the common men, melodramas and mysteries expanded on themes of the short stories (*ch'uan-ch'u*) of the T'ang dynasty and stories from other sources of past and present, woven around persons of all classes and walks of life, depicting vividly the virtues and vices of nearly every phase of society. From the Yuan dynasty to this day the Chuang Yuan (candidate who has been awarded a first) has always been the favourite hero who wins the fair, as through examinations even the poorest and most despised could be raised to the highest rank and salary and thus become the flower of Chinese society. The state examination and the grand reviser of court decisions often take the part of *deus ex machina* in discovering the guilty and rewarding the virtuous. With the exception of *The Western Chamber* in which the hero and heroine follow the dictates of love rather than those of Confucian morality, most plays uphold virtues such as filial piety and the wife's devotion to her husband, as in *P'ei-P'ei Ch'u* (*The Story of the Lute*), loyalty and self sacrifice as in *Chao-Shih-Ku-Erh* (*The Little Orphan of the House of Chao*), the theme taken by Voltaire in *L'Orphelin de la Chine*, chastity, fortitude, honesty and so on. The Chinese audience abhorred an unjust ending, so much so that often spirits were brought back onto the stage to be witness against the wicked. As the Chinese stage is bare, with colour depending on the gorgeous costumes and headgear of the actors, and properties are few, often of symbolical character, there is no difficulty at all in allowing ghosts or immortals to stalk among the human beings—characterized as they will be by what they wear and carry.

The traditional plays of China cannot be classified strictly as tragedies and comedies, for they usually include both comic and tragic events. Where a character has suffered at the hands of evil people or through fate, the suffering does not seem to call forth nobility and magnanimity from him, for the story will rather pile misfortune upon misfortune on the poor creature who suffers like a dumb animal. The three unities were never recognized by Chinese playwrights, and the audience was accustomed to follow the story through years and over hundreds of miles.

From the Yuan dynasty down to the present the traditional theatre has appealed to all classes of Chinese society, who participate in the joy and sorrow of the characters on the stage and follow intently the music of the orchestra and every word sung by the chief actors as well as the actors' movements, with all the nuances and variations which they will introduce in spite of the stylized conventions.

At the end of the Manchu dynasty and after the Chinese Revolu-

tion of 1911, experiments were made with plays without music, called *wen ming hsü*. They could not compete with the traditional plays in popularity as they failed to transport the audience into that "suspension of disbelief" which the miming and singing and conventions, main attractions for the audience of the older play, were able to create. There was a surge of dramatic activity in propaganda plays during the Japanese invasion of China beginning in 1937, an example is *The Lone Battalion*, depicting the desperate struggle of a few last men in a Shanghai godown, and modern plays have been written about social problems, as, for instance, *Slaughter*, which dramatizes the moneylender's exploitation of the farmer, and there are also translations and adaptations of favourite Russian stories and Shakespearean plays as well as more modern ones.

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JAPANESE DRAMA

Traditional Japanese drama forms are *nô*, *jôruri* and *kabuki*. The *nô* derives partly from religious dances at Japanese shrines and partly from entertainments imported from China, it was given substantially its final form by Kan'amî Kiyoetsugu and his son Se amî Motokiyo (1363-1443) at Nara. Since the 16th century its language, costumes and settings have not changed, its audiences are mainly connoisseurs and it is deeply involved in Zen mysticism. The stage is square, with the audience on three sides. Toward the back, projecting obliquely from the left, is an open passage (*hashigakari*) leading from the dressing rooms. Along this the actors (who are all male) make their entrances. The acting is stately and formal, the scenery nonexistent or merely symbolic, the costumes magnificent. The principal actor generally wears a mask or succession of masks corresponding to a development of character. Concentration and a feeling of identity with the role enacted are considered essential for a *nô* actor. Facial expression being impossible, it is partly replaced by conventional manipulation of the fan (tears, for example, being indicated by a fluttering movement of the fan alternately over each eye). Emotion is also expressed by rhythmical stamping of the feet, the stage being resonant. An orchestra of three drums and a flute, and dances by the actors, serve to intensify the drama. A chorus comments on the action and, when the chief actor dances, chants his part. The language is a combination of verse and prose, with many allusions to earlier literature. Subjects are drawn mainly from Japanese history and legend, but also include Chinese stories and Indian and native Buddhist themes. A *nô* program consists of several plays, with comic interludes (*kyôgen*).

Jôruri is puppet drama. It enjoyed great popularity between 1650 and 1730, but is now restricted to the Bunraku theatre in Osaka, where scenes from famous plays are performed. This drama, which carries puppet manipulation to a higher level of complicated skill than anywhere else in the world, arose about 1600 from the collaboration of puppeteers attached to temples and shrines (where they performed scenes from Buddhist or Shinto legend), with performers who chanted to the accompaniment of the *shamisen* (a three-stringed instrument then recently introduced into Japan). The puppets, about three feet high, are manipulated each by as many as three men. Movement even of tongue, finger joints, and eyelids is possible. Scenery is of great complexity, the revolving stage having been introduced early in the 18th century. The possibilities of the puppet theatre had been quickly recognized in Yedo (now Tokyo), where Satsuma Jôun (d. 1666) produced many plays on the life of Kimpira, a legendary general, in these the use of puppets permitted gruesome scenes of bloodshed. *Jôruri* would not have been very important, however, had not Chikamatsu Monzaemon (1653-1724), Japan's greatest dramatist, worked with the reciter Talemoto Gidayû (1651-1714) in Osaka. He transformed the violent plays of

Yedo into highly complicated and fantastic pseudohistorical dramas, the most famous being the *Battles of Coxinga*. Chikamatsu also initiated the *sewamono*, the plots of which were drawn from contemporary incidents, they were usually stories of illicit love, often ending in a suicide pact, as in the *Love Suicide at Sonezaki* and *Courier from Hades*. Other important *jōruri* dramatists are Ki no Kaion (1663-1742) and Takeda Izumo (1691-1756).

After 1730 *jōruri* declined and was replaced in popular favour by *kabuki*, which is played by live actors. It also originated about 1600, with performances in Kyoto by a female dancer, O Kuni *Kabuki* developed into normal drama, at first using only woman actors, governmental bans upon woman and then boy actors hampered its development until Ichikawa Danjūrō, in Yedo, about 1680, presented *kabuki*, now using only adult male actors, with vivid scenes of violence, bizarre make up and exaggerated gestures. *Kabuki* appropriated the entire *jōruri* repertory, and borrowed heavily from the *no*, no outstanding original dramatist having emerged. Its stage has complicated scenery, and a gangway (*hanamichi*), along which protracted exits and entrances are possible, stretches from it to the back of the auditorium. *Kabuki* remains widely popular, its acting style reveals much puppet influence. Since 1868 modern western style plays have appeared, apart from translations, there are many good original pieces, such as *Father Returns* by Kikuchi Kan and *The Priest and His Disciples* by Kurata Momozō.

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INDIAN DRAMA

The earliest texts of the Indian classical drama, which consist of fragments of three plays dating from the 2nd century A.D., reveal certain characteristic features which were destined to remain in the drama throughout the period of its greatest brilliance and subsequent decline. Much speculation has arisen, therefore, as to the probable sources of the dramatic form. Native tradition affords a purely mythical explanation on this point. Modern scholarship has put forward various theories, attempting, on the one hand, to derive the origins of the drama from certain of the Vedic hymns which were cast in dialogue form, on the analogy of known developments in ancient Greece, and, on the other, to place the sources of the drama in the recitation, accompanied by gesture, of epic tales. That religious subjects were favoured for such representation is suggested by a reference in the *Mahābhārata* (*The Great Commentary*) of Patañjali (2nd-3rd century A.D.) to two dramatic themes dealing with episodes of the Kṛṣṇa (Kṛṣṇa) cult, while the fact that Śaṅkara, the language of

to instruct the sage Bharata in his creation, does at least give prominence to the essential elements of the Sanskrit theatre, with its conventional gestures, alternation of prose and verse, and subordination of plot and character to emotional content.

The Classical Drama—The first drama of known authorship, which appears among the 2nd-century fragments mentioned above, is the *Sūtrputra-prakarana* of the Buddhist author Asvaghosa (1st century A.D.), dealing with the theme of conversion to Buddhism found also in his two poetic works. Enough of the text remains to show that the division into acts, the use of both

prose and verse, and the appearance of a Prākṛit-speaking *Vaiśākha* were features already well established in Asvaghosa's time. One of the other two fragmentary plays, depicting a religious allegory, represents a type of composition which was to culminate in the 11th century *Prabodhacandrodaya* (*The Rise of the Moon of Knowledge*).

Such are the first records of the drama, and between Asvaghosa and Kālidāsa no accurately datable work is known. The 13 plays published at Trivandrum in 1912 were at one time attributed to Bhāsa, whom Kālidāsa mentions as a predecessor, but much has been said against this view. Three of the plays, however, *Śaṅkharavāsavadattā* (*The Vision of Vāsavadattā*), *Pratītyāyagandharayana* (*Yagandharāyana's Vows*) and *Cāruddatta*, are most probably, because of their literary qualities, to be ascribed to Bhāsa. The plot of the first two is taken up later in *Ratnāvalī* (*The Pearl Necklace*), while the third foreshadows *Mrcchakatika* (*The Little Clay Cart*). However uncertain the date and authorship of the Trivandrum plays may be, there is general agreement as to the position of the next writer who appears in Indian literary history. Most scholars have placed Kālidāsa's date at approximately A.D. 400, and it is probable that he enjoyed the favour of the Gupta kings at their court in Ujjain. The supreme figure in Sanskrit letters, Kālidāsa is the author, among other works, of three dramas, one of which, *Abhayānandakuntala*, was known in Europe in 1789 (in English translation) and earned unstinted praise from Goethe, who possibly imitated its form in the opening scenes of *Faust*. The play describes the love of King Dasyanta for the fair Sakuntalā, and the plot, a favourite one in Sanskrit drama, revolves around their first meeting, subsequent separation and final recognition and reunion. Similar is the theme of *Vikramorvashī* (*Vikrama and Urvashī*), which tells of the love of the mortal king Puruṣarava for the divine nymph Urvashī, a tale as old as the Vedas, though it has lost some of its former effectiveness because of the demands of the courtly drama. The third play, *Mālavikāgnimitra* (*Mālavikā and Agnimitra*) is of unequal merit.

Harsa, a 7th century king of northern India, is assured an important place among Sanskrit dramatists for his *Ratnāvalī*, where the ever-popular triangle problem is posed and solved in Indian fashion. King Udayana falls in love with a maiden of unknown descent, Sagarikā, and causes great distress thereby to his queen Vāsavadattā. After many misunderstandings and jealous protests, the difficulties are resolved by Vāsavadattā's final acceptance of Sagarikā, who turns out to be a princess, as a co-wife. Of the other two plays of Harsa, the *Priyadarśikā* is a more feeble treatment of the same theme, while the *Nāgananda* (*The Joy of the World of Serpents*) describes a young lover's self sacrifice for religious reasons, the ultimate reward of which is reunion with his beloved.

Bhavabhūti (8th century), whose dramas are generally considered to rival those of Kālidāsa, is nevertheless of more serious temperament. The story of Rāma and Sītā, involving marriage, separation and reunion, which he dramatized in *Mālvadivācarita* (*The Fortunes of the Great Hero*) and its sequel, *Uttaradivācarita* (*The Later Fortunes of Rāma*), hailed by many as his greatest play, depicts a passion deeper and more enduring than the love affairs which form Kālidāsa's material. Bhavabhūti's third play, *Mālatīmādhava* (*Malati and Madhava*), follows the adventures of a young couple in overcoming the difficulties placed in the way of their marriage. It is interesting in that it contains a subplot involving a second pair of lovers, but because of the looseness of its construction and its excessive length the play fails to be dramatically effective.

The *Vamsamahārā* (*The Binding of the Tress of Hair*) of Bhaṭṭa Nārāyaṇa, whose date cannot be later than A.D. 800, derives its material, in somewhat prolix and disjointed fashion, from the *Mahābhārata*. The same fault is visible in the *Bālārāmāyana* (*The Lesser Rāmāyana*) and the incomplete *Blabharāta* (*The Lesser Bhārata*) of Rājasekhara, but Rājasekhara wins an enduring place with his *Karṣṇarāmāyaṇa* (*The Camphor Cluster*), a play entirely in Prākṛit, which takes up, once again, the Ratnāvalī theme.

Drama Proper—At the times of Sung and Chin (Khitai) Ta tars, 1115-1234) long acts of dancing and singing with a chorus in incorporating popular tunes and representing some narrative were called *yuan pên* or *tsa chu*, but it was only in *Yuan* times (1280-1367) that the drama proper, again called *tsa-chu* or *pei ch'u*, actually appeared. It included singing of the poetic parts which were the popular tunes (*chu hung-tiao*), dialogues, mime and dancing when it could fit in, and for the first time the actor spoke in the first person. These dramas or operas or plays, whatever one chooses to call them, were in four acts with occasionally a *hsieh-tsu* (wedge) taking the place of a prologue or epilogue, according to its position. They were necessarily short plays, seeing that at a banquet or celebration a play was only one feature of a variety of entertainment. When a longer story took it, had to be done in more plays than one. A story like that of *Hsi Huang Chu* (The Western Chamber) took up the time of five plays of four acts each. The peculiar feature of these plays was that only one person did the singing throughout one play, and so hero and heroine never sang together. Later during the Ming dynasty in the 16th century the *k'ün ch'u* or music from the Wu district became the most popular and plays of this style abolished the earlier restrictions of the four act rule as well as that of allowing only one person to sing throughout the play. The play probably then became independent as a complete entertainment with more than one singer and was able to be as long as its theme required, without the previous time limit. The construction of the play became freer after *Yuan* times.

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tion of 1911, experiments were made with plays without music, called *wen ming hsi*. They could not compete with the traditional plays in popularity as they failed to transport the audience into that "suspension of disbelief" which the miming and singing and conventions, main attractions for the audience of the older play, were able to create. There was a surge of dramatic activity in propaganda plays during the Japanese invasion of China beginning in 1937, an example is *The Lone Battalion*, depicting the desperate struggle of a few last men in a Shanghai godown, and modern plays have been written about social problems, as, for instance, *Slaughter*, which dramatizes the moneylender's exploitation of the farmer, and there are also translations and adaptations of favourite Russian stories and Shakespearean plays as well as modern one-acts.

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JAPANESE DRAMA

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Jôruri is puppet drama. It enjoyed great popularity between 1650 and 1730, but is now restricted to the Bunraku theatre in Osaka, where scenes from famous plays are performed. This drama, which carries puppet manipulation to a higher level of complicated skill than anywhere else in the world, arose about 1600 from the collaboration of puppeteers attached to temples and shrines (where they performed scenes from Buddhist or Shinto legend), with performers who chanted to the accompaniment of the *shamisen* (a three stringed instrument then recently introduced into Japan). The puppets, about three feet high, are manipulated each by as many as three men. Movement even of tongue, finger joints, and eyelids is possible. Scenery is of great complexity, the revolving stage having been introduced early in the 18th century. The possibilities of the puppet theatre had been quickly recognized in Yedo (now Tokyo), where Satsuma Jôn (d. 1669) produced many plays on the life of Kimpri, a legendary general, in these the use of puppets permitted gruesome scenes of bloodshed. *Jôruri* would not have been very important, however, had not Chikamatsu Monzaemon (1653-1724), Japan's greatest dramatist, worked with the rector Takemoto Gidayû (1651-1714) in Osaka. He transformed the violent plays of

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(C. I. D.)

INDIAN DRAMA

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The Classical Drama—The first drama of known authorship, which appears among the 2nd-century fragments mentioned above, is the *Sāṃputra-prakaraṇa* of the Buddhist author Aśvaśaśa (1st century A.D.), dealing with the theme of conversion to Buddhism found also in his two poetic works. Enough of the text remains to show that the division into acts, the use of both

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Such are the few records of the drama, and between Aśvaghoṣa and Kālidāsa no accurately datable work is known. The 13 plays published at Trivandrum in 1912 were at one time attributed to Bhāsa, whom Kālidāsa mentions as a predecessor, but much has been said against this view. Three of the plays, however, *Śvaṇnavaśavadattā* (*The Vision of Vāsavadattā*), *Pratītyāyagandharāyana* (*Yaṅgandharāyana's Vows*) and *Carudattā*, are most probably, because of their literary qualities, to be ascribed to Bhāsa. The plot of the first two is taken up later in *Ratnāvalī* (*The Pearl Necklace*), while the third foreshadows *Mrcchakatika* (*The Little Clay Cart*). However uncertain the date and authorship of the Trivandrum plays may be, there is general agreement as to the position of the next writer who appears in Indian literary history. Most scholars have placed Kālidāsa's date at approximately A.D. 400, and it is probable that he enjoyed the favour of the Gupta kings at their court in Ujjain. The supreme figure in Sanskrit letters, Kālidāsa is the author, among other works, of three dramas, one of which, *Abhayinīśakuntalā*, was known in Europe in 1789 (in English translation) and earned unstinted praise from Goethe, who possibly imitated its form in the opening scenes of *Faust*. The play describes the love of King Duśyanta for the fair Sakuntalā, and the plot, a favourite one in Sanskrit drama, revolves around their first meeting, subsequent separation and final recognition and reunion. Similar is the theme of *Vikramorvśī* (*Vikrama and Urvśī*), which tells of the love of the mortal king Purūrasa for the divine nymph Urvśī, a tale as old as the Vedas, though it has lost some of its former effectiveness because of the demands of the courtly drama. The third play, *Mālavikāgnimitra* (*Mālevikā and Agnimitra*) is of unequal merit.

Harṣa, a 7th century king of northern India, is assured an important place among Sanskrit dramatists for his *Ratnavali*, where the ever popular triangle problem is posed and solved in Indian fashion. King Udayana falls in love with a maiden of unknown descent, Sāgarikā, and causes great distress thereby to his queen Vasavadattā. After many misunderstandings and jealous protests, the difficulties are resolved by Vasavadattā's final acceptance of Sāgarikā, who turns out to be a princess, as a co wife. Of the other two plays of Harṣa, the *Prayodadattā* is a more feeble treatment of the same theme, while the *Nāgānandā* (*The Joy of the World of Serpents*) describes a young lover's self sacrifice for religious reasons, the ultimate reward of which is reunion with his beloved.

śhaṅbhūti (8th century), whose dramas are generally considered to rival those of Kālidāsa, is nevertheless of more serious temperament. The story of Rāma and Sītā, involving marriage, separation and reunion, which he dramatized in *Mahāvīrarāma* (*The Fortunes of the Great Hero*) and its sequel, *Uttararāma* (*The Later Fortunes of Rāma*), hailed by many as his greatest play, depicts a passion deeper and more enduring than the love affairs which form Kālidāsa's maternal. Śhaṅbhūti's third play, *Mālatīmādhava* (*Malati and Madhava*), follows the adventures of a young couple in overcoming the difficulties placed in the way of their marriage. It is interesting in that it contains a subplot involving a second pair of lovers, but because of the looseness of its construction and its excessive length the play fails to be dramatically effective.

The *Veṇiśaṃhāra* (*The Binding of the Tress of Hair*) of Bhāṭṭa Nārāyaṇa, whose date cannot be later than A.D. 800, derives its material, in somewhat prolix and disjointed fashion, from the *Mahābhārata*. The same fault is visible in the *Bālarāmāyana* (*The Lesser Rāmāyana*) and the incomplete *Bhīṣakārata* (*The Lesser Bharata*) of Rājasekhara, but Rājasekhara wins an enduring place with his *Karpuṛaṃayāri* (*The Camphor Cluster*), a play entirely in Prakṛit, which takes up, once again, the Rātnavālī theme.

Particularly interesting because of their treatment are the *Mrechakatika* of Śāṅkara and the *Mudrarakṣasa* (*Rakṣasa* and *the Sāl*) of Viśākhadatta. The first is centred in bourgeois life and relates the courtship and marriage of a noble Brahman, Cāruddatta, with a courtesan, Vāsuntisēnā, and the second abounds in the traditional love interest, forming a well-knit drama of political intrigue, with Cāṇakya, the Mūrchavelli of Indian tales, as the prominent character.

A different but at one time popular type of drama is the *bhāna*. Only one character appears, the *Vīla*, who carries on imaginary conversations about his adventures among the less reputable quarters of the big cities. Four such plays were discovered and published in 1927 under the general title *Caturbhāna*.

Finally, there is the late but important *Prabodhacandrodāya* of Kṛṣṇamitra (11th century). A philosophical allegory with abstract qualities is the characters, it portrays with much skill the strife of good and evil forces in man's mind.

After the 11th century and the Moslem invasions the Sanskrit drama suffered a decline, and most of the productions of the following centuries are inferior to those of the great age. The forms remained, but the inspiration was lacking, the romantic drama never again reached its former heights, Kṛṣṇamitra, like Calderón de la Barca, had no worthy successors, while plays like the *bhāna* and the *prahasana* (farce) degenerated into mere crudities. The new theatre of India was destined to arise out of the modern dialects.

Species of Drama.—The Sanskrit drama, no less than Sanskrit poetry, has been subjected to the traditional Hindu criticism, a purely analytic process carried out with a regard for minutiae and fine distinctions unknown to other literatures. Bharata's *Nāṭyaśāstra*, a large compendium of criticism on all the arts and the first authoritative work to survive, lays down the criteria for determining the main types of drama. These pedantic rules are further developed and elaborated in later works dealing exclusively with the theatre, notable among which are the *Daśarūpa* (*The Ten Forms [of Drama]*) (10th century) and the later *Sāhityadarpāna* (*The Mirror of Poetry*), new divisions being added and general rules frequently being inferred from single instances.

Dramas are termed, in a general manner, *rūpaka*, of which ten species are recorded, the division resting on the content, type of hero and sentiment (*rasa*) to be evoked. Secondary types, termed *uparūpaka*, also came to be classified, and of these 15 to 18 species are mentioned. The highest form of *rūpaka* is the *nāṭika*, where the subject is legendary, the hero a royal or divine personage and the sentiment heroic or erotic (*Abhijñānaśākuntala*, *Mahāvīra-carita*). Another form, the *prakaraṇa*, is similar in theme, but the main characters are drawn from ordinary society (*Mrechakatika*, *Mālatīmadhava*). Among the *uparūpaka* may be mentioned the *bhāna* and, on a still lower scale, the *prahasana* or farce.

What is remarkable to the western mind in this classification is not merely the elaborate nature of the criteria, but the very basis of the criticism. The division into tragedy, tragicomedy and comedy which has developed in the west is irrelevant in the case of Sanskrit drama. The tragic denouement of a play was expressly prohibited, and whatever the sufferings of the characters during the course of the play, a happy ending was considered essential, even if it involved the introduction of *deus ex machina*. Again, whereas in western drama importance is placed on a plot worked out through psychological conflict, the chief aim of the Sanskrit theatre was to evoke a sentiment or *rasa*, of which more than eight types have been classified. For its reason the Hindu play approximates more closely to the dramatic poem of western literature. Apart from the basic types of *uparūpaka*, which did not conform to the main rules of the drama, the Hindu theatre was designed to satisfy the tastes of an intellectual aristocracy, its very life was bound up with the interests of a cultured Sanskrit-speaking minority.

Structure.—The Indian play begins generally with a benediction (*mantra*) which is followed by a prologue (*prastāvanā*) where the stage manager (*utpatti*) engages the attention of the audience or more of the cast to introduce the subject matter of the play.

The play itself is divided into acts (*anaka*), which vary considerably in number from play to play. Characteristic is the use of both prose and lyrical verse in Sanskrit drama, while the appearance of Prakṛit, or dialect, beside Sanskrit, the latter spoken by the hero and the chief male characters, is a noteworthy feature. The heroines and, in general, all the female characters speak Prakṛit, usually Sauraseni, while Māhārāṣṭri is used for the songs. Prakṛit is also spoken by the *Vidūṣaka*, a Brahman who is represented as the hero's friend. He is an important character in the play and bears a certain resemblance to the fool of the Elizabethan stage. His attempts to further the hero's love intrigues are usually mis-placed, and his remarks are designed purely to raise laughter.

Scenery was not used, since, although types of stage were described in the dramatic treatises, plays were generally performed at royal courts or in the open air. Change of scene, which was freely permitted, was therefore indicated in the text. Duration of action, the unity of which was enjoined but, unfortunately, not always followed in practice, was usually limited to one year, while the length of an act was not to be more than 24 hours. Death and violence were prohibited on the stage and practices such as kissing and eating were not approved.

Summary.—The Indian drama moves and has its being in an idealistic atmosphere and treats its problems with an acute perception of the workings of human passion. Love and heroism are its most popular themes, and these are portrayed within the range of a clearly defined and complete philosophy, which allows, nevertheless, for the intervention of fate or divine decree. Nature is the storehouse whence the Indian poet draws his wealth of imagery, and it is in lyrical scenes, such as the meeting of Duryānta and Śakuntala, that the Indian drama makes its particular appeal to the western reader. Despite the restrictions imposed on it by its limited audience, and despite the fact that it is built up not only on an alien system of philosophy but on an outlook and a standard of comparisons drawn from a vastly different environment, the Hindu theatre nevertheless will amply reward him who gives it his attention, for it is worthy to rank high among the dramas of the world.

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(J E B G)

PERSIAN DRAMA

Persian literature, until late in the 19th century, exhibits no true dramatic form, either borrowed or of its own invention, which would allow of comparison with the Greek tragedies or the great dramas of western Europe. In virtually all other fields of literature—the epic and the lyric in particular, but also the narrative, the memoir, the essay and the fantasy—some comparison could be drawn, though the canons applying on either side are utterly at variance in most cases, but the dramatic, in Persia as indeed throughout most of the Islamic world, seems to have struck no clear responsive chord in the creative mind. That the Arabo-Persian civilization of the 8th-10th centuries should have worked every vein of Greek treasure but the dramatic is, however, considerably less of an enigma, for, in the Byzantine Hellenic world with which that civilization was in such fruitful contact, though science and philosophy still flourished abundantly, the tradition of Greek drama was long dead.

There is nevertheless in the Persian character a powerful historic instinct that to such all travellers from the time of Herodotus onward, have borne both direct and indirect witness, and this has tended, for centuries past, to find its expression in the religious 'mudrāma' (*ta'ziyah*, mourning or condolence) and the popular comedies (*tavāshā*, spectacle or *tanāh*, mimicry).

The former is commonly ascribed to be in its present form at the little older than in the 17th-18th century, but it is still to be seen as considerably more colourful and ancient than it then was. It probably received its first powerful impulse after the thirteenth

tion of Shi'ite Islam with Persian nationalism, an ancient, often blighted hope which became a successful official policy under the Safawi dynasty (16th-17th centuries). Such plays, forming part of the *Muharram* (holy month) religious celebrations, tell of the "martyrdom" of Al Husayn, the younger son of Ali and retrospective focal point of Shi'ite aspiration—how, in his final struggle at Karbala in 680, he fought against pitiless odds, both natural and human, until with a tiny band of faithful followers he eventually succumbed to the forces of the "accursed Yazid." Though lacking the essentially dramatic development of the Christian Passion narratives, the tale is told and played with such lyrical intensity and such epic force as to spare none of the feelings of the devout audience, many of whom, indeed, often discard their semipassive role for one of active participation drawing their own blood with knives and chain saws and chanting hypnotic incantations until, not seldom, oblivion supervenes. Under Riza Shah Pahlavi such spectacles were forbidden as degrading to Persian honour in the eyes of the modern world, but after his abdication in 1941 they were revived with considerable success as (ironically enough) a triumphant affirmation of Persian national pride in all its politico-religious fervour.

The "knockabout" comedy bears easy comparison with the *commedia dell'arte* and the Punch and Judy show equally in regards themes, techniques and players (many of whom are of gypsy stock). Literary allusions to it would seem to carry it back in one form or another for nearly a millennium, but it is almost certainly, of its simple yet stereotyped nature, much older than that. Despite increasingly unfavourable conditions it is still to be found, particularly in the provinces.

The modern Persian drama, though attempting more and more to use native material, is (like its Arabic counterpart) an almost wholly foreign importation, indeed, it would scarcely be unfair to suggest that it is composed for the most part of translations and free adaptations, particularly from the French. The comedy of manners has found the widest popularity, probably as representing an easily assimilated extension of the native farce, transplanted into the plebeian playhouses (*tamashakhana*) that accommodated its predecessor, it gives every promise of thriving. The more serious type of "problem play" is seldom performed, and an attempt to introduce the opera failed.

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MEDIAEVAL DRAMA

In the midst of the condemnation with which the Christian church visited the stage, we find such works as the *Xpistos pástxwv* (*Passion of Christ*), formerly attributed to St. Gregory Nazianzen, and the *Querolus*, long fathered upon Plautus himself, which were doubtless mostly written for educational purposes. The same was probably the design of the famous "comedies" of Hroswitha, the 10th-century Benedictine nun of Gandersheim, in Eastphalian Saxony. While avowedly imitated in form from the comedies of Terence, these religious exercises derive their themes—martyrdoms (*Galicanus*, part II, *Sapientia*) and miraculous or otherwise startling conversions (*Galicanus*, part I, *Calimachus*, *Abraham*, *Paphnutius*)—from the legends of Christian saints. Thus, from perhaps the 9th to the 12th centuries, Germany and France and, through the latter, England, became acquainted with the literary monastic drama. Thus the *Play of St. Katharine* was acted at Dunstable about the year 1110 in "copies" by the scholars of Geoffrey, the Norman, afterward abbot of St. Albans, and was certainly not regarded as a novelty.

From about the 6th to the 11th century the Latin and the Teutonic elements of mediaeval "minstrelsy" more or less imperceptibly coalesced. The traditions of the disestablished *munus* combined with the "occupation" of the Teutonic scop, who is found under this name or that of the "gleeman" in Anglo-Saxon literature, before it fell under the control of the Christian church

How far these jugglers kept alive the usage of entertainments more essentially dramatic than the minor varieties of their performances, we cannot say. In different countries these entertainments suited themselves to different tastes and to different literary tendencies. The literature of the troubadours of Provence which communicated itself to Spain and Italy, came into only isolated contact with the beginnings of the religious drama; in northern France the jongleurs, as the jugglers were now called, were confounded with the *trouvères* (*q.v.*). As appointed servants of particular households they were there and afterward in England, called *menestrels* (from *ministerium*) or *minstrels*. In England such accomplished minstrels enjoyed the favour of the Norman, Angevin and Plantagenet kings. But there, as elsewhere, the humble members of the craft spent their lives in strolling from castle to convent, from village green to city street, exhibiting their skill in dances, tumblers and jugglers proper and in masques and conductors of bears and other dumb contributions to popular wonder and merriment.

Pagan Elements—From the days of Gregory the Great, the western church tolerated and even attributed to its own festivals popular customs which were in truth relics of heathen ritual. Such were the Mithraic feast of Dec. 25, or the egg of Eostre tide, and a multitude of Celtic or Teutonic agricultural ceremonies of a semidramatic nature: such as processions of beasts or men in beast masks, dressing trees with flowers and the like, but above all, ceremonial dances often in disguise. The sword dance, recorded by Tacitus, of which an important feature was the symbolic threat of death to a victim, endured (though it is rarely mentioned) till the latter middle ages by which time it had attracted to itself a variety of additional features and of characters familiar as page-eggers, mummers and morris dancers (probably of distinct origin).

The dramatic "expulsion of death," or winter, by the destruction of a lay figure—common through western Europe about the 8th century—seems connected with a more elaborate rite, in which a disguised performer (who perhaps originally represented summer) was slain and afterward revived (the *Pinguet*, jack in the green or Green Knight). This representation after acquiring a comic complexion, was annexed by the character dancers, who about the 15th century took to adding still livelier incidents from songs treating of popular heroes, such as St. George and Robin Hood, which latter found a place in the festivities of May day with their central figure, the May queen. The feast of fools (or asses), which enjoyed the greatest popularity in France (though protests against it are on record from the 11th century till the 17th) was well known from London to Constantinople. It was probably derived from the ancient Kalend feasts. In the 16th century the feast of fools was combined with the elaborate festivities of the 12 Christmas feast days—the season when throughout the previous two centuries the "mummers" especially flourished, who in their disguises and *usesels* began as dancers gesticulating in dumb show, but ultimately developed into actors proper.

Christian Elements—Thus the literary and the professional element, as well as that of popular festive usages, had survived to swell the main stream of the early Christian drama, which had its direct source in the liturgy of the church itself. The service of the mass contains in itself dramatic elements, and at a very early period—certainly already in the 5th century—it was used on special occasions to illustrate the Gospel narrative by living pictures accompanied by songs. The insertion, before or after sung portions of the service, of tropes, originally one or more verses of texts, usually serving as intonations and in connection with the Gospel of the day, and recited by the two halves of the choir, led to dialogue chanting, and this was frequently accompanied by illustrative action, such as drawing down the veil from before the altar.

This practice of interpolations in the offices of the church, which is attested by texts from the 9th century onward (the so-called "Winchester tropes" belong to the 10th and 11th), progressed till the liturgical mystery—the earliest form of the Christian drama—was gradually called into existence. As early as the

10th century on great ecclesiastical festivals the priests performed in the churches these offices (as they were called). The whole Easter story, from the burial to Emmus was thus presented, the Maries and the angel adding their lyrical *placatus*, while the surroundings of the Nativity—the Shepherds, the Innocents, etc.—were linked with the Shepherds of Epiphany by a recitation of "Prophecs," including Virgil and the Sibyl. Before long, from the 12th century onward, mysteries, as they were called, were produced in France on scriptural subjects such as the Wise and Foolish Virgins Adam (with the fall of Lucifer), Daniel, Lazarus etc. These mysteries and miracles, being as yet represented by the clergy only, the language in which they were usually written is Latin, the earliest example in the vernacular being the 11th-century mystery of the Resurrection.

Mysteries, Miracles and Moralities—It is usual to divide the productions of the medieval religious drama into three classes. The mysteries proper deal with scriptural events only, and set forth with the aid of the prophetic history of the Old Testament and the fulfilling events of the New the central mystery of the Redemption of the world, as accomplished by the Nativity, the Passion and the Resurrection. But in fact these were not kept distinctly apart from the miracle plays, or miracles, which are strictly speaking concerned with the legends of the saints. Thirdly, the moralities, or moral plays, teach and illustrate the same truths allegorically, their characters being personified virtues or qualities.

As the plays grew more elaborate and their spectators more numerous, they began to be represented outside as well as inside the churches, at first in the churchyards, and in the vulgar tongue. A Beverly Resurrection play (c. 1220) and some others are bilingual. Miracles were less dependent on this connection with the church services than mysteries proper, and lay associations, guilds in particular, soon began to act plays in honour of their patron saints in or near their own halls. Lastly, as some of these characters came to be depended on by the audiences for conventional extravagance or fun, every new Herod seeking to out Herod his predecessor, and the devils asserting themselves as indispensable favourites, the comic element in the religious drama increased, and that drama itself grew more profane. The endeavour to sanctify the popular tastes to religious uses, which connects itself with the institution of the great festival of Corpus Christi (1264, confirmed 1311), when the symbol of the mystery of the Incarnation was borne in solemn procession, led to the closer union of the dramatic exhibitions (hence often called *processus*) with this and other religious feasts, but it neither limited their range nor controlled their development.

France—In France, where dramatic performances had never fallen entirely into the hands of the clergy, the progress was speediest and most decided toward forms approaching those of the modern drama. The earliest play in the French tongue, however, the 12th century *Adam*, supposed to have been written by a Norman in England (as is a fragmentary *Résurrection* of much the same date), still reveals its connection with the liturgical drama. Jenn Bodel of Arras' miracle play of *St Nicolas* (before 1205) is already the production of a secular author, and has some realistic features. On the other hand, the *Theophilus* of Rutebeuf (d. c. 1280) treats its Faustlike theme in a rather lifeless form but in a highly religious spirit, and belongs to the cycle of miracles of the Virgin, of which examples abound throughout this period. Easter or Passion plays were fully established in the towns of France by the end of the 14th century, and in 1402 the *Conférence de la Passion* obtained a royal privilege for their performance.

Of these series of religious plays perhaps the most notable (c. 1450) is that by Arnoul Greban, a canon of La Mans. Its revision, by Jean Michel (first performed at Angers in 1486), was very popular. Still more elaborate is the Rouen Christmas mystery of 1474, and the celebrated *Mystère du Vieux Testament*, produced at Abbeville in 1458 and performed at Paris in 1500. Most of the Provençal Christmas and Passion plays date from the 14th century, as well as a miracle of St Agnes. The miracles of saints were popular in all parts of France, and the diversity of local colouring contributed materially to the growth of the early French

drama.

The earliest known secular plays presented by university students in France were moralities, performed in 1426 and 1431. These plays depicting the struggle between good and evil in the human soul, become more frequent from about this time. Now it is (at Rennes in 1439) the contention between *Bien avisé* and *Mal avisé*, now, one between *l'homme juste* and *l'homme mondain*. Political and social problems are likewise similarly treated, the *Mystère du Concile de Bale*—a historical morality—dates back to 1432, and in 1507 there is even found a hygienic or abstinence morality (by N de la Chesnaye) in which 'Banquet' enters into a conspiracy with 'Apoplexy,' 'Epilepsy' and 'the whole regiment of diseases.'

From the beginning of the 14th century onward the famous fraternity of the Basoche (clerks of the *parlement* and the *châtelle*) had been entrusted with the conduct of popular festivals at Paris, and had performed plays. But after the *Conférence de la Passion* had monopolized the religious drama, the *basochiens* confined themselves to moralities and farces, in which popular satire found a place. A third association, the *Enfants Sans Souci*, had, apparently also early in the 15th century, acquired celebrity by its performances of short comic plays called *otons*, not very distinct from the farces of the Basoche. Other confraternities and associations readily took a leaf from the book of these devil may care good fellows and interwove their religious and moral plays with comic scenes and characters from actual life, thus unconsciously preparing the transition to the regular drama.

The earliest known example of a serious secular play written in the French tongue is the *Estoire de Griselidis* (1393) which is largely indebted to Petrarch. The *Mystère du siège d'Orléans*, on the other hand, written about half a century later, in the epic tediousness of its manner comes near to a chronicle history, and interests us chiefly as the earliest of many efforts to bring Joan of Arc on the stage. Jacques Mile's celebrated mystery of the *Destruction de Troye la Grant* (1452) seems to have been addressed to readers and not to hearers only. The beginnings of the French regular comic drama are more difficult to ascertain. But there is ample evidence that the most famous of all mediaeval farces, the immortal *Maître Pierre Pathelin* (otherwise *L'Avocat Pathelin*), was written before 1470 and acted by the *basochiens*, and we may conclude that his delightful story of the biter bit and the profession outwitted typifies a multitude of similar comic episodes of real life, dramatized for the delectation of clerks, lawyers and students and of all lovers of laughter.

Other Countries—In the neighbouring Netherlands many Easter and Christmas mysteries are noted from the middle of the 15th century, and with them the celebrated series of the Seven Joys of Mary. To about the same date belongs the small group of *abele spelen* ('is who should say plays easily managed'), chiefly on chivalrous themes. The moralities were specially cultivated during this century by the *Roderijkers* (rhetoricians)—civic associations which cultivated learned poetry and took an active share in the festivals that formed one of the most characteristic features of the life of the Low Countries. Among these moralities was that of *Eclikerlye* (printed 1495), which is regarded as the original of the finest of English moralities *Everyman*.

In Italy traces of the liturgical drama are few and confined to the northeast. The collective mystery so common in other western countries, is represented by a single example only—a *Passione di Gesù Cristo*, performed at Revello in Saluzzo in the 15th century—though there are some traces of other cyclic dramas of the kind. The Italian religious plays, called *figure* when on Old, *vangelis* when on New, Testament subjects, differ from those of northern Europe chiefly by the lesser degree of coarseness in their comic characters, and seem largely to have developed from the processional element in the festivals of the church. Besides such processions as that of the Three Kings at Epiphany in Milan, there were the penitential processions and songs (*laude*), which at Assisi, Perugia and elsewhere already contained a dramatic element, and at Siena, Florence and other centres these again developed into the so-called (*sacre*) *representations*. Such

a piece was the *San Giovanni e San Paolo* (1489), by Lorenzo the Magnificent, another was the *Santa Teodora*, by Luigi Pulci (d. c. 1484), *San Giovanni Gualberto* (of Florence) treats the religious experience of a latter day saint, *Rosana e Ulimento* is a love story with a Christian moral. Passion plays were performed at Rome in the Coliseum by the Compagnia del Gonfolone, but there is no evidence of this before the end of the 15th century. In general, the spectacular magnificence of Italian theatrical displays accorded with the growing pomp of the processions, both ecclesiastical and lay, which *trionfi* already in the days of Dante, while the religious drama gradually acquired an artificial character and elaboration of form assimilating it to the classical attempts, to be noted below, which gave rise to the regular Italian drama.

In Spain hardly a monument of the mediaeval religious drama has been preserved. There is manuscript evidence of the 11th century attesting the early addition of dramatic elements to the Easter office, and a Spanish fragment of the Three Kings Epiphany play, dating from the 12th century, is one of the very earliest examples of the mediaeval drama in the vernacular. But that religious plays were performed in Spain is clear from the permission granted by Alphonso X of Castile (d. 1284) to the clergy to represent them, while prohibiting *jugos de escarnio* (mocking plays).

The German religious plays in the vernacular, the earliest of which date from the 14th and 15th centuries and were produced at Trier, Wolfenbützel, Innsbruck, Vienna, Berlin, etc., were of a simple kind, but in some of them, though they were written by clerics, there are traces of the minstrel's hands. The play of *The Wise and the Foolish Virgins*, in a Thuringian manuscript thought to be as early as 1328, a piece of remarkable dignity, was evidently based on a Latin play. In the same century miracle plays began to be performed in honour of St Catherine, St Dorothea and other saints. The Corpus Christi plays, or *Frohnleichnamsspiele*, are notable, since that of Innsbruck (1391) is probably the earliest extant example of its class.

The number of nonscriptural religious plays in Germany was much smaller than that in France, but the theme of the last judgment was common in Germany in the later middle ages. Of this theme *Antichrist* may be regarded as an episode, though in 1469 an *Antichrist* appears to have occupied at Frankfurt four days in its performance. The earlier (12th century) *Antichrist* is unique of its kind, this political protest breathes the Ghibelline spirit of the reign (Frederick Barbarossa's) in which it was composed. While the Shrove Tuesday plays (*Fasnachts-spiele*) of the professional strollers (*fahrende Leute*) reproduced the practical fun of common life, they occasionally, as in the Lubeck *Fasnachts-spiel* of the five virtues, contained an element of the morality, but the main productivity of the writers of moralities and cognate productions falls into the periods of Renaissance and Reformation.

The performance of miracle plays is traceable in Sweden in the late 14th century, and the Germans who immigrated into the Carpathian lands, and into Poland in particular, in the later middle ages brought with them their religious plays. This fact is the more striking, as, though Czech Easter plays were performed about the end of the 14th century, none are known among the Magyars or among their neighbours of the eastern empire.

Religious Drama in England.—Coming now to the English religious drama, we find that from its extant literature a fair general idea may be derived of the character of these mediaeval productions. The miracle plays, miracles or plays (these being the terms used in England) of which we hear in London in the 12th century were probably written in Latin and acted by ecclesiastics, but in the following century mention is made—in the way of prohibition—of plays acted by professional players. In England as elsewhere, the clergy either sought to control the religious plays, which were occasionally acted in churches even after the Reformation, or else reprobated them, with or without qualifications. In Cornwall miracles in the native Cymric dialect were performed at an early date in extensive amphitheatres constructed for the purpose—two of which, at St Just near Penzance, and Perranzabuloe, are still extant, but the miracles which have

been preserved are apparently copies of English or French originals.

The flourishing period of English miracle plays begins with the practice of their performance by trading companies in the towns. Of this practice Chester is said to have set the example (1268–69), which was followed by many other towns. These towns with their neighbourhoods include, starting from East Anglia, where the religious drama was particularly at home Wymondham, Norwich, Sleaford, Lincoln, Leeds, Wakefield, Beverley, York, New castle upon-Tyne, with a deviation across the border to Edinburgh and Aberdeen. In the northwest they are found at Kendal, Lancaster, Preston, Chester, whence they may be supposed to have migrated to Dublin. In the west they are noticeable at Shrewsbury, Worcester and Tewkesbury, in the midlands at Coventry and Leicester, in the east at Cambridge and Basingbourne, Heybridge and Manningtree, to which places have to be added Reading, Winchester, Canterbury and London, in which last the performers were the parish clerks. Four collections, in addition to some single examples of such plays, have come down to us: the York plays, the so called *Towneley* plays, which were probably acted at the fairs of Widkirk, near Wakefield, and those bearing the names of *Chester* and of *Coventry*. Their dates are more or less uncertain, that of the York seems to be earlier than that of the *Towneley*, which were probably put together about the middle of the 14th century, the *Chester* may be ascribed to the 14th or early 15th, the body of the *Coventry* to the 15th or 16th. Many of the individual plays in these collections were doubtless founded on French originals, others are taken direct from Scripture, from the apocryphal gospels, or from the legends of the saints. Their characteristic feature is the combination of a whole series of plays into one *collective* whole, exhibiting the entire course of Bible history from the creation to the day of judgment. The oldest of the series—the York plays—exhibits a fairly close parallel to the scheme of the *Cursor mundi* (q.v.). Among the isolated plays may be mentioned *The Hurrowing of Hell* and several belonging to a series known as the *Digby Mysteries*, including *Parf're's Candlemas Day* (the massacre of the Innocents) and the miracle of *Mary Magdalene*. Of the so called "paternoster" and "creed" plays (which exhibit the miraculous powers of portions of the church service) no example remains, though of some we have an account, the Croxton *Play of the Sacrament*, the late 15th century manuscript of which is preserved at Dublin, exhibits the triumph of the holy wafer over wicked Jewish wiles.

Each play was performed by the representatives of a particular trade or company, after whom it was called the fishers' gloves', etc., pageant, a general prologue was spoken by a herald. As a rule the movable stage sufficed for the action, though we find horsemen riding up to the scaffold, and Herod instructed to "rage in the pagod and in the strete also." There is no evidence that the stage was, as in France, divided into three platforms with a dark cavern at the side of the lowest, appropriated respectively to the Heavenly Father and his angels, to saints, to mere men and to souls in hell. But hell was frequently displayed in the English miracles, with or without fire in its mouth.

The costumes were in part conventional—divine and saintly personages being distinguished by gilt hair and beards, Herod being clad as a Saracen, the demons wearing hideous heads, the souls black and white coats according to their kind and the angels gold skins and wings. The plays contained an element of humour, often broadly farcical, but much that seems ludicrous or coarse to modern standards of taste would not have so struck contemporaries. The York Corpus Christi plays (48) are comparatively free from the tendency to jocularity and vulgarity observable in the *Towneley*, several of the plays concerned with the New Testament and early Christian story are, however, in substance common to both series. The *Towneley* plays or *Wakefield* mysteries (32), composed by the friars of Widkirk or Nostel, are of a popular character, and are superior in vivacity and humour to both the later collections. The *Chester* plays (25) were indebted to the *Mystère du Vieux Testament* and to earlier French mysteries, they are less popular in character than the two earlier cycles, and on the

whole undistinguished by pathos or humour. While these plays were performed at Whitsuntide, the *Coventry* plays (42) were Corpus Christi performances. They are far more effectively written than the *Chester* plays, and occasionally rise to real dramatic force. In the *Coventry* series there is already to be observed an element of abstract figures, which connects them with the moralities.

English Moralities—The moralities corresponded to the love for allegory which, while dominating the whole field of mediaeval literature, was nowhere more evident than in England. Moreover, a specially popular element was supplied to these plays in a character borrowed from the miracles and usually provided with a companion whose task it was to lighten the weight of such abstractions as Sapience and Justice. These were the Devil and his attendant, the Vice, of whom the latter seems to have been of native origin, and, as he was usually dressed in a fool's habit, was probably suggested by the custom of keeping an attendant fool at court or in great houses. The Vice had many aliases (Shift, Ambidexterity, Sin, Fraud, Iniquity, etc.), but his usual duty was to tease the Devil his master for the edification and diversion of the audience. He was gradually blended with the domestic fool, who survived in the regular drama.

The earlier English moralities—from the reign of Henry VI to that of Henry VIII—usually allegorize the conflict between good and evil in the mind and life of man, without any side intention of theological controversy. Such also is still essentially the purpose of the extant morality, *Magnificence*, by Henry VIII's poet, the witty Skelton. *Everyman* (c. 1539), perhaps the most perfect example of its class, contains passages certainly designed to enforce the specific teaching of Rome. But its Dutch original was written at least a generation earlier, and could have no controversial intention. On the other hand, R. Wever's *Lusly Juventus* breathes the spirit of the dogmatic reformation of the reign of Edward VI. Theological controversy largely occupies the moralities of the earlier part of Elizabeth's reign, and connects itself with political feeling in Sir David Lindsay's *Satre of the Three Estaitis*, written and acted (at Cupar, in 1539) on the other side of the border, where the religious drama proper had been extinguished by the Reformation. Only a single English political morality proper remains to us, which belongs to the beginning of the reign of Elizabeth (*Albion Knight*). Another series connects itself with the ideas of the Renaissance rather than the Reformation, treating of intellectual progress rather than of moral conduct, thus extending from the reign of Henry VIII to that of Elizabeth. Besides these, there remain some Elizabethan moralities which have no special theological or scientific purpose, and are none the less lively in consequence.

The transition from the morality to the regular drama in England was effected, on the one hand, by the intermixture of historical personages with abstractions—as in Bishop John Bale's *Kyng Iohn* (c. 1538)—which easily led over to the chronicle history, on the other, by the introduction of types of real life by the side of abstract figures. This latter tendency is observable in several of the 16th-century moralities, but became most of these were written, a further step had been taken by a man of genius, John Heywood (b. c. 1500, d. between 1577 and 1587), whose "interludes" were short farces in the French manner. Heywood's interludes dealt entirely with real—very real—men and women. Other writers, such as T. Ingulph, took the same direction, and the allegory of abstractions was thus undermined on the stage. Thus the interludes facilitated the advent of comedy, without having superseded the earlier form. Both moralities and miracle plays survived into the Elizabethan age after the regular drama had already begun its course.

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THE MODERN NATIONAL DRAMA

ENGLISH DRAMA

Early Tudor Drama—Modern investigation has shown that English secular drama takes its beginning from the earliest Tudor period, and in all probability from the end of the 15th century. *Fulgens and Lucres* (a copy of which came to light in 1919), an interlude by Henry Medwall, chaplain to John Cardinal Morton, may be dated about 1496. Its theme, the contest between a plebeian love-loving patrician and a high-principled commoner for the hand of Lucres, is based upon a humanist tale, it anticipates Shakespearean technique by adding a comic subplot which is a variation of the main subject. Medwall's other extant play, *Nature*, though in form a morality, shows much of the technical skill and realistic observation of *Fulgens and Lucres*. John Rastell, brother-in-law of Sir Thomas More, who printed *Fulgens and Lucres*, was himself the author of *The Interlude of the Four Elements* and of *Gentleness and Nobility*, two didactic plays, without accent, but reflecting his interest in scientific and social problems. He also probably adapted from his Spanish source the fragmentary romantic drama *Calisto and Melibea*. John Rastell's daughter, Joan, married John Heywood, with whose name six interludes are traditionally associated. This authorship of four of these, the manuscript *Wittys and Wylless*, the *Play of Love* and the *Play of the Wether* (both printed by his brother-in-law, William Rastell)

and *The Four PP* (printed by W. Middleton), is beyond reasonable doubt. *Wether* and *The Four PP* have a raciness of dialogue and characterization that is almost Chaucerian. Two other, more acidly farcical, plays, *Johan Johan* and *The Pardoner and the Frere*, have points of affinity with *The Four PP*, but there is no external evidence for Heywood's authorship of these. It has been suggested that they may have been among the *comediae juveniles* attributed by Bale to Sir Thomas More. In any case all the plays mentioned above form an early Tudor group, predominately English in spirit and treatment, unaffected in their construction by classical influences.

It was chiefly through the schools and universities that these influences gradually spread and, blending with native and traditional elements, produced the distinctively Elizabethan "romantic" types of comedy and tragedy. The boys of St Paul's school acted plays of Plautus and Terence before Thomas Cardinal Wolsey in 1527 and 1528, and among the performances, which were part of the regular curriculum at Eton, Westminster Merchant Taylors' and other schools, the two masters of Roman comedy had an important place. Scarcely less influential were a group of continental neo-Latin playwrights such as Johannes Ravius Textor, Georgius Macropedius and Gulhelmus Fullonius (Gnapheus), whose dramas on the theme of the prodigal son gained great popularity. The most famous of these, the *Acolastus* of Gnapheus, was issued in England with a translation by John Palsgrave in 1540.

Classical, neoclassical and native elements are blended in the work of Nicholas Udall, successively headmaster of Eton and Westminster. His *Ralph Roister Doister*, a clever adaptation to English conditions of types from the *Miles Gloriosus* of Plautus, was probably written in 1553 when he was "schoolmaster" to Bishop Stephen Gardiner, and is the first English play divided into acts on the classical model. Udall was also probably the author about 1537 of the clever adaptation of Textor's dialogue, *Thersites*, and there is reason to suppose that his biblical play, *Esechias* (revived at Cambridge before Elizabeth in 1564), was another early work. Another attractive biblical play, *Jacob and Esau*, has features in common with *Roister Doister*, and may well be from Udall's pen. *Jacob and Esau* belongs to the prodigal son class, and other variations on this type are Thomas Ingelend's *The Disobedient Child*, adapted from a Textor dialogue, the powerful anonymous *Misogonus*, and George Gascoigne's *The Glaspe of Government* (1575), heavily didactic, but notable as the first prodigal son play written in prose.

It was not from the neoclassical but from the Italian drama, however, that the English amateur stage had taken the crucial step of borrowing prose as the instrument of comedy. In 1566 Gascoigne had translated for performance before the lawyers of Gray's Inn Lodovico Ariosto's *Gli Suppositi*, of which there were both prose and verse forms, but which he turned entirely into English prose. For a time his innovation found no imitators. *The Bugbears*, another (anonymous) adaptation of an Italian comedy, J. Phillip's recently recovered *Patient Grissell* and the numerous lost plays on Italian themes mentioned in the Revels' accounts were (so far as is known) in the traditional rhyming metres. So also were the few plays still surviving from the early years of Elizabeth's reign on purely English themes, such as *Tom Tyler* and *His Wife* and the admirably constructed Cambridge farcical comedy, whose authorship is still a problem, *Gammer Gurton's Needle*. In another group, represented by *Common Conditions*, *The Rare Triumphs of Love and Fortune* and *Sir Clyomon and Sir Clamides*, romantic subjects, sometimes combined with allegorical features, were boldly but unskillfully handled.

Influence of Seneca.—If English comedy intermingled traditional native elements with those borrowed from ancient and Renaissance Italy, English tragedy in its beginnings was predominantly indebted to one classical source, the rhetorical drama of imperial Rome. In the year of Elizabeth's accession a group of English university scholars began to put forth a series of translations of the ten tragedies of Seneca, which one of them, Thomas Newton, in 1581 collected into a single volume. To the direct influence of Seneca is to be ascribed the composition of the first Eng-

lish tragedy which we possess. *Gorboduc* or *Ferrex and Porrex*, by Thomas Norton and Thomas Sackville, was first acted on Jan. 18 1562, by the members of the Inner Temple before Queen Elizabeth. Though its subject is a British legend, and though the action is neither copied nor adapted from any treated by Seneca, yet the resemblance between this tragedy and the *Thebais* is too strong to be fortuitous. In all formal matters—chorus, messengers, etc.—*Gorboduc* adheres to the usage of classical tragedy, but the authors show no respect for the unities of time or place and they introduce before each act the nonclassical device of a dumb show. What gives the play its chief importance is the use, for the first time in English drama of blank verse. The model of *Gorboduc* was followed at Gray's Inn in 1566 when Gascoigne produced with the aid of two associates (F. Runwellmerish and Sir C. Yelverton) *Jocasta*, a virtual translation of L. Dolce's *Giocasta*, which was an adaptation of a Latin translation of the *Phoenissae* of Euripides. R. Edwards' *Damon and Pithias* (c. 1564–65) shades off from tragedy into what soon came to be called tragicomedy. More rudely constructed plays of the same class, also on classical themes, are J. Pickering's *Horestes* (1567), Richard Bowser's *Apus and Virginia* (1575) and T. Preston's *Camibses* (c. 1569). Two more notable examples have Italian sources. *Gismonde of Salerne*, drawn from Boccaccio, was acted before Queen Elizabeth at the Inner Temple in 1568, nearly a generation before it was published, rewritten in blank verse by R. Wilmot, one of the performers. G. Whetstone's *Promos and Cassandra*, founded on a tale by G. Cinthio (from which came the plot of *Measure for Measure*) followed in 1578.

In addition, the universities provided a field for neo-Senecan tragedy and tragicomedy, both in Latin and English. N. Grimald's *Christus Redivivus* and *Archpropheta* (on John the Baptist) were followed from 1581 onward by W. Gager's series of Latin plays at Christ Church, Oxford, of which *Ulysses Redivivus* is the most notable. At Cambridge T. Watson's *Abolom*, J. Christopherson's *Jephtha* (both in Greek and Latin) and T. Legge's *Richardus III* (1579) cast biblical or national history into classical moulds.

Chronicle Histories.—From the double danger which threatened English tragedy in the days of its infancy—that it would congeal on the wintry heights of classical themes, or dissolve its vigour in the glowing heat of a passion fiercer than that of the Italians—it was in part preserved by its association with the traditions of the national history. An exceptional position might seem to be in this respect occupied by T. Hughes's tragedy *The Misfortunes of Arthur* (1587). But the author of this play—in certain portions of whose framework there were associated with him seven other members of Gray's Inn, including Francis Bacon, and which was presented before Queen Elizabeth like *Gorboduc*—followed the example of the authors of *Gorboduc* in choice of theme, details of form and a general though free imitation of the manner of Seneca, with some borrowings from Lucan.

Fortunately at this time a new sphere of activity suggested itself in which English dramatists speedily came to feel at home. In their dramatization of portions of English history classical models would be of scant service, while Italian examples of the treatment of national historical subjects, having to deal with material so wholly different, could not be followed with advantage. Nor did Bishop Bale's experiment in *Kynge Johan* (c. 1548) of combining historical matter with personifications such as Sedition find imitators. The typical English chronicle history, which designedly assumed this name in order to make clear its origin and purpose, essayed nothing more or less than a dramatic version of an existing chronicle. Obviously, while the transition from half historical, half epical narrative often implied carrying over into the new form some of the features of the old, it was only when the subject matter had been remoulded and recast that a true dramatic action could result. But the histories to be found among the plays of Shakespeare and one or two other Elizabethans are true dramas, and it would be inconvenient to include these in the transitional species of those known as chronicle histories. Among these is *The Famous Victories of Henry the Fifth*, known to have been acted before 1588, in which both the verse and the prose are

frequently of a very rude sort but which has considerable vigour and freshness. Another is *The Troublesome Raigne of King John*, in two parts (1591), neither a didactic effort like Bale's, nor a living drama like Shakespeare's, but in its own way an effective treatment of its historical theme. The *True Chronicle History of King Lear* (first acted c. 1593-94) seems, with all its defects, only to await the touch of the master's hand to become a tragedy of supreme effectiveness.

Elizabethan Theatres and Companies—Out of such promises as these the glories of English drama were ripened by the warmth and light of the great Elizabethan age—of which the beginnings may fairly be reckoned from the third decade of the reign to which it owes its name. Against the attacks which a nascent Puritanism was already directing against the stage by the hands of J. Northbrooke, the repentant playwright S. Gosson, P. Stubbes and others were to be set the steady though frugal favour of royalty and the more liberal patronage of great nobles. This patronage was made a necessity by the act of 1572 by which all common players were declared rogues and vagabonds unless they were in the service of some lord. Hence the rapid development of companies bearing the name of a prominent nobleman, of which the two chief in the later years of Elizabeth were known as the lord chamberlain's (including Richard Buryage, William Kempe and Shakespeare) and the lord admiral's (of which Edward Alleyn was the leading figure).

These organized companies needed permanent playhouses, of which the first, the Theater, was built by J. Buryage in Shore-ditch in 1576, and was soon followed by the Curtain in Finsbury. These were the predecessors of the Rose and the Swan, the Globe and the Fortune, the first and the second Blackfriars theatres. How intimately the construction of Elizabethan plays is bound up with the "platform stage" of these theatres and with the absence of a drop curtain has been made increasingly clear by modern research. And the employment of boys in women's parts accounts for the numerous plots in which the heroine dons doublet and hose. Nor did the "little eyases" perform only in the professional companies. The children of the chapel and the children of Paul's (the choristers of the chapel royal and the cathedral) stood midway between the young professionals and the purely amateur school boys.

Shakespeare's Predecessors—It was for the children of the chapel and the children of Paul's that John Lyly wrote his plays. Some features of the euphuism, to which his famous romance gave its name, reappear in his mythological, quasi-historical, allegorical comedies. But his real service to the progress of English drama is to be sought neither in his choice of subjects nor in his imagery—though to his fondness for fairy lore and for the whole phantasmagoria of legend, classical as well as romantic, his contemporaries, and Shakespeare in particular, were indebted. It does not even lie in the songs interspersed in his plays, which did not appear till the publication of the edition of 1632 and are of doubtful authorship. It consists in his adoption of Gascoigne's innovation of writing plays in prose, and in his having, though with elements of an affected style, given the first examples of brisk and vivacious dialogue—an example to which even such successors as Shakespeare and Jonson were indebted. Thomas Kyd, the author of the *Spanish Tragedy*, had the born playwright's instinct for effective situations, often but not always of a lurid kind, and may have preceded Christopher Marlowe in the use of blank verse on the popular stage. He almost certainly wrote a lost play on *Hamlet*, while *Soliman and Perseda* and *Arden of Feversham* belong to his school if not to his pen. Marlowe's earliest play, *Tamburlaine the Great*, captured the theatrical public by its "high astounding terms" in which the hero's passion for infinite power found superb though at times too grandiloquent utterance. In *Doctor Faustus* the passion for infinite knowledge and in *The Jew of Malta* the passion for infinite wealth (both as sources of power) are the leading motives. In *Edward II* the colours are quieter but there is an advance in dramatic technique, and the closing scenes are marked by truly tragic pity and terror. Compared with *Edward II*, George Peele's *Chronicle of Edward I* still stands on the level of the species to which its title and character alike assign it. Peele's finest play is

David and Bethsabe, which resembles *Edward I* in construction but surpasses it in beauty of language and versification, besides treating its subject with superior dignity. We seem to come into something like a Shakespearean atmosphere in more than one passage of the plays of Robert Greene. His art, most conspicuous in plays treating English life and scenes, could at times free itself from the pedantry apt to beset the flight of Peele's and at times even of Marlowe's muse. His most delightful work, *Friar Bacon and Friar Bungay*, seems to breathe something of the air which blows over an English countryside. Thomas Lodge, Thomas Nashe, Henry Chettle and Anthony Munday, who wrote the original text of the composite play *Sir Thomas More* (of which Shakespeare has been credited with three leaves in the manuscript) and other works, are among the other more important writers of the early Elizabethan drama.

Although the chief of these poets are marked off from one another by the individual genius which impressed itself upon both the form and the matter of their works, yet the stamp of the age is upon them all. Writing for the stage only, of which some of them possessed a personal experience, they acquired an instinctive insight into the laws of dramatic cause and effect, and infused a warm vitality into the dramatic literature which they produced, so to speak, for immediate consumption. On the other hand, the same cause made rapidity of workmanship indispensable to a successful playwright. How a play was produced, how many hands had been at work upon it, what loans and what spoliations had been made in the process, were considerations of less moment than the question *whether* it was produced, and whether it succeeded.

This period of the English drama could not therefore yet be one of full consummation. In tragedy the advance which had been made in the choice of great themes, in knitting closer the connection between the theatre and the national history, in vindicating to passion its right to adequate expression, was already enormous. In comedy the advance had been less decisive and less independent, and something had been gained in reaching greater freedom of form and in something in enlarging the range of subjects, but artificiality had proved a snare in one direction, and the licence of the comic stage in another.

Shakespeare—These were the circumstances under which the greatest of dramatists began to devote his genius to the theatre. William Shakespeare's (q.v.) career as a writer of plays can have differed little in its beginnings from those of his contemporaries and rivals. Before or while he was proceeding from the retouching and rewriting of the plays of others to original dramatic composition, he was most gifted of his predecessors had died. Shakespeare was no doubt happy in his times, which intensified the strength of the national character, expended the activities of the national mind and were able to add their stimulus even to such a creative power as his. He was happy in the antecedents of the form of literature which commended itself to his choice, and in the opportunities which it offered in so many directions for an advance to heights yet undiscovered and unknown.

The great and irresistible demand on the part of Shakespeare's public was for *incident*—a demand which of itself necessitated a method of construction different from that of the Greek drama or of those modelled more or less closely upon it. Hence in part arose the circumstance that Shakespeare so constantly combined two actions in the course of a single play, not merely supplementing the one by means of the other as a byplot or underplot. And where he thus led many have followed. Should it, however, be sought to express in one word the greatest debt of the drama to Shakespeare, this word must be the same as that which expresses his supreme gift as a dramatist. It is in *characterisation*—in the drawing of characters ranging through almost every type of humanity which furnishes a fit subject for the tragic or the comic art—that he remains absolutely unapproached, and it was in this direction that he pointed the way which the English drama could not henceforth desert without becoming untrue to itself.

Pastoral and Masque—By the numerous body of poets who, contemporary with Shakespeare or in the next generation, cultivated the wide field of the national drama, every form commending itself to the tastes and sympathies of the national genius was

essayed. None was neglected except those from which the spirit of English literature had been estranged by the Reformation, and those which had from the first been artificial importations of the Renaissance. The mystery could not in England, as in Spain, produce such an aftergrowth as the *auto*, and the confines of the religious drama were only now and then tentatively touched. The direct imitations of classical examples were few and feeble. Samuel Daniel (1562-1619) may be regarded as a belated disciple of Seneca, while experiments like Sir W. Alexander's *Monarchicke Tragedies* (1603-05) are the isolated efforts of a student. At the opposite end of the scale, the light gaiety of the Italian and French farce could not establish itself on the English popular stage without more substantial adjuncts, the Englishman's festive digestion long continued robust, and he liked his amusements solid. In the pastoral drama and the masque, however, many English dramatists found opportunities for the exercise of their lyrical gifts and of their inventive powers. The former could never become other than an exotic, so long as it retained the artificial character of its origin. Shakespeare had accordingly only blended elements derived from it into the action of his romantic comedies. In more or less isolated works Ben Jonson, John Fletcher, Daniel, Thomas Randolph, and others sought to rival Torquato Tasso and Giovanni Guarini—Jonson in *The Sad Shepherd* coming nearest to nationalizing an essentially foreign growth by the fresh simplicity of his treatment, Fletcher in *The Faithful Shepherdess* by beauty of poetic execution, Daniel in *The Queen's Arcadia* by simpler beauties of style in both verse and prose.

The masque was a more elastic kind of composition, mixing in varying proportions its elements of declamation and dialogue, music and dancing, decoration and scenery. It was introduced, after the manner of Italy, at the court of Henry VIII in 1512. A frequent ornament of Queen Elizabeth's court festivities and progresses, it was cultivated with increased assiduity in the reign of James I, and in that of his successor rivalled, by the favour it enjoyed, the attractions of the regular drama itself. Most of the later Elizabethan dramatists contributed to this species, but by far the most successful writer of masques was Ben Jonson, of whose numerous compositions of this kind many hold a permanent place in English literature, and "next" to whom, in his own judgment, "only Fletcher and Chapman could write a masque." From a poetic point of view, however, they were at least rivalled by Daniel, William Browne and Thomas Carew, in productivity and favour. Thomas Campion for a time excelled. It was for the performance of a masque in a great nobleman's castle that Milton in 1634 wrote one of the lofliest and loveliest of English poems (*Comus*). In later times the masque merged into the opera, or continued a humble life of its own apart from contact with higher literary effort.

Later Elizabethan Drama.—The annals of English drama proper in the period reaching from the closing years of Elizabeth to the outbreak of the great Revolution include, together with names relatively insignificant, many illustrious in the history of English poetic literature. Among Shakespeare's contemporaries and successors Jonson alone by the energy of his genius, not less than by the circumstances of his literary career, reached undepicted primacy among his fellows. Yet his pre-eminence did not extend to both branches of the regular drama. In tragedy he fell short of the highest success, the weight of his learning lay too heavily upon his efforts, to draw from deeper sources than those which had sufficed for Shakespeare. Such as they are, his tragic works stand almost, though not quite, alone in his period as examples of sustained effort in historic tragedy proper. George Chapman treated stirring themes, especially from modern French history, with genuine effectiveness, but, though rich in beauties of detail, he failed in this branch of the drama to follow Shakespeare in the art of fully developing a character by means of the action. With the great body of the English dramatists of this and of the next period, tragedy had passed into a phase where its interest depended mainly upon plot and incident. The romantic tragedies and tragicomedies which crowd English literature at this time constitute together a growth of astonishing exuberance, and in mere externals of theme—ranging as these plays do from Byzantium to

ancient Britain, and from the Cæsars of ancient Rome to the tyrants of the Renaissance—of equally astonishing variety. The sources from which these subjects were derived had been perennially augmenting. Besides Italian, Spanish and French fiction, original or translated, besides British legend in its romance dress and English fiction in its humbler or in its more ambitious and artificial forms, the contemporary foreign drama, especially the Spanish, offered opportunities for resort. To the English as to the French and Italian drama of both this and the following century, the prolific dramatists clustering round Lope de Vega and Calderón and the native or naturalized fictions from which they drew their materials supplied a whole arsenal of plots—among others to Thomas Middleton, to John Webster and most signally to Francis Beaumont and John Fletcher. And, in addition to these resources, a new field of supply was at hand since English dramatists had begun to regard events and episodes of domestic life as fit subjects for tragic treatment. Domestic tragedy of this description was indeed no novelty on a stage which had produced *Arden of Feversham* and *A Yorkshire Tragedy*, but Thomas Heywood was the first playwright to be identified as having achieved works of distinctive originality in this class (*A Woman Killed with Kindness*, *The English Traveller*), to which some of the plays of Thomas Dekker, Middleton and others likewise more or less belong. Yet the number of motives employed—at least as a rule—in the tragic drama of this period was comparatively small and limited. Scheming ambition, conjugal jealousy, absolute female devotion, unbrield masculine passion—such are the motives which continually recur. But though the common features of the romantic tragedy are sufficiently marked they leave unobscured the distinctive features in its individual writers. In Webster, master as he is of macabre effects, and in John Ford, seductive in his sweetness, the monotony of exaggerated passion is broken by those marvellously sudden and subtle touches through which their tragic genius creates its most thrilling effects. Nor will the tendency to excess of passion which Beaumont and Fletcher exhibit be confounded with their distinctive power of sustaining tenderly pathetic characters and irresistibly moving situations in a degree unequalled by any of their contemporaries—a power seconded by a beauty of diction and softness of versification which for a time raised them to the highest pinnacle of popular esteem, and which entitles them in their conjunction, and Fletcher as an independent worker, to an enduring pre-eminence among their fellows. Distinctive, too, are the manliness of sentiment and occasionally greater width of outlook which ennoble the rhetorical genius of Philip Massinger, and the gift of poetic illustration which entitles James Shirley to be remembered not merely as the latest and the most fertile of this group of dramatists.

In comedy, on the other hand, the genius and the insight of Jonson pointed the way to a steady and legitimate advance. His theory of "humours" (which found the most palpable expression in two of his earliest plays), if translated into the ordinary language of dramatic art, signifies the paramount importance in the comic drama of the presentation of distinctive human types. In the actual reproduction of humanity in its infinite but never, in his hands, alien variety, it was impossible that Shakespeare should be excelled by Jonson, but in the consciousness with which he recognized and indicated the highest sphere of a comic dramatist's labours, he rendered to the drama a direct service which the greater master had left unperformed. By the rest of his contemporaries and his successors, some of whom, such as Richard Brome, were content avowedly to follow in his footsteps, Jonson was only occasionally rivalled in individual instances of comic creations, in the entirety of its achievements his genius as a comic dramatist remained unapproached in its own sphere. The favourite types of Jonsonian comedy, to which Dekker, John Marston and Chapman had added others of their own, were elaborated with incessant zeal by their contemporaries and successors. The inexhaustible verve of Middleton, the buoyant productivity of Fletcher, the observant humour of Nathan Field and the artistic versatility of Shirley mirrored in innumerable pictures of contemporary life the follies and foibles of mankind.

Later Academic Drama.—The academic drama of the later

Elizabethan period and of the first two Stuart reigns did not fall off either in activity or in variety from that of the preceding generations. At Oxford a long succession of English and Latin plays were performed, from the early years of the 17th century onward. The production of these plays was distributed among several colleges, among which the most conspicuously active were Christ Church and St. John's, where a series of performances took place in 1607-8 under the collective title of *The Christmas Prince*. Other notable Oxford plays are Daniel's pastoral drama *The Queen's Arcadia* (1605), Barten Holiday's *Technogamia* (1618), W. Strode's *Floating Island* and William Cartwright's *The Royal Slave* (1636), all of which formed part of royal entertainments. At Cambridge the list of plays performed in the latter half of Elizabeth's reign at Trinity, St. John's, Queens' and a few other colleges contains several of special interest. Among Latin comedies E. Forsetti's *Pedantus*, probably acted at Trinity in 1581, ridicules Gabriel Harvey, *Laelia*, acted at Queens' in 1590 and again in 1598, resembles *Twelfth Night* in part of its plot, while in *Silvanus*, performed in 1597 at St. John's, there are similarities to *As You Like It*. The most interesting of the English plays of the later Cambridge series are the *Parnassus Plays*, successively produced at St. John's in 1598-1602, which illustrated the unfortunate relations between university life and the outside world, including the world of letters and of the stage as represented by Shrike-speare's fellows Burbage and Kempe. Upon a different aspect of English university life—the relations between town and gown—a partisan light is thrown by *Club Law*, acted at Clare in 1599, and by G. Ruggle's Latin comedy of *Ignoramus*, twice acted by members of Clare at Trinity in 1615 before King James I. Other Cambridge English plays of note are T. Tomkys' allegorical *Lingua* (1607) and Phineas Fletcher's *Scofieldes* (1615), a "psittacary" (i.e., a pastoral drama in which the place of the shepherds is taken by fishermen). Latin and English plays continued to be brought out in Cambridge till the year of the outbreak of the Civil War, Peter Hausted, Thomas Randolph and Abraham Cowley being among the authors of some of the latest so produced.

The Drama and Puritanism—Up to the outbreak of the Civil War the drama in all its forms continued to enjoy the favour of the court, although a close supervision was exercised over attempts to make the stage the vehicle of political references. The official agent of this supervision was the master of the revels, but under James I a special ordinance, in harmony with the king's ideas concerning the dignity of the throne, was passed "against representing any modern Christian king in plays on the stage." But the sympathies of the dramatists were so entirely on the side of the court that the real difficulties against which the theatre had to contend came from an opposite quarter. With the growth of Puritanism the feeling of hostility to the stage increased in a large part of the population, well represented by the civic authorities of the capital. Puritans of the more pronounced type openly aimed at the permanent closing of the theatres. The war between them and the dramatists was accordingly a life and death kind. On the one hand, the drama heaped its bitterness and often coarsest attacks upon whatever savoured of the Puritan spirit, gibes, taunts, caricatures in ridicule of Puritans furnish part of the comic literature of the later Elizabethan and Stuart drama. On the other hand, the looseness of tone, the mockery of ties sanctioned by law and consecrated by religion, the tendency to treat middle class life as the hunting ground for the diversions of the upper classes, which infected so much of the dramatic literature of the age, intensified the Puritan opposition to all and any stage plays. This was most loudly voiced in William Fynde's *Historie-Mastus* (1632), which invoked its author in persecution but did not remain wholly without effect upon the tone of the dramatic literature of the subsequent period.

The quarrel between Puritanism and the theatre was, however, too old and too deep to end in any but one way, so soon as the latter was deprived of its protectors. The Civil War began in Aug. 1642, and early in the following month was published the ordinance of the lords and commons, which, after a brief and solemn preamble, commanded "that while these sad causes and

set times of humiliation do continue, public stage plays shall cease and be forborne." Though there is evidence that dramatic entertainments of one kind or another continued to be occasionally presented, stringent ordinances gave summary powers to magistrates against any players found engaged in such proceedings (1647), and bade them treat all stage players as rogues, and pull down all stage galleries, seats and boxes (1648). A few dramatic works were published in this period, while at fairs about the country were acted farces called "drolls," consisting of the most vulgar scenes to be found in popular plays. Thus the life of the drama was not absolutely extinguished.

Revival of the Drama—Already "in Oliver's time" private performances took place from time to time at noblemen's houses and (though not undisturbed) in the old haunt of the drama, the Red Bull. In 1656 the ingenuity of Sir William Davenant, whose name is memorable as connecting two distinct periods, ventured on a bolder step in the production of a quasi dramatic entertainment "of declamation and music", and in the following year he brought out with scenery and music a piece which was afterward acted in an enlarged form and printed as the first part of his opera *The Siege of Rhodes*. This entertainment he afterward removed from the private house where it had been produced to the Cockpit, where he soon ventured upon the performance of regular plays written by himself. Thus, under the cover of two sister arts, whose aid was in the sequel to prove by no means altogether beneficial to its progress, the English drama had boldly anticipated the Restoration, and was no longer hiding its head when that event took place. Soon after Charles II's entry into London, two theatrical companies are known to have been acting in the capital. For these companies patents were soon granted, under the names of "the Duke (of York's)" and "the King's Servants," to Davenant and Thomas Killigrew, respectively—the former from 1662 acting at Lincoln's Inn fields, then at Dorset garden in Salisbury court, the latter from 1663 at the Theatre Royal near Drury lane. These companies were united from 1668, a royal licence being granted in 1695 to a rival company which performed in Lincoln's Inn fields, and which migrated to Covent garden in 1733. Meanwhile, Vanbrugh had in 1705 built the theatre in the Haymarket, and a theatre in Goodman's fields—afterward rendered famous by the first appearance of David Garrick—led a fitful existence from 1729 to 1733. The act of 1737 deprived the crown of the power of licensing any more theatres, so that the history of the English stage for a long period was confined to a restricted area. The rule which prevailed after the Restoration, that neither of the rival companies should ever attempt a play produced by the other, operated beneficially both upon the activity of dramatic authorship and upon the progress of the art of acting. This art has rarely flourished more in England than in the days of Thomas Betterton and his contemporaries, including Charles Hart, Michael Mohun, Edward Kynaston, James Nokes or Nokes, Elizabeth Barry, Mrs. Betterton, Anne Bracegirdle and Eleanor Gwyn. It is to be noted also that during the greater part of the 18th century the Dublin stage rivalled the English in the brilliancy of its stars. Betterton's rival Robert Wilks, Garrick's predecessor in the homage he paid to Shakespeare, Charles Macklin and his competitor for favour, the "silver-tongued" Spranger Barry, were able products of the Irish stage, as were Peg Woffington and other well known actresses.

Restoration Drama Heroic Tragedy—Owing in part to the influence of the French theatre, which by this time had taken the place of the Spanish as the ruling drama of Europe, the separation between tragedy and comedy is clearly marked in post-Restoration plays. Lord Orrery, in *deference*, as he declares, to the expressed tastes of his sovereign King Charles II himself, was the first to set up the standard of heroic plays. This new species of tragedy (for such it professed to be) commended itself by its novel choice of themes, to a large extent supplied by recent French romances—the *romans de longue haleine* of the Scudérys and their contemporaries—and by French plays treating similar themes. It likewise borrowed from France that garb of rhyme which the English drama had so long abandoned, and which now reappeared in the heroic couplet. In conjunction

with his brother-in-law, Sir Robert Howard, and afterward more confidently by himself. John Dryden threw the vigour and brilliancy of his genius into the scale. At first, in his *Essay of Dramatic Poesy*, he claimed for English tragedy the right to combine its native inheritance of freedom with these valuable foreign acquisitions. Nor was he dismayed by the ridicule which the burlesque (by the duke of Buckingham and others) of *The Rehearsal* (1671) cast upon heroic plays, but returned, in his *Essay of Heroic Plays*, to the defense of a species which he himself was to abandon in the end. Among the other tragic poets of this period, Nathaniel Lee, in the outward form of his dramas, accommodated his practice to that of Dryden, like whom he allowed political partisanship to intrude upon the stage. His rhetorical genius was not devoid of genuine energy, nor is he to be regarded as a mere imitator of Thomas Otway, the most gifted tragic poet of the younger generation contemporary with Dryden, inherited something of the spirit of the Elizabethan drama, he had at his command tragic pathos and melting tenderness. Among dramatists who contributed to the vogue of the "heroic" play may be mentioned John Banks, J. Weston, C. Hopkins, E. Cooke, R. Gould, S. Pordage, T. Rymer and Elkanah Settle. The productivity of John Crowne (d. c. 1703) covers part of the earlier period as well as of the later, to which belong Thomas Southerne, a writer gifted with much pathetic power, but probably chiefly indebted for his long lived popularity to his skill in the discovery of "sensational" plots, and Lord Lansdowne ("Granville the polite") (c. 1667-1735). William Congreve, by virtue of a single tragedy (*The Mourning Bride*), and Nicholas Rowe may be further singled out from the list of the tragic dramatists of this period, many of whom were, like their comic contemporaries, mere translators or adapters from the French. The tragedies of Rowe indicate the transition from the fuller declamatory style of Dryden to the calmer and thinner manner of Joseph Addison. The excesses of the past period had produced an inevitable reaction, decorum was asserting its claims on the stage as in society, and French tragedy had set the example of sacrificing what passion—and what vigour—it retained in favour of qualities more acceptable to the "reformed" court of Louis XIV. Addison, in allowing his *Cato* to take its chance upon the stage, when a moment of political excitement (April 1713) ensured to it an extraordinary success, unconsciously sealed the doom of English national tragedy. The "first reasonable English tragedy," as Voltaire called it, had been produced, and the oscillations of the tragic drama of the Restoration were at an end.

Restoration Comedy—English comedy in this period displayed no similar desire to cut itself off from the native soil and it exhibits the influence of Jonson and Fletcher though it freely borrowed the materials for its plots and many of its figures from Spanish, and afterward more generally from French, originals. The higher efforts of French comedy of character, as well as the refinement of expression in the list of their models, notably in Molière, were alike seasoned to suit the grosser palates of English patrons. This is especially true of the comedies of Dryden, from *The Wild Gallant* (1663) to *The Spanish Friar* (1680). In no field did Dryden's versatile genius appear, on the whole, to less advantage, but in his presentation of pairs of witty lovers he anticipates one of the main features of the comedy of manners, which is the most typical product of the Restoration stage. As a modern historian of that stage (A. Nicoll) observed, "the invariable elements of the comedy of manners are the presence of at least one pair of witty lovers, the woman as emancipated as the man, their dialogue free and graceful, an air of refined cynicism over the whole production, the plot of less consequence than the wit, an absence of crude realism, a total lack of any emotion whatever." There is a further approach to the type in Sir Charles Sedley's *The Mulberry Garden* (1668) and it is definitely established in plays of Sir George Etherege. Other comic types are exemplified in Thomas Shadwell's Jonsomian plays, from the *Sullen Lovers* (1668) to *The Squire of Alsatia* (1688), in Sir S. Tuke's and Mrs. Aphra Behn's comedies of intrigue (1672-79), and in Thomas d'Urfey's partly farcical, partly sentimental plays (1676-96). But it was in the comedy of manners that the most powerful, and the most polished, dramatist of the age found each

his medium. William Wycherley drew his characters with vigour and distinctness, and constructed his plots and chose his language with natural ease. He lacks gaiety of spirit, and his wit is of a cynical turn. But, while he ruthlessly uncloaks the vices of his age, his own moral tone is affected by their influence in as marked a degree as that of the most light-hearted of his contemporaries. Congreve is not only one of the wittiest of English writers, but excels in the graceful ease of his dialogue, and draws his characters with the same masterly skill. His *Way of the World* has been truly called "the master creation of the school of manners." Mirabell and Millamant look back to Benedick and Beatrice and forward to Tanner and Ann Whitfield in George Bernard Shaw's *Man and Superman*. Sir J. Vanbrugh lacked Congreve's brilliance, but his lively wit and theatrical sense gave salt to his two best plays, *The Relapse* and *The Provok'd Wife*. G. Farquhar, whose mortality is on a par with that of the other members of this group, is inferior to them in brilliancy, but the pictures of manners, in a wider sphere of life than that which contemporary comedy usually chose to illustrate, give distinction to two of his plays (*The Recruiting Officer* and *The Beaux' Stratagem*), in which we seem to be entering the atmosphere of the 18th-century novel.

Sentimental Comedy—The improvement which now begins to manifest itself in the moral tone and spirit of English comedy is partly due to the reaction against the reaction of the Restoration, partly to the punishment which the excesses of the comic stage had brought upon it in the invective of Jeremy Collier (1698), best founded of all the assaults on the theatre in England and most productive of perceptible results. Writers like Susanna Centlivre became anxious to reclaim their offenders with much emphasis in the fifth act, and Colley Cibber may be credited with having first deliberately made the pathetic treatment of a moral sentiment the basis of the action of a comic drama. But he cannot be said to have consistently pursued the vein which in his *Careless Husband* (1704) he had essayed. His *Non-Juror* is a political adaptation of *Tartuffe*, and his *Provoked Husband* only supplied a happy ending to Vanbrugh's unfinished play. Sir Richard Steele, in accordance with his general tendencies as a writer, pursued a still more definite moral purpose in his comedies, but his genius lacked the sustained vigour necessary for a dramatist, and his humour naturally sought the aid of pathos. From partial he passed to more complete experiment, and thus these two writers, who transplanted to the comic stage a tendency toward the treatment of domestic themes noticeable in such writers of Restoration tragedy as Southerne and Rowe, set the fashion of sentimental comedy, a species which exercised a debilitating influence upon the progress of English drama. With *Cato* English tragedy committed suicide, though its pale ghost survived, with *The Conscious Lovers* English comedy sank for long into the tearful embraces of artificiality and weakness.

There is every reason to conclude that the art of acting progressed in the same direction of artificiality, and became stereotyped in forms corresponding to the "chant" which represented tragic declamation in a series of actors ending with James Quin and Charles Macklin.

It was reserved to the genius of Garrick, whose theatrical career extended from 1741 to 1776, to open a new era in his art. His unparalleled success was due in the first instance to his natural gifts, yet these were enhanced by a careful literary training, and confirmed by a purpose which prompted him to essay the noblest, as he was capable of performing the most various, range of English theatrical characters. By devoting himself as actor and manager with special zeal to the production of Shakespeare, Garrick permanently popularized on the national stage the greatest creations of English drama.

Eighteenth Century Tragedy—The contrast between the tragedy of the 18th century and those plays of Shakespeare and other Elizabethans which in the period before Garrick were known to the English stage was weakened by the mutilated form in which the old masterpieces generally, if not always, made their appearance there. Even so, however, there are perhaps few instances in theatrical history of so unequal a competition being

so long sustained. In the hands of the tragic poets of the age of Pope, as well as that of Johnson, tragedy had hopelessly stiffened into the forms of its accepted French models. Direct reproductions of these continued, as in Ambrose Philips' and Charles Johnson's (1679-1748) translations from Racine, and Aaron Hill's from Voltaire. Among other tragic dramatists of the earlier part of the century may be mentioned John Hughes, who, after assisting Addison in his *Cato*, produced at least one praiseworthy tragedy of his own (*The Siege of Damascus*), Elijah Fenton, a joint translator of "Pope's Homer," and the author of one extremely successful drama on a theme of enduring interest (*Marianna*), and Lewis Theobald the first hero of the *Dunciad*. A more distinguished name is that of James Thomson, whose unlucky *Sophonisba* and subsequent tragedies are, however, barely remembered by the side of his poems. The literary genius of Edward Young, on the other hand, possessed vigour and variety enough to distinguish his tragedies from the ordinary level of Augustan plays, in one of them (*The Revenge*) he seems to challenge comparison in the treatment of his theme with *Othello*, but by his main characteristics as a dramatist he belongs to the school of his contemporaries. The endeavours of George Lillo, in his *London Merchant*, or *George Barnwell* (1731), to bring the lessons of terror and pity directly home to his fellow citizens exercised an astonishingly widespread as well as enduring effect on the history of the 18th century drama. At home, they gave birth to the new, or, more properly speaking, the revived, species of domestic tragedy. Abroad, this play supplied the text to the teachings of Diderot, as well as an example to his own dramatic attempts, and through Diderot the impulse communicated itself to Goethe and Lessing, and long exercised a great effect upon the literature of the German stage. "Classical" tragedy in the generation of Johnson pursued the even tenor of its way, the dictator himself treading with solemn footfall in the accustomed path and W. Mison imitating the futile attempt to produce a close imitation of Greek models. The best-remembered tragedy of the century, John Home's *Douglas* (1757), was the production of an author whose famous kinsman, David Hume (though no friend of the contemporary English stage), had advised him "to read Shakespeare, but to get Racine and Voltaire by heart."

English Opera—While thus no high creative talent arose to revive the poetic genius of English tragedy, comedy, which had to contend against the same rivals, naturally met the demands of the conflict with greater buoyancy. In one form the English opera was preserved as a pleasing species of the popular drama. The pastoral drama had (in 1725) produced an isolated aftergrowth in Allan Ramsay's *Gentle Shepherd*, which, with genuine freshness and humour but without a trace of burlesque, transferred to the scenery of the Pentland hills the tale of Florizel and Perdita. The dramatic form of this poem is only an accident, but it doubtless suggested an experiment of a different kind to the most playful of London wits. John Gay's "Newgate pastoral" of *The Beggar's Opera* (1728), in which the text of a burlesque farce was interspersed with songs set to popular airs, caught the fancy of the town and became the ancestor of a series of productions, none of which, however, not even its own continuation, *Polly*, have ever rivalled it in success or celebrity. Among these may be mentioned the pieces of H. Carey, T. Holcroft, C. Coffey, I. Bickerstaffe and C. and J. T. Dibdin. The opera in England thus absorbed what vitality remained to the pastoral drama, while to the ballet and the pantomime (whose glories in England began at Covent garden in 1733, and to whose popularity even Garrick was obliged to defer) was left the inheritance of the external attractions of the masque and the pageant.

Later 18th-Century Comedy—In the face of such various rivals it is not strange that comedy, instead of adhering to the narrow path which Steele and others had marked out for her, should have permitted herself some vagaries of her own. Gay's example pointed the way to a fatally facile form of the comic art, and burlesque began to contribute its influence to the decline of comedy. In an age when party government was severely straining the capabilities of its system, dramatic satire had not far to look for a source of effective seasonings. The

audacity of H. Fielding, whose regular comedies have secured no enduring place on the stage, accordingly ventured in two extravaganzas (*Pasquin* and *The Historical Register* for 1736) upon a larger admixture of political with literary and other satire. A third attempt (*The Golden Rump*), which never reached the stage, furnished the offended minister, Sir Robert Walpole, with the desired occasion for placing a curb upon the licence of the theatre, such as had already been advocated by a representative of its old civic adversaries. The act of 1737 asserted no new principle, but converted into legal power the customary authority hitherto exercised by the lord chamberlain (to whom it had descended from the master of the revels).

Farce had now become a genuine English species, and has as such retained its vitality through all the subsequent fortunes of the stage, it was actively cultivated by Garrick as both actor and author, and he undoubtedly had more than a hand in the best farce of this age, which is ascribed to clerical authorship (*High Life below Stairs*, 1759). S. Foote, whose comedies and farces are distinguished both by wit and by variety of characters, introduced into comic acting the abuse of personal mimicry. Meanwhile, the domestic drama of the sentimental kind achieved, though not immediately, a success only inferior to that of *The London Merchant*, in *The Gamester* of E. Moore, to which Garrick seems to have contributed, and sentimental comedy gained sympathetic applause in the works of R. Cumberland, F. Reynolds and H. Kelly. It cannot be said that this species was extinguished, as it is sometimes assumed to have been, by Goldsmith, but he certainly published a direct protest against it between the production of his admirable character comedy *The Good-Natured Man*, and his delightfully brisk and fresh *She Stoops to Conquer*. The most successful efforts of the elder G. Colman had in them something of the spirit of genuine comedy, besides a finish which is one of the qualities which ensure a long life to a play. And in the masterpieces of Richard Brinsley Sheridan some of the happiest features of the comedy of Congreve were revived, together with its too uniform brilliancy of dialogue, but without its indecency of tone. The varnish of the age is indeed upon the style, and the hollowness of its morality in much of the sentiment (even where that sentiment is meant for the audience) of *The Rivals* and *The School for Scandal*, but in tact of construction, in finish of character drawing and in pungency of social satire they are to be ranked among the glories of English comedy. Their continued popularity has in fact unduly overshadowed the merits of other later 18th century plays. T. Morton's *Speed the Plough* (where we first hear of "Mrs Grundy"), A. Murphy's *The Way to Keep Him* and *The School for Guardians*, and the humanitarian drama of T. Holcroft (*The Road to Ruin* and *The Deserted Daughter*) and Elizabeth Inchbald (*Every One Has His Faults* and *Wives as They Were and Maids as They Are*) all have distinctive qualities. Notable too are Hannah Cowley ("Anna Matilda") and G. Colman the younger, both writers of popular comedies, as well as the prolific J. O'Keefe (1746-1833), who contributed to nearly every species of the comic drama.

19th Century Drama—With the beginning of the 19th century came a decline of dramatic composition of the higher class. Joanna Baillie's well meant but anaemic attempts to rejuvenate poetic tragedy and comedy in her plays on the passions were based on a misleading theory. In any case the times were out of joint for such an endeavour. The poems, with which Scott and Byron, and the novels, with which Scott both satisfied and stimulated the imaginative demands of the public, diverted the attention of the cultivated classes from dramatic literature, which was unable to escape, with the light foot of verse or prose fiction, into "the new, the romantic land." Scott, who in his earlier days had translated Goethe's *Götz von Berlichingen*, gained no reputation by his own dramatic compositions. W. S. Landon, apart from those *Imaginary Conversations* upon which he best loved to expend his powers of observation and characterization, cast in a formally dramatic mould studies of character of which the value is far from being confined to their wealth in beauties of detail. Of these the magnificent, but in construction altogether undramatic, *Count Julian* is the most noteworthy. Shelley's

The Cenci, on the other hand, is not only a poem of great beauty, but a drama of true power, abnormal in theme but singularly pure and delicate in treatment. A humbler niche in the temple of dramatic literature belongs to some of the plays of C R Maturin, Sir T N Talfourd and Dean Milman.

Never was the divorce between the theatre and literature so complete and prolonged as during the major part of the 19th century. Fertilizing ideas, distinction of style, whether in poetry or prose, and originality in technique were all wanting. Among the professional playwrights only a few have a claim to remembrance. Sheridan Knowles composed his conventional senescent of genuine tragedy and comedy (*Virginius* and *The Hunchback*) with a thorough knowledge of stage effect. The first Lord Lytton, though his plays were for the most part of a lighter texture, showed even more artificiality of sentiment in their conception and execution, but the romantic touch which he imparted to the *Lady of Lyons* accounts for its long-lived popularity. T W Robertson in *Society* (1866) followed by *School and Castle* brought back a refreshing breath of naturalness into comic drama, Tom Taylor made little pretense to original invention, but adapted with an instinct that rarely failed him.

In the last decades of the Victorian age, the revival of public interest in the theatre co-operated with a gradual change in poetic taste to awaken the hope of a future living reunion. Among English poets who lived in this period, Sir Henry Taylor and R H Horne caught something of the Elizabethan accent and spirit. Of the chief poets of the age, Tennyson in his later years attempted, with partial success, a form of composition not fully suited to his genius (though his *Becket*, as interpreted by Irving, was a memorable stage ecclesiastic). Memorable also are the plays of Robert Browning (especially *Stratford*), some of whose distinctive gifts are displayed in his dramatic work, and the sustained endeavours of A C Swinburne, after adding *Atlantis* in *Calydon* to the wreath which the lovers of the Attic muse have laid at her feet, to enrich the national historic drama by a trilogy on the fortunes of Mary queen of Scots.

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The Theatre of Charles Kean and Samuel Phelps—During the greater part of the 19th century the English drama was more fitly to be considered as a part of the general industry of entertainment than as a serious contribution to the world's art of the theatre. When Matthew Arnold protested in 1879 that there was no English theatre he did not, of course, mean that there were no stages, no actors and no audiences, but that England was not taking a considerable or a worthy part in the development of a dramatic form of expression which had other ambitions than mere showmanship and the establishment of box office standards of success. The English drama did, in fact, conform to its position in the industry of catering for the popular leisure by expanding with expanding commerce. It even followed the economic trend so closely that it acquired free trade at the time when free trade was becoming a dominant social issue. The lingering and rather futile efforts to protect the economic interests of the two historic patent theatres of London, Drury lane and Covent garden, by giving them a monopoly of the legitimate drama were abandoned in 1843, when an act of parliament granted a comprehensive freedom to the stage. Drama was thus liberated like any article of commerce and, as the population was growing rapidly in numbers and in wealth, there was a swift expansion of dramatic output. But what was offered to the new public must, unfortunately, be considered in terms of quantity rather than of quality. Commercial standards became more frankly accepted and the ideal of the "long run" supplanted the old conceptions of a classical repertory in which it was the function of the leading players to appear continually and to display their various powers and graces in a great variety of traditional and testing parts. The old policy, however, of a classical routine, was maintained by Charles Kean who became lessee of the Princess's in 1850 and by Samuel Phelps at Sadler's Wells. Kean, on the one hand, was endeavouring to sustain the best kind of dramatic appeal by throwing in costly embellishments which a later taste would have considered unnecessary or even absurd. Phelps, on the other, did splendid work, not only for the public that still wanted Shakespeare, but for the Shakespearean text itself, by going back to the folio for his matter instead of using the adaptations and "versions" which had been started during the Restoration with the authority of Dryden and had continued to grow in numbers and stupidity throughout the 18th century. Even John Philip Kemble, who had been considered something of a puist in these matters, played a musical version of *The Tempest* which contains lyrics in the style of an 18th century ballad opera. Against such barbarism, long taken for granted even by cultured people, Phelps made a strong and splendid stand at Sadler's Wells and during his management there, which lasted from 1844 till 1862, he maintained a dignified level of dramatic art while the national theatre as a whole was concerned only with rhetoric and sensation and with reaping the financial benefits of its new freedom.

After the act of 1843 there was a rapid growth of theatres proper or lord chamberlain's houses, they could multiply according to popular demand while the old saloon theatres, which had

been outside the patent and had dealt mainly in imported romantic dramas and light operas, found that the new rivalry necessitated new measures. The saloon theatres accordingly relied more and more upon song and dance and became the parents of the music hall, while the orthodox houses were occupied by all that early Victorian England could offer in the shape of drama. It was not very much. Right on up to the '80s the Victorian theatre was dominated by the French tradition in farce and melodrama, with the result that many English writers, who might have been the "abstracts and brief chronicles" of their time, or who might at least have given to the actors opportunities for fulfilling the high function ascribed by Hamlet to the players, remained mere hacks engaged in adapting imported material.

T W Robertson's Comedies—A distinct change was made by T W Robertson (1829-71), whose comedies seem to the present-day reader to be painfully stilted and artificial. Robertson, none the less, was the supposed rebel and realist of his times, he believed that he was bringing the drama back to life from the pretty Alsatias and the notorious nonsense works to which it had been driven. He became dramatist to the Bancroft management at the Prince of Wales's theatre where a new school of realistic staging and acting was begun in self-conscious revolt against the tawdry romanticism, the pomposities of rhetoric and spectacle and the wild fustian of the general drama of the time. Robertson's most important contribution to the theatre of that period was his refusal to accept the battered types which passed for figures of fun. To playwrights 50 years later *Society* (1865) and *Caste* (1867) seemed almost laughably artificial, but they were considered by contemporary critics to be daring essays in naturalism and actuality. Before Robertson's time the writing and the acting of character parts were limited by certain acknowledged formulas. There was a routine of the ridiculous in the theatre, as there was afterward in the music halls where noses had to be red by regulation and umbrellas broken as it were by schedule. Squire and Effie Bancroft, working on Robertson's pieces, abolished these traditional restrictions upon truth and tried to substitute fresh individual characters for the stale humours of the type. The whole policy was to let the breeze of actuality into the hot, stale atmosphere of the playhouse, and in this invigorating change they had important allies in two actors of consequence, E A. Sothern and John Hare. The latter wrote of Robertson that "As nature was the basis of his work, so he sought to make actors understand that it should be of theirs. He thus founded a school of natural acting which completely revolutionized the then existing method and, by so doing, did incalculable good to the stage." Unfortunately Robertson lacked successors. James Albery was credited with imagination and wit but he found the way of the adapter easier than that of the creator, and H J Byron altogether fell away from the standards which Robertson had endeavoured to institute. Adaptations went briskly on and it was significant that when Beerbohm Tree went into management at the Haymarket in 1887 he relied mainly upon plays of foreign origin. Until the '80s were well advanced the practice of adaptation from the French (and sometimes, as in the case of the ever-popular farce *The Private Secretary*, from the German) was held to be the legitimate as well as the customary occupation of a British playwright. To create original or character was a rarity. Among those who occasionally created and more often adapted were W S Gilbert and Tom Taylor.

The New Theatre—But, while the mid-Victorian years were largely sterile in authorship, important changes were being made in the organization and social status of the English theatre. In early Victorian times the actor was usually expected to be a Bohemian and might even be an outcast. The playhouse itself might be rough and ready and the society to be met there little better. The Bancrofts were responsible not only for freshening the quality of stage writing and production, but for reintroducing the theatre to the attention of the prosperous middle class and of those who might previously have hesitated before being seen in such a place. The Bancrofts may not have found their public and cultivated society of playgoers which Meredith postulated as essential to the production of comedy, but they rendered admirable

service to the drama by restoring it to its place among the exercises and adornments of a civilized community.

Another of their achievements was the reorganization of theatrical life throughout the country. Provincial production had hitherto been left to stock companies or to travelling troupes working on local circuits. The national development of communications made travel far easier than it had been and it was possible to carry proper scenery from place to place instead of relying upon the accident of local provision. In 1867 Bancroft organized for tour an exact reproduction of the London presentation of *Caste* and the quality of the performance appears to have been greatly appreciated in the towns which were visited. Buckstone's company from the Haymarket followed suit and it soon became common for actor managers to go on tour and so bring to the various towns a smoothness and a virtuosity of performance to which the local audiences were quite unused. By the end of the 19th century all the great London actors and important foreign visitors, like Sarah Bernhardt, habitually took their companies on tour and the centralization of theatrical activity in the capital was considerably diminished.

The Stage Divorced from National Culture.—It is plain from what has been said of the early and mid-Victorian stage that the play was not the thing. The playgoer's motive was rarely literary nor did he regard it as the function of the dramatic art to hold the mirror up either to human nature, to current manners or to problems of the hour or of eternity. The period was one of intensely dramatic changes in the national life. The whole economic structure of society was altering, science was coming forward to challenge dogma, the strife of classes and of generations was taking shape in conflicts whose natural artistic expression should surely have been dramatic. But to the student who wishes to map out the social landscape of the time the stage offers extremely little evidence. In no sense were the actors the abstracts of their time. Both the pride in the new progress and the protests against it were made vocal in the novel and in poetry. Unfortunately the English stage was so far divorced from the national culture that it totally failed to interpret in terms of drama the immensely important and immensely exciting developments in the knowledge, wealth and power of mankind. If ever history was throwing material to the playwright it was then, but the playwright was too busy with importing French trivialities or concocting the farces of the routine to pay any attention to his superb opportunities of doing for the theatre what Dickens and Thackeray were doing for the novel. It was only after Ibsen had revolutionized the European theatre by making his drama into a vivid criticism of actual social values that English writers who had a similar artistic purpose came to use the dramatic medium.

An Actor's Theatre.—But in the absence of a great school of playwrights there was both demand and supply of great acting. There are always three parties to the act of the theatre. There is the man who writes, the man who acts and the man who makes the spectacle. That is a simple analysis which is capable of much refinement in one way or expansion in another. The history of the theatre shows that those three parties are continually engaged in rivalry as well as in co-operation. A struggle for the balance of power is ever in progress. Accordingly, whereas one epoch or generation is particularly distinguished for the quality of its plays and of the author, whom it attracts to theatrical service, another is the golden age of the great actor who is admired for himself alone and not in relation to the splendour or the subtlety of that in which he acts, while at another time the emphasis centres on display of scene or on the mass effects controlled by the producer and the present master. The theatre of England in the 19th century (or at least until the renaissance of English dramatic composition in the '80s) was predominantly an actor's theatre. Pageantry there might be, personality there had to be. The playgoer thought in terms of the actor and his individual magnetism.

The Reign of Henry Irving.—The sovereignty of Henry Irving in the theatre of the time can best be understood if we remember to what extent that theatre was under the actor's

domination Irving carried on the social service of the Bancrofts in bringing honour to his art and rescuing his profession from squalor and from disrepute. Yet of this most eminent Victorian, whose name is almost synonymous with the national theatre of his time, an otherwise sympathetic critic could remark, "His managerial career had scarcely any significance for the living English drama. He seldom experimented with a new play, and of the few which he did produce, only *The Cup* and *Becket* by Lord Tennyson have the remotest chance of being remembered." And even these were soon forgotten. But the man was not. To see *The Bells*, an adaptation from the French of Erckmann-Chatrian, without Irving was to see an ordinary melodrama which might in later years have formed part of a Grand Guignol program. But Irving's emotional powers enabled him to turn "tushery" into tragedy, he could strike terror, though he some times failed to raise compassion, with the result that his melodramatic villains were more successful than his tragic heroes. His reign at the Lyceum (1878-99), in which for so long he had Ellen Terry as his colleague in command, was a sustained and, on the whole, successful demonstration of the benefits that may be in an actor's dominion over the dramatic art. His Richard III, Iago and Shylock were commonly accepted as brilliant and he could raise a melodrama like *The Lyons Mail* from its natural level of efficient artifice to the higher category of the tragedian's art. There will always be different delights of the theatre and it is a fair distinction which separates the drab talents from the flamboyant. By drab one seeks, without slight, to denote the quiet pleasures of logic, the whisper of realism and the pounce of that art which is, on the surface, no more than a hint. The Victorian theatre was the home of the rhetoricians and the flamboyants, and Irving, who went into battle nightly with all his drums beating, was at once the sovereign and the symbol of his time.

Melodrama.—This cult of flamboyance had naturally its various levels. One aspect was the popularity of translations of V. Sardou, a French playwright who exploited situation with exceptional cunning. His play *Dora*, first produced in English as *Diplomacy* at the Prince of Wales's in 1878 and later frequently revived in London and elsewhere, is a perfect example of the well-made play built to frame highly coloured acting. Lower down the scale there was a steady flow of melodrama, and Henry Arthur Jones, afterward to be a considerable master of the comedy of manners, won an early success with *The Silver King*, which was produced at the Princess's in 1882 and showed a technical adroitness later to be expended on less crude material. In this genre Wilson Barrett was a great performer, George R. Sims a competent and fluent librettist and the Adelphi theatre a constant home of flamboyant spectacle and unabashed sensationalism. At Drury Lane the famous Christmas pantomimes with their vast display and costly transformation scenes were followed by equally resplendent dramas and the management of Sir Augustus Harris (1879-96) provided many popular triumphs in this type of work. Arthur Collins, who later carried on and developed the tradition of Drury Lane, was no less successful. Melodrama in its crudest form had great difficulty in surviving the competition of the films, but it stayed on obstinately at the Elephant and Castle theatre in south London and there was a large middle class audience which made pilgrimages to see and to titter at such flamboyant folk plays as *Maria Marten* and *Sweeney Todd*.

The mid-Victorian musical stage was in subjection to the Offenbach tradition. That might have meant delightful entertainments, but the adaptations were badly made and now seem pitifully inane. Another form of entertainment was the burlesque which was initiated by J. R. Planché and well developed by the founder's hand, but it was grossly abused by less competent people and the fact that the lamp might shine brightly at the Gaiety did not guarantee a parallel radiance elsewhere. The great mid-Victorian contribution to light opera and the musical theatre in general was the partnership of W. S. Gilbert with Arthur Sullivan. The brief extravaganza *Iolanthe* (1882) was followed by a long series of operettas, gentle satirical and exquisitely melodious, of which *Patience*, a brilliant lampoon of the aesthetic movement, was perhaps the cleverest, and *The Mikado* and

The Yeomen of the Guard remained the most popular. Though the two great co-operators were frequently at odds with one another they did their best work in association and the Richard D'Oyly Carte management at the Savoy theatre from 1891 onward enjoyed a constant, a wide and a discriminating support. Meanwhile burlesques fell out of favour and were displaced by "musical comedy" of which the first example was *In Town*, produced in 1892. It, in turn, found a new rival in "revue," a form of song and dance show interspersed with skits and sketches.

H. A. Jones and A. W. Pinero.—The orientation of theatrical effort toward great feats of acting and displays of personal magnetism continued until the end of the century. The visits to England of Eleonora Duse and Sarah Bernhardt and the emergence of an English actress of great power and individuality in Mrs. Patrick Campbell created an intense and stimulating rivalry and a triangular tournament of talent. In June 1895 Bernard Shaw, then critic of the *Saturday Review*, wrote, "We critics can at last outdo Hazlitt and Leigh Hunt if we have a mind to, for we have just had two Mrs. Ebbsmiths to compare, beside a fourth Fedora, and Duse and Bernhardt playing *La Dame aux Camélias* and Sudermann's *Hemst* against one another at Daly's theatre and at Drury Lane." At the same time, however, the author was recovering his position in the English theatre and a distinct renaissance of the playwright's art began to be noticeable in the '80s. Henry Arthur Jones graduated from emotional drama to write urbane comedy such as *The Lure* (1897), or deft plays of situation such as *Mrs. Dane's Defence* (1900), while A. W. Pinero, beginning (1885-87) as a farceur with three very promising pieces, *The Magistrate*, *The Schoolmistress* and *Dandy Dick*, passed on by way of sentimental comedy (*Sweet Lavender*) to become a master of drawing room drama and England's most important manipulator of the fashionable problem piece. After composing some pieces of improving quality he wrote *The Second Mrs. Tanqueray*, which was produced at the St. James's theatre in 1893 and caused an immediate sensation. Undoubtedly the power and the expertness of this drama presented Pinero with a reputation which was European as well as English. Mrs. Tanqueray's story was followed by a rapid succession of pieces which kept the dramatist in perpetual discussion and made attendance at his work an essential pleasure for the educated members of London society. *Trelawny of the Wells* was one of his most popular comedies, while *The Gay Lord Quex*, *Iris*, *Letty* and *His House in Order* revealed the many facets of his industry and his technical competence. Meanwhile the successes of Pinero and Jones were calling the notice of managers and actor-managers to the possibilities of using the fresh work of English authors instead of relying, as of old, upon a flow of adaptations. Hence it was that Sydney Grundy, R. C. Carton, Haddon Chambers and others found their opportunities and took them. The partnership of Jones's writing with Charles Wyndham's acting was a notable feature of the '90s. Carton turned out a very capable sequence of light comedies in which his wife, who acted as Miss Compton, was a constant and all conquering performer. *Lady Huntworth's Experiment* and *Mr. Hopkinson* were typical of his light invention.

A new generation of playwrights began to appear. The theatre had recovered its esteem and men of letters need no longer hesitate to contribute to it lest their work should be touched by vulgarity of performance or despised because of the house in which it was lodged. Oscar Wilde, for instance, turned to the theatre in 1892 and brought to the art of comedy his extraordinary brilliance in artificial dialogue. His mastery of epigram and paradox may seem a brittle talent, but it carried distinction of style into a region from which style had long been absent. Between 1892 and 1895 Wilde wrote *Lady Windermere's Fan*, *A Woman of No Importance*, *An Ideal Husband* and, most durable of all, *The Importance of Being Earnest*. Between 1902 and 1908 J. M. Barrie, a journalist turned novelist and then dramatist, gave to the stage *Quality Street*, *The Admirable Crichton*, *Little Mary*, *Peter Pan*, *Allice Sit by the Fire* and *What Every Woman Knows*. Among other names that must be mentioned as valuable servants of the stage at that period are those of H. V. Esmond, Albert Sutro and Hubert Henry Davies.

Ibsen's Influence.—At this point it is necessary to turn back and to trace as briefly as possible the external forces which were helping to recreate the English drama after the long inertia of the 19th century. Henrik Ibsen's influence had begun to penetrate Europe in 1875 and for the next 20 years his steady output of plays, in which the driving actuality of a realistic method was applied to a social criticism and a radical philosophy of personal independence, made him a pre-eminent figure in any centre where the stage was considered as something more than a pastime and a plaything. When the rebellious wife, Nora, banged the door of *A Doll's House* (1880), the echo of that violence was heard across the continent, and the bitter criticisms of respectability which followed in *Ghosts* started a battle of the critics and a storm of discussion wherever that play was produced.

As Ibsenism gathered force there were sporadic but simultaneous movements in the great capitals with the common goal of a new theatrical art freed from the old bondage of routine entertainment, from the rhetoric and the rant of the old acting, and from the foppiness of the old method of presentation. The new drama was to be expressive of the social needs and purposes of the time. André Antoine, a gas works clerk who began his theatrical experiments in a garret to which he pushed his properties in a handcart, founded the Théâtre Libre in Paris in 1887 and transferred to the stage the naturalism which had replaced romanticism in the French fiction of his time. He strove to develop a drama which should mirror the pains, pleasures and problems of the day and a style of acting which should be quietly harmonized with the new method of writing. The revolt spread rapidly and "free theatres" were founded in the various capitals and, in turn, gave rise to other small, independent playhouses with such titles as the Modern theatre or the Art theatre. The famous Moscow Art theatre was founded in 1895 as a practical protest against the fustian of alien origin and the eternal traffic in stale French trifles which obstructed all progress on the Russian stage. The idea of the founders, V. Nemirovitch-Danchenko and Stanislavsky, was to elicit in terms of what they called "spiritual realism" a native Russian drama which should be representative of the younger generation, of its criticism of life and of its aspirations and its resolves. "In our destructive and revolutionary aims," wrote Stanislavsky, "in order to rejuvenate the art we declared war on all the conventionalities of the theatre wherever they might occur—in the acting, the properties, the scenery, or the interpretation of the play." As a result the author Anton Chekhov, who had been on the verge of a suicidal despair, was able to do his work in sympathetic company and comparative cheerfulness and so to achieve his loveliest self-expression before he died. The new theatres, in short, were fostering new dramatists who, in turn, were fostering a new modesty and veracity in the players for whom they provided truthful and subtle dialogue and situations sincerely contrived instead of the familiar clichés of theatrical word and melodramatic deed.

The Arrival of Bernard Shaw.—The English parallel of the various free theatres was called the Independent by its founder J. T. Grein and was opened in 1891 with a performance of *Ghosts*. To begin with its directors were naturally attracted by translations of the new and important foreign work. The Independent gave Ibsen and Zola. But in the winter of 1892 it found its mission in *Man and Superman* by George Bernard Shaw who produced and met with no particular enthusiasm. But a new master had broken into the theatrical world and one who was admired by many to be the greatest English dramatist since Shakespeare began to compose regularly on the stage. The theatre would no longer be the industry of entertainment, now being begun by rejecting his invasion as it had resisted the arrival of Ibsen and the Ibsenites. But the art of the drama was not to be kept free or in complete subjection to the commercial machine. The new drama had to live from hand to mouth by subscription performances on Sunday nights by special matinees and by the efforts of amateurs. But it lived audaciously and obstinately and established its independence. The Stage society was founded in 1900 to produce on Sunday evenings the plays of merit and of experiment which could not find a home inside the ordinary playhouse, and there were many subsequent organizations of a similar type and

a similar object. The Stage society discovered H. G. Granville Barker as author and producer and it was the Vedrenne-Barker partnership at the Court theatre (1904-07) which won for the first time a considerable English public and a wide recognition for Bernard Shaw. The Court became a practical academy for young actors in search of experience and an outlet for the new author who were using the method of Ibsen to record their affirmations about every aspect of life. The chief Shaw successes at the Court were *You Never Can Tell*, *Man and Superman*, in which Granville Barker gave a particularly brilliant performance of the chief part *John Bull's Other Island*, *Major Barbara* and *The Doctor Dilemma*. Another outstanding production was that of *The Silver Box*, which introduced John Galsworthy to the playing public and Gilbert Murray's translations of Euripides were also among the novel features of the Court program. St. John Hank (1869-1909) was a new dramatist to whom the commercial theatre was not usually hospitable. The Court season gave him new opportunities, while Granville-Barker's own play *The Voyage I Inheritance* was staged under the inspiring direction of the author.

The "Literary" Drama.—From this it may be seen that remarkable and valuable change had come to the English theatre. The sovereignty of the actor and the actor manager did not pass away because a few challenging trumpets had been blown outside the walls of the commercial theatre. Sir Herbert Beerboom Tree continued at His Majesty's theatre to blend poets with pageantry and both with personality. Stephen Phillips, poet whose reputation stood astonishingly high in his time but was doomed to an almost complete eclipse after his death, composed *Ulysses* (1902) and *Nero* (1906) for Tree, who also employed Comyns Carr and Louis N. Parker as dramatists; perhaps it would be fair to say as librettists for his grand opera in stagecraft and mass production. Tree's Shakespearean ventures were launched upon a full spread of scenic canvases and he himself was an actor of resource with a rich technique for the elaborate character parts. But outside and beyond the splendours of His Majesty's, with its tonnage and poundage of panoramic effects, its occasional droves of livestock and its constant largesse of the incidentals and accessories of drama, the new English voice was making itself heard. It was often quiet and argumentative in distinction to the rhetoric and the colour of conventional work but it became attractive to the young men and women who were in the theatre a mode of expression which would never have been contemplated by their fathers. There had, of course, been Victorian "literary" drama. All Tennyson's verse plays were acted (*Harold*, long neglected, was given in London in 1928 while Swinburne's large output of tragedy was strangely underrated despite his lack of concentration he had some sense of the theatre as well as a superb fluency, and his trilogy on Marston of Scots might yet survive if carefully prepared for the stage. Most poets of the period composed occasionally in dramatic form. Robert Bridges wrote *Prometheus* (1883) and *Nero* (1885) while John Davidson poured his wild fancy, anger and despair into a series of published plays. Thomas Hardy also presented his gigantic study of the Napoleonic wars in three volumes of acts and scenes. *The Dynasts*, with its cosmic sweep and philosophic chants as well as its routs and triumphs of embattled hosts, might seem to be beyond the compass of an stage but Granville Barker produced an action which was

Repertory Theatres.—The Vedrenne-Barker season at the Court was the prelude to the revival of the English stock-company system with a heightened ambition. The new movement abandoned the name of "stock" for that of "repertory" and it was to the new repertory theatres that the men of letters and the

young dramatists eagerly turned for their opportunities. Shaw had already revealed an example of how inclusive the kingdom of drama might become. The new dramatists were not only to abandon the old theatricalism with its tedious repetition of plots in which farcical misunderstandings or sexual intrigues were almost the only constituents, they were to shrink from nothing in politics or economics, in ethics or metaphysics. They were to resume the Ibsenite tradition and make the English theatre an informed critic and mouthpiece of its age with the actor no longer domineering in all the richness of a star part and exhibiting a star personality but co-operating with the dramatist as an abstract and brief chronicle of the time.

At the Court theatre in London the example had been set, it was in the provinces, however, that the distinctive "repertory" movement was established. The absence of any national or municipal endowments for the theatre meant that the necessary funds for the creation of theatres which could hardly be (and were not intended to be) serious competitors in the industry of entertainment had to be found among private patrons of the arts and enthusiasts for dramatic enterprise. Alfred Wareing, a young touring manager fired by a great enthusiasm for the new drama, was enabled by some men of civic spirit in Glasgow to take over the Royalty theatre as a citizens' playhouse and there he maintained an ambitious repertory for several years. Annie E. F. Horniman, who had been private secretary to W. B. Yeats and had backed the production of Shaw's *Arms and the Man* at the Avenue theatre in 1894, opened the Abbey theatre in Dublin ten years later. The rise of this theatre was a natural part of the Irish literary renaissance which came in with the 20th century. It was due partly to the earlier experiments of George Moore and Edward Martyn, and partly to the reaction upon Irish intellectuals of the general wave of artistic endeavour in the theatre. The governing influence fell in the end to W. B. Yeats and Lady Gregory, both dramatists, and it was under their influence that the genius of J. M. Synge, an invalid who died before he was 40, found expression with *Riders to the Sea*, *The Well of the Saints* and *The Playboy of the Western World*. Other writers of distinction connected with this theatre were Lennox Robinson and St. John Ervine, and in 1922 a Dublin plasterer named Sean O'Casey made his reputation there with *The Shadow of a Gunman*. The Abbey Theatre company at this time had a wide and well earned fame, and while the broad humours of Arthur Sinclair, the early beauty and maturing powers of Sara Allgood and Maude O'Neill may be selected for particular praise, the team as a whole had a common quality that made their visits to England an exceptional pleasure to connoisseurs of acting.

In 1907 Miss Horniman purchased the Gaiety theatre in Manchester and ran it until 1927, when it was sold to a motion-picture syndicate. The great period of the Gaiety was in the years between 1908 and 1914, during which time it attracted the widespread attention of critics and authors, enlisted the services of young players and producers who were afterward to become leaders of the English theatre and gave the name of "Manchester school" to a particular kind of play and type of presentation in which quaintness and sincerity were familiar characteristics. Among the authors who found fine opportunities at the Gaiety were Allan Monkhouse, John Masefield, Stanley Houghton and St. John Ervine, while the works of established playwrights of the new school like Shaw and Galsworthy were constantly in the program. Among those who were graduating in mastering their art in the "Manchester school" were Sybil Thormdike, Lewis Casson and Basil Dean. Dean in 1912 became director of the Liverpool Playhouse repertory. In 1913 Barry Jackson founded and directed the Birmingham repertory company and built for it a special theatre. The Liverpool and Birmingham repertories survived, and the latter was able to send companies to London where important conquests were made. The Birmingham company, for instance, was the first to act Shaw's vast "metabolological pentateuch" *Back to Methuselah*, which was given in 1923 at Birmingham and subsequently at the Court theatre in London.

The repertory movement may have often been responsible for hasty and unripe presentations, but there is no doubt that it

evolved new talents in writing and acting and had a freshening and vitalizing effect upon the whole British drama of the period. The theatre was honoured. No man of letters henceforward could be too proud to write for it and it is significant that the most distinguished novelists of the time were eager to be dramatists. One effect, and that an important one, of the repertory movement was to restore the theatre to its proper place in the national culture. The drama became once more representative and expressive of the living mind and the social purpose.

But it must not be supposed that the repertory movement was as widely prosperous as it was intellectually significant. From a financial point of view it was often a failure and the London theatre was still dominated by the actor-manager who chose his plays to suit his particular talent. Yet the sovereignty of such men as Sir Herbert Beerhohn Tree, Sir George Alexander and Sir Charles Wyndham, all of whom died during World War I, was a beneficent form of government compared with that of the financial syndicates which followed them and turned the playhouses into counters in a great game of hazards rather than of skill. The effect of the war on the English drama was inevitably disastrous. When so many towns, particularly the capital, were lodgishouses between life and death in which men on leave snatched what relief they could, the industry of entertainment naturally flourished at the expense of the art of the theatre. The new syndicates which trafficked in playhouses and plays found a ready market for anything trivial or spectacular which would bring some anodyne to the mind oppressed with care. London was packed with soldiers from all over the world to all of whom a rousing display or a racy farce was at least intelligible. Hence it was that the typical war play was *Chu Chin Chow*, an elaborately oriental panorama with music which ran at His Majesty's theatre for 2,238 performances, or *The Maid of the Mountains*, a highly competent musical comedy which was played at Daly's 1,352 times, or *A Little Bit of Fluff*, a hilarious and risqué farce whose life extended to 1,241 nights. The war brought enormous runs because money was plentiful and taste was not exacting. It was a period of quantity not quality. Sir Gerald du Maurier, one of the surviving actor-managers, did, however, maintain a standard of dignity and restraint and had a long run with *Dear Brutus*. (I Bx, X)

After World War I.—In the early 1920s two main influences were at work upon the theatre, one material and one spiritual. Materially, times were difficult because the competition to acquire London theatres for revues and farces had quadrupled the rents. Spiritually, they were hard for the high-aspiring artist because the public was in a cynical and disillusioned mood. The older generation of playgoers was still faithful to Galsworthy and other products of the prewar repertory movement, and Barrie was still writing, but the spirit of the time was more truly reflected by such plays as W. Somerset Maugham's *Our Betters* (the least considerable of all his works), or the sophisticated and deft comedies of Frederick Lonsdale and Noel Coward. The more sensu-mundum among this public made an idol of Bernard Shaw, who now found himself, much to his surprise and not altogether to his pleasure, the most popular of living dramatists. The essential point about this postwar public, in London at any rate, was that it had taken the lessons of its youth too much to heart, and would tolerate no plays not realistically written and no acting that was not "natural." It seemed, indeed, to be impatient of any drama that did not exactly mirror the normal life of its own time and its own country. Plays of foreign life, even of American life, were seldom acceptable to this public unless they had been adapted to fit the English scene, while the classics, and "period" plays generally, were banished almost entirely from the London stage.

The immediate effect was to drive those managers and playgoers to whom realism was only one among many forms of theatrical expression out of central London and into the suburbs, where financial risks were comparatively small. An outer ring of theatres came into being, on whose stages were seen some of the most memorable productions of the time. First of these theatres, in order of time and importance, was the Old Vic, a large dingy building south of the river near Waterloo station. After beginning as a low music hall, and then struggling to bring a little

uplift into the mean streets about it, it found itself unexpectedly thrust into public notice as Shakespeare's only established refuge in London. Lilian Baylis, its manager, found greatness thrust upon her and rose nobly to the test. Even before World War I ended, Sybil Thorndike had made her name at the Old Vic, and in 1919 Robert Atkins, rejoining the company as stage director, built up a first class team and attracted a public from all parts of London. The Old Vic audience soon became an entity which shared the fame of the theatre, and was almost the only really responsive theatre audience of the time.

Second in distinction only to the Old Vic was the Lyric theatre at Hammersmith, a derelict place rediscovered by Nigel Playfair and opened by him and Arnold Bennett as a home for period pieces. The most popular of the Hammersmith revivals was *The Beggar's Opera*, decorated by Claud Lovat Fraser, which was produced in June 1920, became the rage of the town and ran for nearly four years. Previously, Hammersmith had yielded a long run to John Drinkwater's chronicle play *Abraham Lincoln*. Another of Playfair's notable productions was Congreve's *Way of the World* (in all other hands an intractable masterpiece), in which Edith Evans, as Millamant, first demonstrated her brilliance in artificial comedy. Meanwhile, at Barnes, Philip Ridgeway turned a disused movie house into a theatre and with the help of the Russian producer Theodore Komisarjevsky gave British theatregoers their first real chance to understand Chekhov's plays. Very few grasped the opportunity.

At such a time, the arrival of an actress like Sybil Thorndike at a position of honour in the West End theatre was an extraordinary feat, since she had to swim against the stream of popular prejudice. Remarkable performances of Euripides' *Heccuba* and *Medea* at a series of matinees established her reputation as a tragic actress, and, though she had to demonstrate her abilities in contemporary comedy before the general public lost its mistrust of her, she found a following which enabled her to restore to Shakespeare an insecure foothold on the fashionable stage. This following enlarged itself greatly, however, when the production of *Saint Joan* brought her to the notice of the by now immense Shaw public in 1924. The play, by fairly general consent the most memorable piece of dramatic writing of the time, found in this actress an exponent of the name part the memory of whose performance has never been effaced. If the spirit of the time had been with her instead of against her, she might well have written her name in the list of great tragic actresses. It was her misfortune that she reached the peak of her power at a time when tragedy was not wanted, so that in her later career she had to fall back on her fine but less remarkable comic gifts.

She and her husband, Lewis Casson, however, had done much to keep alive the idea that acting could consist of something more than a mere imitation of the surface of life and so to pave the way for another equally gifted player whose methods were more in accordance with the taste of the time. In 1929 John Gielgud, following the example of other actors of high ambition, sacrificed the rewards of a growing West End reputation to become leading man of the Old Vic, and made so great a success as Hamlet that the fashionable scoffers were not merely silenced but impelled to go on pilgrimage to see him. In the following year the production was repeated at the Queen's theatre, just in time to end an undistinguished and vandalistic decade with a promise of something better in store.

A Dangerous Rival.—In actual fact, the first experience the early 1930s had in store for the theatre was financial disaster on a scale hitherto unimagined. The invention of the talking motion picture destroyed almost overnight the complicated touring system whereby the theatres outside London had been kept supplied with plays. Now that they could hear as well as see world-famous players on the screen, provincial audiences refused to be entertained by less known actors on the stage. Except in the big towns which could offer performances by London companies on tour after successful runs, theatres everywhere were closed down or converted into motion picture houses. It was commonly and quite seriously thought that the theatre, proverbially dying for many generations, was moribund at last, and in the years that followed,

when enthusiastic playgoers had to wait until they could spend a holiday in London before they could indulge their taste, it seemed possible that such prophets of disaster might be right. A whole generation was growing up which had never known what it was to see live actors perform, while the existing London public consisted of middle-aged people who cared nothing for the art of the theatre.

Yet even so, the hope of better things persisted, based on three considerations. First, an unprecedented activity was to be seen in the schools, whose dramatic societies, with the approval and assistance of education authorities, were doing ever more ambitious and effective work and familiarizing children with good drama at the most impressionable age. Second, the amateur movement had assumed a new importance. No longer did the amateur actor content himself with repetitions of faded West End successes, the community drama ranged from experiments in mediaeval mystery to the latest philosophy of the intellectual theatre, and with the partial collapse of the professional stage, the movement took on an access of strength. Third, the place of the defunct touring companies was to some extent filled by small repertory theatres which sprang up on all sides and produced a new play every week, working for the most part on incredibly narrow financial margins. These theatres should not be confused with the more solidly established institutions already mentioned which had long existed in large cities—namely Birmingham and Liverpool—in order to give true theatre lovers something outside the limited scope of the commercial theatre. The new stock theatres had as a rule no high artistic aims, they were concerned not to raise the standard of drama, but simply to keep it alive in any form that the public would accept, and the public—except for a small inner circle of enthusiasts—was in no mood for experiment.

Experimental Drama.—But a hopeful sign in the 1930s was that leading dramatists were in such a mood. William Archer, who had fought the battle of realism ever since he had introduced it to the English speaking theatre with his translations of Ibsen, had brought his writing career to an end in 1923 with a claim that victory was won. "Drama," he said in *The Old Drama and the New*, "has cast out the foreign elements of rhetoric and lyricism, and become a pure art of interpretation through imitation." Archer's ink was not long dry when Bernard Shaw, his ally in the Ibsen campaign, went over to the enemy. From 1929 onward he contributed to the Malvern festivals, inaugurated in his honour by Barry Jackson, a series of discussion plays beginning with *The Apple Cart* in which rhetoric had a far more important share than imitation. And in the same year, 1929, Sean O'Casey abandoned the realistic method which had brought him fame with *Juno and the Paycock* and *The Plough and the Stars* and began with *The Silver Tassie* a deliberate attempt to bring back to the stage the other "foreign element," lyricism.

A few years later still J. B. Priestley, who had emerged as a prolific and highly popular dramatist in the realistic manner with *Dangerous Corner* (1932), *Laburnum Grove* (1933), *Eden End* (1934) and others, began experimenting in his turn in *Music at Night* (1938) and *Johnson Over Jordan* (1939). None of these attempts to break down the tyranny of the imitative method received much encouragement. None of Shaw's Malvern plays, except *The Apple Cart* itself, proved popular in London, O'Casey lost his hold on the West End altogether, Priestley's *Johnson Over Jordan* failed with splendour, but it failed. Only T. S. Eliot, with a new conception of poetic drama, could be said to have struck a really effective blow for a freer theatre, and that was because his *Murder in the Cathedral*, written for a Canterbury festival and hardly aimed at a wider public, was able to climb quietly to fame by a multiplicity of modest performances in small theatres before audiences of enthusiasts, and was never forced to compete in the commercial hurly-burly.

World War II.—When World War II broke out, every theatre in Britain was closed by government order, and thereafter, until the Germans broke off their main air attack in May 1941, the "commercial" theatre lived a precarious existence. London, and the big towns generally, ceased to be centres of theatrical activity of any importance. Not until the late summer of that year did the

West End return to normality, and it was then taken sadly for granted that a drop in the standard of public taste similar to that of World War I would happen. The event proved very different. It was true that, as in World War I, the fighting forces on leave liked entertainment of light texture, but a companion of London's playbills at corresponding points of the two wars proved that whereas in 1914-18 the discriminating playgoer in London could hardly find himself catered for at all, in 1939-45 he could always find intelligent and sometimes serious entertainment. As in World War I, popular plays had very long runs, but this time it was not musicals or wild farces which topped the thousand performances, but comedies of some merit—Noel Coward's *Blasted Spirit* (1,997), Terence Rattigan's *While the Sun Shines* (1,154), Esther McCracken's *Quiet Week* end (1,059) and the *U.S. Arsenal and Old Lace* (1,337).

Also, during and after World War I an eager escapism had led the public to shun war plays, so that not till 1929 was the first realistic stage representation of the war (R. C. Sherriff's *Journey's End*) presented, and then only with misgiving. This frame of mind was so alien to the spirit of the World War II public that Eynon Williams' *The Morning Star*, written as a tribute to the tough fibre of London's population under aerial attacks, and containing a realistic representation of a raid, was received with acclamation in Dec. 1941, only six months after those attacks had ceased.

ENSA and CEMA—Meanwhile, many events up and down the country showed that there was no real reason to fear that the art of the theatre would be swamped by a desire for crude relaxation. The Entertainments National Service Association (ENSA), a vast organization with Basil Dean at its head which supplied every kind of show to every branch of the forces, often found itself under criticism if it rated the taste of its audiences too low. The Old Vic, which had withdrawn to Burnley in Lancashire, found responsive audiences in districts which had long had no living theatre at all. Other organizations which sprang up to supply war workers in hostels and camps with drama told the same story. And the Council for the Encouragement of Music and the Arts (CEMA), brought into being to co-ordinate this work with money supplied by the Pilgrim trust and a cautious government, proved its usefulness so thoroughly that it became an entirely state aided department and extended its aims to cover the professional theatre. After the war, under the more resounding title of the Arts Council of Great Britain, it continued to administer government subsidies and to give moral as well as material support to theatrical ventures over a wide field.

Stratford and Old Vic—Perhaps the best barometer of the change in taste is to be found in the history of the new Shakespeare Memorial theatre at Stratford-on-Avon, which was opened in 1932. Up till this time the Stratford festivals had been parochial in character. Sir Archibald Flower, whose family had built the first theatre (burned out in 1926), was anxious to keep this modest quality, and had the support of a majority of the governors. But the new theatre was not a private venture. It had been built and endowed by public international subscription, and pressure of public opinion gradually brought it home to the local authorities that their theatre was now a showpiece and a place of pilgrimage. One continuous season superseded two short ones, and in the years before the war the theatre was commercially successful. Artistically, it remained inadequate to its new status.

During World War II the governors were, naturally enough, content to mark time so far as policy was concerned, but were very soon to discover the changed temper of their audiences. To see the theatre crammed to the doors became an ordinary instead of an unusual experience. At the time this was accounted for by the presence in and near Stratford of Allied armies, particularly Americans, on leave, but after these soldiers left the records of attendance at the theatre rose in spite of transport difficulties unknown before the war. Eager playgoers in every part of the country organized motor-coach trips to Stratford. A new generation of governors, led by Lord Liff and Lieut. Col. Fordham Flower, recognized that the old parochial days were gone and appointed one of their number, Sir Barry Jackson, to reorganize the com-

pany on a more ambitious scale. Under Jackson and his successor, Anthony Quayle, the Memorial theatre at last attained its proper artistic quality as a serious rival to the Old Vic.

The Old Vic itself, by the end of the war, had reached the highest peak yet of its honourable career. In the autumn of 1944 Laurence Olivier and Ralph Richardson (both knighted in 1947) were released from the forces to become codirectors of the company, and for two seasons they led it in a whole series of productions which proved not only that acting on the grand scale was still possible, but that it was once again very much to the public taste. Olivier's Richard III and Oedipus (in *Oedipus Rex*), and Richardson's Falstaff in both parts of *King Henry IV*, were achievements of the highest rank. After these two players left the company in 1946, the organization developed weaknesses and the standard fell for a time, but it had grown to be an understood thing that the Old Vic was the nucleus on which the National theatre—for the establishment of which £1,000,000 was made available by parliament in 1949—would take shape.

Just before the Old Vic's return to London, in the spring of 1943, John Gielgud had had proof of the public's change of heart. He staged Congreve's *Love for Love*, with so little faith in its popular appeal that he produced it as a non-profit-making venture with the backing of the CEMA. It ran for a year.

Retreat from Realism—Side by side with the established naturalistic theatre, therefore, Britain by 1946 had a theatre of universal appeal in which experiments that before World War II would have seemed outrageous had a good chance of success. With responsive audiences, courageous directors and actors who could recall the spaciousness of earlier days without their flamboyance, it seemed possible that a new era of greatness might be about to dawn. There was, however, one very serious obstacle to this—a dearth of new dramatists. The years immediately succeeding the war were singularly unproductive of new plays of distinction, and such as did appear—J. B. Priestley's *The Linden Tree*, Terence Rattigan's *The Winslow Boy* and *The Browning Version*, Eynon Williams' *The Wind of Heaven*, for instance—showed no sign of any breakthrough from naturalism. Economic conditions were difficult, and managers were disinclined to take risks with new works when they could more safely cater for the public's new-found liking for the classics and "period" plays generally.

Not until 1949, indeed, were any new plays written that could be said to reflect the younger generation's catholicity of taste. In that year a new note was struck when *Daphne Laureola*, a piece in James Bridie's most idiosyncratic manner and with almost no plot at all, gave Edith Evans one of her greatest successes, when *The Lady's Not for Burning*, a verse play by Christopher Fry, the first new dramatist of distinction to emerge after the war, ran for many months, and when T. S. Eliot's *The Cocktail Party*, a mystical piece also written in verse, was produced at the Edinburgh festival and acclaimed as a masterpiece. In 1950 another poetical play from Fry's pen, *Venus Observed*, was given a warm welcome for the splendour of its language in spite of manifest faults in the handling of its plot. Not one of these plays could have survived in the West End between the wars, and their success completed the evidence that a fresh and very different chapter of stage history had been opened.

The Rise of the Producer—During the first half of the 20th century there were three distinct phases of theatrical history. An actor's theatre was succeeded by an author's theatre and this in turn was followed by a producer's theatre. Although the stage director never attained in Great Britain to the absolute monarchy which men like Max Reinhardt achieved in Europe, it was an Englishman, Edward Gordon Craig, whose theories and occasional practice inspired this development. Craig's ideas affected the land of his birth only at second hand, but perhaps it was better so. His erratic genius was not well suited to a workaday playhouse, though he would never admit this. Nevertheless, his influence was strong, and English methods of production showed much benefit from the lessons he had to teach. The work of such men as Nigel Playfair, Basil Dean and H. K. Ayllin in the older generation, and Tyrone Guthrie, John Gielgud, Laurence Olivier and Peter Brook among the younger men, showed a power to experiment without

treating the author's text as a mere libretto or the actor as a unit in a regiment of automata. In short, they accepted the threefold partnership between actor, author and producer and worked loyally to sustain it

(W A Dn)

FRENCH DRAMA

France was the only country besides Italy in which classical tragedy was naturalized. In 1531 the Benedictine Barthélemy of Loches printed a *Christus Xylonicus*, and a very notable impulse was given both to the translation and to the imitation of ancient models by a series of efforts made in the University of Paris and other French places of learning. The most successful of these attempts was the *Johannes Baptistes* of George Buchanan, who taught in Paris for five years and at a rather later date lived at Bordeaux, where in 1540 he composed his celebrated tragedy (afterward translated into four or five modern languages), in which it was now ascertained that he had in view the trial and condemnation of Sir Thomas More. He also wrote *Jephthah*, and translated into Latin the *Medea* and *Alcestis* of Euripides. At a rather later date the great scholar M. A. Muret (Muretus) produced his *Julius Caesar*, but inferior to it in likeness to life. About the same time the enthusiasm of the Paris classicists showed itself in several translations of Sophoclean and Euripidean tragedies into French verse, and in 1540 Pierre de Ronsard translated the *Philoctetes* of Aristophanes. Thus the beginnings of the regular drama in France came to connect themselves directly with the great literary movement of the Renaissance.

Jodelle—Among the disciples who gathered round Ronsard, and with him formed the "Pléiade" of French literature, Étienne Jodelle, the reformer of the French theatre, soon held a distinguished place. The stage of this period left ample room for the enterprise of this youthful writer. The popularity of the old entertainments had reached its height when Louis XII, in his conflict with Pope Julius II, had not scrupled to call in the aid of Pierre Gringore (Gringon), and when the *Mère sotte* had mockingly masqueraded in the petticoats of holy church. In the reign of Francis I the Inquisition, and on occasion the King himself, had to some extent succeeded in repressing the audacity of the actors, whose follies were at the same time an utter abomination in the eyes of the Huguenots. For a time the very mysteries of the Brethren of the Passion had been prohibited, while the moralities and farces had sunk to an almost contemptible level. Isolated translations of Italian as well as classical dramas had in literature begun the movement which Jodelle now transferred to the stage itself. His tragedy *Cléopâtre captive* was produced on the same day as his comedy *L'Eugène*, in 1552, his *Didon se sacrifiant* following in 1558.

The history of French tragedy begins with *Cléopâtre captive*, in the representation of which the author, together with other members of the Pléiade, took part. It is a tragedy in the manner of Seneca, devoid of action and provided with a ghost and a chorus. Though mainly written in the five foot iambic couplet, it already contains passages in the Alexandrine metre, which soon afterward J. de la Pérouse by his *Médée* (1556) established in French tragedy, and which Jodelle employed in his *Didon*. Numerous tragedies followed in the same style by various authors, among whom Gabriel Bonny produced the first French regular tragedy on a subject neither Greek nor Roman (*La Sotanie*, 1561) and the brothers Jacques and Jean de la Taille and J. Grévin distinguished themselves by their style. Antoine de Montchrestien exhibited unusual vigour of rhetoric and in R. Garnier's much tragedy reached the greatest height in nobility and dignity of style, as well as in the exhibition of dramatic passion, to which it attained before Corneille. In Garnier's tragedies choruses are still interspersed among the long Alexandrine tirades or the dialogue.

Comedy under Italian Influence—During this period comedy had likewise been influenced by classical models, but the distance was less between the national farces and Terence than between the mysteries and moralities and Seneca and the Greeks. *L'Eugène* differs little in style from the more elaborate of the old farces, and while it satirizes the foibles of the clergy without

any appreciable abatement of the old licence, its theme is the favourite burden of the French comic theatre in all times—*le cocuage*. The foremost French comic poet of the century, Pierre de Larivey, born in Florence and originally named Pietro Guntia, openly professed to imitate the poets of his native country. His plays are more or less literal translations of L. Dolce, Secchi and other Italian dramatists, and this lively and witty author, to whom Molière owes much, thus connects two of the most important and successful growths of the modern comic drama.

Much of the French drama of the next age is of the same kind as its romance literature, like which it fell under the polite castigation of Nicolas Boileau-Despréaux's satire. Heroic love (quite a technical passion), "fertile in tender sentiments," seized hold of the theatre as well as of the romances, and G. de C. de la Calprenède, G. de Scudéry (*L'Amour tyrannique*) and his sister and others were equally fashionable in both species. A mixture of the forms of classical comedy with elements of Spanish and of the Italian pastoral was attempted with great temporary success by A. Hardy. The mixture of styles begun by him was carried on by the marquis de Racan, J. de Rotrou and others, and among these comedies of intrigue in the Spanish manner the earlier efforts of Corneille himself are to be classed. Rotrou's noteworthy productions are later in date than the event which marks an epoch in the history of the French drama, the appearance of Corneille's *Cid* (1636).

Corneille—Pierre Corneille is justly revered as the first, and in some respects the unequalled, great master of French tragedy. The attempts of his predecessors had been without life, because they lacked really tragic characters and the play of really tragic passions, while their style had been either pedantically imitative or a medley of plagiarisms. He conquered tragedy at once for the national literature by a few masterpieces, which may be held to be comprehended within the ten years 1636 to 1646, for in his many later tragedies he never again proved fully equal to himself. The French tragedy, of which the great age begins with the *Cid*, *Horace*, *Cinna*, *Polyeucte* and *Rodogune*, was not, whatever it professed to be, a copy of the classical tragedy of Greeks or Romans, or an imitation of the Italian imitations of Greeks or Romans, or his later tragedies Corneille depended less and less upon characters and more and more, after the fashion of the Spaniards, upon situations, and even more upon spectacles, were the forms of the Spanish drama able to assert their dominion over the French tragic stage. The mould of French tragedy was cast by Corneille, but the creative power of his genius was unable to fill it with more than a few examples.

In comedy also Corneille begins the first great original epoch of French dramatic literature, but *Le Menteur* was itself derived from a Spanish original, which it did not (as was the case with the *Cid*) transform into something new.

Racine—The tragic art of Jean Racine supplements rather than surpasses that of his older contemporary. His works reflect the serene and settled formality of the age. That Racine should permanently hold the position which belongs to him in French dramatic literature is due to the fact that to him it was given to present the forms approved by his age in what may reasonably be called perfection. Thomas Corneille, J. G. de Campistrion, Joseph Duche (1668-1704), Antoine de Lafosse (c. 1653-1708) and Philippe Quinault were mere followers of one or both of the great masters of tragedy, though the last-named achieved a reputation of his own in the bastard species of the opera.

The type of French tragedy thus established, like everything else which formed part of the "Age of Louis XIV," proclaimed itself as the definitively settled model of its kind, and was accepted as such by a submissive world. The unities of time and place, with the Greeks mere rules of convenience, French tragedy imposes upon itself as a permanent yoke. The Euripidean prologue is judiciously exchanged for the exposition of the first act, and the lyrical element essential to Greek tragedy is easily suppressed in its would be copy, byl passages still occur in some of Corneille's early masterpieces, but the chorus is consistently banished, to reappear only in Racine's latest works as a scholastic experiment appropriate to a conventual atmosphere. Its uses for ex-

planation and comment are served by the expedient, which in its turn becomes conventional, of the conversations with *confidants* and *confidentes*, which more than sufficiently supply the foil of general sentiments. The epical element is allowed full play in narrative passages, more especially in those which relate parts of the catastrophe, and, while preserving the stage intact from realism, suit themselves to the generally rhetorical character of this species of the tragic drama.

18th Century Tragedy—The universal genius of Voltaire found it necessary to shine in all branches of literature. He succeeded in impressing the world with the belief that his innovations had imparted a fresh vitality to French tragedy, in truth, however, they represent no essential advance in art, but augmented the rhetorical tendency which paralyzed true dramatic life. Such life as his plays possess lies in their political and social sentiments, their invective against tyranny and their exposure of fanaticism. In other respects his versatility was barren of enduring results. Voltaire's would be rival, the "terrible" Crébillon the elder, professed to vindicate to French tragedy, already mistress of the heavens through Corneille, and of the earth through Racine, Pluto's supplementary realm, but, though thus essaying to carry tragedy lower, failed to carry it farther. Shakespeare, as manipulated by J. F. Ducis—an author whose tastes were better than his times—failed to bring about a change. "It is a Moor, not a Frenchman, who has written this play," cried a spectator of Ducis's *Othello* (1791), but F. J. Talma's conviction was almost as strong as his capacity was great for convincing his public, and he certainly did much to prepare the influence which Shakespeare was gradually to assert over the French drama, and which was aided by translations, more especially that of Pierre Letourneur (1736–88), which had attracted the sympathy of Diderot and the execrations of the aged Voltaire. Like Rachel after him, Talma reconciled French classical tragedy with nature.

Molière—The rival influences, under which classical tragedy after a long struggle virtually became a thing of the past in French literature, are also to be traced in the history of French comedy, which under the co-operation of other influences produced a wide variety of growths. The germs of most of these—though not of all—are to be found in the works of the most versatile, the most sure footed and, in some respects, the most consummate master of the comic drama whom the world has known—Molière. What Molière found in existence was a comedy of intrigue, derived from Spanish or Italian examples, and the elements of a comedy of character, in French and more especially in Italian farce and ballet pantomime. Corneille's *Le Menteur* had pointed the way to a fuller combination of character with intrigue, and in this direction Molière's genius exercised the height of its creative powers. After beginning with farces, he produced in the earliest of his plays (from 1652), of which more than fragments remain, comedies of intrigue which are at the same time marvellously lively pictures of manners, and then proceeded, with the *Ecole des maris* (1661), to begin a long series of masterpieces of comedy of character.

Molière is both a satirist and a humorist, he displays at times the sentiments of a loyal courtier, at others that gay spirit of opposition which is all but indispensable to a popular French wit. His comedies offer elaborate and subtle—even tender—pictures of human character in its eternal types, lively sketches of social follies and literary extravagances, and broad appeals to the ordinary sources of vulgar merriment. Light and perspicuous in construction, he is master of the delicate play of irony, the penetrating force of wit and the expansive gaiety of frolicsome fun. His morality is the reverse of rigid, but its aberrations are not those of prurience, nor its laws those of pretense. He raised the comedy of character out of the lower sphere of caricature, and in his greatest creations subordinated to the highest ends of all dramatic composition the plots he so skillfully built and the pictures of the manners he so faithfully reproduced.

Molière's Successors—If the mantle of Molière can be said to have fallen upon any of his contemporaries or successors, this honour must be ascribed to J. F. Regnard, who imitated the great master in both themes and characters.

In the next generation (that of Voltaire) comedy gradually—

but only gradually—surrendered for a time the very essence of its vitality to the seductions of a hybrid species, which disguised its identity under more than a single name. A. R. Lesage, who as a comic dramatist at first followed successfully in the footsteps of Molière, proved himself on the stage as well as in picturesque fiction a keen observer and imitable satirist of human life. The light texture of the playful and elegant art of J. B. L. Gresset was shown on the stage in a character comedy of merit (*Le Méchant*), and in a comedy which reveals something of his pointed wit (*La Métronomie*). A. Piron produced something like a new type of enduring ridiculousness.

P. C. de Marivaux is usually supposed to have formed the connecting link between the "old" French comedy and the "new" and bastard variety. Yet, in *marivaudage* proper the wit holds the balance to the sentiment, and in some of this writer's earlier and most delightful plays the elegance and gaiety of diction are as irresistible as the pathetic sentiment. Some of the comedies of P. H. Destouches no doubt have a serious basis, and in his later plays he comes near to a kind of drama in which the comic purpose has been virtually submerged. The writer who is actually to be credited with the transition to sentimental comedy was Nivelle de la Chaussée, in whose hands French comedy became a champion of the sanctity of marriage, and reproduced the sentiments—in one instance even the characters—of Richardson. To his play *La Pausse antipathie* the author supplied a critique, amounting to an apology for the new species of which it was designed as an example.

The new species known as *comédie larmoyante* was now fairly in the ascendant, and even Voltaire, who had deprecated the innovation, introduced the sentimental element into some of his comedies. The further step, by which *comédie larmoyante* was transformed into *tragédie bourgeoise*, from which the comic element was to all intents and purposes extruded, was taken by a great French writer, Denis Diderot, to whose influence it was largely due that the species which had attained to this consummation for more than a generation ruled supreme in the dramatic literature of Europe. Diderot announced his plays as examples of a third dramatic form—the *genre sérieux*—which he declared to be the consummation of the dramatic art. Making war upon the frigid artificiality of classical tragedy, he banished verse from the new species. The theatre was to become a real and realistic school of the principles of society and of the conduct of life.

Comedy of the Revolution and First Empire—Among the successful dramatists following on Diderot may be mentioned the critical and versatile J. F. Marmontel, and more especially M. J. Sedaine, who though chiefly working for the opera produced two comedies of acknowledged merit (*Le Philosophe sans le savoir* and *La Gageure imprévue*). P. A. C. de Beaumarchais (1732–99), who for his early sentimental plays, in which he imitated Diderot, invented the appellation *drame*—so convenient in its vagueness that it became the accepted name of the hybrid species to which they belonged—in two works of a very different kind, the famous *Barbier de Séville* and the still more famous *Mariage de Figaro*, boldly carried comedy back into its old Spanish atmosphere of intrigue, but, while surpassing all his predecessors in the skill with which he constructed his frivolous plots, he drew his characters with a lightness and sureness of touch peculiar to himself, and seasoned action as well as dialogue with a political and social meaning which marks his *Figaro* as a herald of the Revolution.

The comedy of the Empire is, in the hands of Collin d'Harleville, Louis Picard (1769–1828), A. Duval, C. G. Étienne and others, mainly a harmless comedy of manners. Sedaine was the father of the *opéra comique* proper, J. F. Marmontel, as well as J. J. Rousseau, likewise composed *opérettes*—a smaller sort of opera, at first of the pastoral variety, and these flexible species easily entered into combination. The melodrama proper, of which the invention is also attributed to Rousseau, in its latter development became merely a drama accentuated by music.

The chief home of the regular drama, however, demanded efforts of another kind. At the Théâtre Français, or Comédie Française, whose history as that of a single company of actors had begun in 1680, the party strife of the times made itself

judible, and the most prominent tragic poet of the Revolution, M. J. de Chénier, a disciple of Voltaire in dramatic poetry as well as in political philosophy, wrote for the national stage the historical drama—with a political moral—in which in the memorable year 1789 the actor Talma achieved his first complete triumph. But the victorious Revolution proclaimed among other liberties that of the theatres in Paris, of which soon not less than 50 were open. In 1807 the Empire restricted the number to nine and reinstated the *Théâtre Français* in sole possession (or nearly such) of the right of performing the classic drama. The tragedies of C. Delavigne represent the transition from the expiring efforts of the classical to the ambitious beginnings of the romantic school of the French drama.

The Romantic School—Of modern romantic drama in France it must suffice to say that it derived some of its characteristics from the general movement of romanticism which in various ways and at various points of time transformed nearly every modern European literature, others from the rhetorical tendency which is a French national feature. Victor Hugo was the founder whom it followed in a spirit of high emprise to success upon success, his own being the most conspicuous of all, A. Dumas the elder its unshrinking middleman. Together with them may with more or less precision, be classed in the romantic school of dramatists A. de Vigny and George Sand, neither of whom, however, attained to the highest rank in the drama. Jules Sandeau and A. de Musset, whose originality pervades all his plays, and whose later works, more especially his prose "proverbs" and pieces of a similar kind, have a flavour of delicacy altogether indescribable.

The theatrical fecundity and the remarkable constructive ability of E. Scribe supplied a long series of productions attesting the rapid growth of the playwright's mastery over the secrets of his craft. After a fashion which would have startled even Diderot, while recalling his efforts in the earnestness of its endeavour to arouse moral interests to which the theatre had long been a stranger, A. Dumas the younger set himself to reform society by means of the stage.

The extraordinary versatility of V. Sardou and his unflinching constructive skill was applied by him to almost every kind of serious or seriocomic drama—even the most solid of all. In the same period, while E. Pailleron revived some of the most characteristic tendencies of the best French satirical comedy in ridiculing the pompous pretentiousness of learning for its own sake, the high-spirited gaiety of E. Labiche changed into something not altogether similar in the production of the comic muse of L. Halevy and H. Meilhac, ringing from the licence of the musical burlesque which was the congenial delight of the later days of the Second Empire to a species of comedy in which the ingredients of bitterness and even of sadness found a place. (P. M. A. F. X.)

Modern Schools—The long-disputed success of the naturalistic school earned everything before it during the years 1875-85. Henry Becque succeeded in embodying the new theories in two plays, which at first met with very indifferent success, but were revived at a later period and finally obtained permanent recognition. In *Les Corbucci* (1882) and *La Parisienne* (1885) the characters are left to tell their own tale in their own words, which are sometimes very comical, sometimes very repulsive, but purport to be always true to nature. Along with Becque may be mentioned the witty and incisive Jules Renard, who might be characterized as a bitter and modern Molière.

Contemporary with the naturalistic theatre, but quite different as to aims and content, was the symbolist theatre. The first plays of Villiers de l'Isle-Adam, such as *Morgane* (1862), with all their flamboyant rhetoric, can be readily traced back to the romantics. But Villiers's later work is typical of the symbolist exploration of the world within, as opposed to the world without—*Une évasion* (1887), *Axel* (1890)—and consequently, though of great literary value, it does not lend itself to the demands of the stage. Wholly romantic was Edmond Rostand, who created a sensation with *Cyrano de Bergerac* (1897) and *L'Aiglon* (1900), but the favourable impression did not last and *Chantecler* (1910) was only half a success. The naturalistic tendency took a social direction with

Paul Hervieu, and Eugène Brieux tackled even bigger social problems, which he perhaps oversimplified, in *La Robe rouge* (1900) and *Les Avariés* (1901). Tristan Bernard, Georges Courteline and Georges Feydeau all achieved success in the lighter and some times the lightest or grossest kind of comedy.

As exceptions among the exponents of the poetic drama, which is usually meant to be read rather than acted, may be mentioned Maurice Maeterlinck and Alfred Jarry, whose works are, in very different ways, meant to be acted. Whereas Jarry, in his *Ubu plays—Ubu Roi* (1895), *Ubu Enchaîné*—succeeds in reconciling the refinements and subtleties of symbolist poetry with vulgar speech, Maeterlinck writes in startlingly simple language, at the same time as he drew upon all the resources of modern sensibility. On the other hand, the third great symbolist playwright, Paul Claudel, in his rich and varied contributions, revived the mediaeval mysteries and the exuberance of Renaissance drama. *Partage de Midi* (1906), *L'Oïlage* (1911) and *Le Soulier de Satin* (1918).

Subsequent trends in French literature proved to be even more antithetical, if possible, to the spirit of the theatre. The surreal movement, which drew upon the best energies of a new literary generation, although too often confusing "acting" with action, had little contact with the theatre, save in a marginal way, the plays of Roger Vitrac and Raymond Roussel may be mentioned. The actor poet Antonin Artaud, also surrealist, although important for the influence he exerted upon new dramatic theories, did not actually write any plays.

In the 1930s the clever but thin and quickly dated plays of Jean Cocteau and Jean Giraudoux successfully held the stage, but they may be said to have been already symptomatic of a certain decadence. More vigorous and less precious, although without introducing any intrinsically new features, the plays of Jean Anouilh and Armand Salacrou held the boards for long runs during the 1940s. It is a fact, however, that for sheer lack of original theatrical material, such excellent directors as Louis Jouvet, Charles Dullin, Gaston Baty, Georges Pioch, Jean Louis Barrault and Jean Vilar were obliged to devote the best of their energies to reinterpretations and innovations of form in presenting classics.

After World War II, the hopes aroused by the first attempts of the existentialist group to embody new ideas in the theatre were disappointed. The well written dramas of Jean Paul Sartre, Albert Camus and Simone de Beauvoir all bore too obvious testimony to the philosophical theories of their authors for it to be possible to judge them as contributions to theatrical literature.

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SPANISH DRAMA

The Beginnings—Spanish drama, which in the 16th century sprang into life and rapidly achieved fame, developed slowly before the Renaissance and produced hardly anything of merit which still survives. As in other countries of Europe, it evolved gradually from liturgical rites, emerging from within the church to portico or cloister, and then moved slowly toward secularization. Its quality is illustrated in 147 extant lines from an Epiphany play, the *Auto de los Reyes Magos*, written chiefly in rhymed couplets, rudimentary in technique but with touches of humour and occasionally some vitality.

By the late 15th century drama was largely secularized, though still somewhat rudimentary. Omitting Fernando de Rojas, whose 21-act *Celestina* (c. 1499) is one of Spain's greatest masterpieces, was never intended for acting, the leading dramatists of this period are three. Juan del Encina, an Italianate poet, composed pastoral dialogues, which he termed "eclogues." Gil Vicente, a Portuguese, influenced by Encina, displayed more art, especially in characterization, and more poetry. Bartolomé de Torres Naharro, in a collection of eight plays (*Propaladia* [1517]), anticipated

golden age drama in construction, characterization and types of play

In the next generation two more playwrights excel. Lope de Rueda (c. 1510-1565) in his prose comedies democratized a genre born in the church and nurtured by the aristocracy but soon to be long to the people. Strongly influenced by Plautus, he wrote prose interludes, or *pasos*, oscillating between realism and caricature, for the companies of professional actors now becoming characteristic of Spanish life. Somewhat later, Juan de la Cueva (c. 1550-c. 1610) utilized ballad material, created the historical play, introduced new metres and exploited ideas expounded in his *Exemplar poético* (1606).

Lope de Vega—One of the most prolific geniuses in history, Lope Felix de Vega Carpio (1562-1635) matched his vast output, of which we have about 500 plays (said to be only a quarter of the whole) and 21 volumes of nondramatic work, by an amazing variety and a remarkably high average of merit. His freshness, abandon and spontaneity are typical of the late 16th century never a pedant, always a poet, he was still writing, when over 70, as if in his prime. Action, usually motivated by love, is his outstanding trait, mastery in exposition and skilful in intrigue, he is sometimes careless in denouements, his characters, though lively and often attractive, have no depth and little verisimilitude. Essentially a people's playwright, he wrote primarily to please, his *Arte nuevo de hacer comedias en este tiempo* describing his principles and methods.

With some exceptions, his plays, all written in verse, fall into three divisions: (1) In the "cloak and sword play," or *comedia de capa y espada* (e.g., *El Acero de Madrid*), the chief characters belong to the upper middle class, its plot, based on gallantry, is regulated by a conventional code of honour, whose rules all playgoers knew, its charm lies in rapid action, a complicated plot and witty, vivacious dialogue. (2) In the heroic drama (e.g., *El Mejor Alcalde*, *el Rey*), the leading personages are of exalted, even royal, rank, the issues involved are grave, and the background is often historical. Both this and the preceding type of play have humorous underplots. (3) In the domestic drama (e.g., *El Curdo en su casa*) such low life characters as appear in these underplots are introduced as the principal actors. But outside these classes stand plays exhibiting the utmost variety. Such are *El Caballero de Olmedo*, an almost pure tragedy, an idyllic comedy, *El Remedio en la desdicha*, *Peribáñez and Fuenteovejuna*, rugged vindications of democracy, and plays of the miracle and mystery type, such as *El Cardenal de Belén*. Lope was long credited, too, with the authorship of a first rate historical play, *La Estrella de Sevilla*, now generally attributed to Pedro de Cárdenas y Angulo.

Forming a group, almost a school, around Lope were many outstanding dramatists. The greatest, a Mercedarian friar named Gabriel Téllez ("Tirso de Molina," c. 1584-1648), equals his master in invention and surpasses him in characterization, especially in the delineation of women. His greatest dramas (*El Burlador de Sevilla*, one of the two principal Spanish treatments of the national type Don Juan, *El Condenado por desconocido*, an impressive and searching theological drama, and *La Prudencia en la mujer*, a historical play with a fine heroine) rank with any written in Spain.

The Mexican Juan Ruiz de Alarcón (c. 1581-1639), a moralist who wrote fewer plays than most of his contemporaries, used considerable gifts of technique and characterization to attack such vices as slander and deceit. From his *La Verdad sospechosa* Corneille took *Le Menteur* and his *Cid* from the *Mocedades del Cid* of Guillén de Castro y Bellvis (1569-1631), another Lopean, best known by this one play. Below these, though still high, stand Antonio Mira de Amescua (c. 1577-1644) and Luis Vélez de Guevara (1579-1644). One magnificent play, *Del Rey abajo, ninguno*, a vindication of the Spanish yeoman against an oppressive aristocracy, distinguishes Francisco de Rojas Zorrilla (1607-48), who also wrote numerous comedies of character and intrigue, and forms a bridge between Lope and Calderón.

Calderón—Pedro Calderón de la Barca (1600-81) dominates the second, or baroque, epoch of the golden age, as Lope de Vega dominated the first, and thus inevitably challenges comparison

with him. To German romantic critics, who rated him equal with Shakespeare, he appealed by his brilliant imagination, reflectiveness and portrayal of character, which more than atoned for his artificialities in characterization and style. These merits are illustrated in his greatest religious and philosophical plays *La vida es sueño*, *El Magico prodigioso*, *El Principe constante* and *La Devoción de la Cruz*. But he could also write lively cloak-and-sword comedies (e.g., *La Dama diuenda*), and in *El Alcalde de Zalamea*, based on an identically entitled Lopean play, he combines naturalness, deep human interest and effective technique. With him the honour concept present in drama since Lope de Vega, assumes its most extreme form. He excels, too, in the one-act *auto sacramental*, a type essayed by many others but chiefly associated with him.

Only Agustín Moreto y Cavaña (c. 1618-69), who wrote charming character plays and comedies of manners (*El Lundo Don Diego*, *El Desdén con el desdén*), approaches Calderón in merit as nearly as the group already described approaches Lope. When Calderón died, Spanish drama had been the predominant genre for more than a century. Even Miguel de Cervantes Saavedra, whom a novel was to immortalize, coveted stage renown and with *Ocho comedias y ocho entremeses* went far toward achieving it. But no single dramatist of merit survived Calderón.

The Rise and Decline of Romanticism—Between 1680 and 1830 no dramas of any merit were produced, save for the sparkling one act plays (*sametes*), picturing contemporary life, of Ramon de la Cruz (1731-94) and Juan Ignacio González del Castillo (1763-1800), and five deservedly popular neoclassical comedies by Leandro Fernández de Moratín (1760-1828), an admirer and translator of Molière, who followed him recognizably, if afar off.

Throughout the 18th century, Spanish literature, and especially drama, was subservient to France. Until about 1750, neoclassicism was *de rigueur*, golden age literature, essentially romantic in character, lost prestige, and the test of dramatic merit became conformity with rule. Lope and Tirso were dismissed as "barbarians", the *auto sacramental* was prohibited by law (1765). Most of the third rate plays current in Spain came from, or via, France. Dissatisfaction with these led to the vogue of nonliterary plays, such as the pantomimic *comedia de magia*, the lachrymose *tragedia urbana* and the distinctively Spanish *comedia heroica*. As the 18th century proceeded, golden age drama was gradually reintroduced, in emasculated form, by *rejudicciones* adapting it to neoclassical taste.

Between 1750 and 1830, theorists advanced in the direction of romantic ideals also. Whereas Ignacio Luzán's *La Poesía* (1737), which, broadly speaking, followed Boileau, had decried golden age drama, Tomás de Ercilla y Zavaleta (1750), Juan Cristóbal Romea y Tapia (1763), Francisco Nieto de Molina (1768), Francisco Cerda y Rico (1776) and many other critics eulogized it. Moratín, in his *Comedia nueva* (1792), eloquently defended Calderón, Rojas Zorrilla and Moreto, and both they and Lope were now being increasingly published and performed. Tirso reappeared only during the early 19th century.

The emergence of a full-fledged romanticism was delayed by the arbitrary rule of Ferdinand VII (1814-33) and the exile of many leading writers. It declared itself, on the stage, with Francisco de Paula Martínez de la Rosa's *La Conjuración de Venecia* (1834), the Duke de Rivas' *Don Alvaro* (1835), Antonio García Gutiérrez's *El Trovador* (1836) and Juan Eugenio Hartzenbusch's *Los Amantes de Teruel* (1837), none of which, however, had any continuous success. Numerous less meritorious plays, and translations from Hugo, Dumas and second- and third-rate French dramatists, flooded the stage, but Moratín and the neoclassical Manuel Breton de los Herreros attracted too. Soon it became clear that, though romanticism might survive (as it did) as an influence and a tendency, it was doomed, as a self-conscious movement, to failure. It was succeeded by an eclecticism which took what was best from the two rival schools, and, in drama, looked back to the golden age, drew extensively on Spanish history, deprecated alike the restrictions of the neoclassicists and the exaggerations of the romantics and welcomed all genius irrespectively of literary creed.

Apart from José Zorrilla y Morán (1817-93), whose *Don Juan Tenorio* (1844) eclipsed Tirso de Molina's *Burlador* in popularity, though not in merit, romantic drama had only one more outstanding exponent, José Echegaray y Eizaguirre (1832-1916). Manuel Tamayo y Baus (1829-98) now alternated and now mingled classical and romantic, combining them most skillfully in *Un Drama nuevo* (1867). Social drama appeared in Joaquín Dicenta's *Juan José* (1895) and in *Electra* (1900) and other plays by Benito Pérez Galdós (1845-1902).

Contemporary Drama.—But the modern era in drama began with Jacinto Benavente, an outstanding, though solitary, figure, whose 'theatre of ideas,' European rather than Spanish and strongly tinged with symbolism and irony, brought its author the Nobel prize and the drama of Spain world prestige. Less varied and profound, but more Spanish, was Gregorio Martínez Sierra (1881-1947), the delicacy of whose art is equally observable in his theme fervently religious, brilliantly mundane or dreamily fantastic. With him may be ranked the brothers Serafin (1871-1938) and Joaquín (1873-1944) Álvarez Quintero, who, in vivid, shimmering dialogue, re-created the grey surface of life in Andalusia. Equally superficial, but less inspired are Manuel Linares Rivas, a master of plot and dialogue, and a highly lyrical dramatist from Granada, Francisco de Villasecas. Lyrical drama is also strongly represented by three very different geniuses, Ramón María del Valle Inclán, Eduardo Marquina and Federico García Lorca. One of the most striking characteristics of 20th century drama was the invasion of this field by exponents of other genres—e.g., the essayist Azorín (José Martínez Ruiz), the essayist and poet Miguel de Unamuno, the novelist and poet Valle Inclán.

The tradition of the one act play (*entremés, auto, sainete*) was revived in the *genero chico*, initiated by Ricardo de la Vega (son of the neoclassical dramatist Ventura de la Vega) and Tomás Luceño, its popularity being enhanced by attractive music. Its vitality, often heightened by caricature and farce, soon became irresistible, and writers of *entremeses, sainetes* and *zarzuelas* sprang up everywhere. Contemporary with Vega and Luceño were F. J. de Burgos, E. Blasco and Vital Aza, somewhat later came José López Silva, Enrique García Álvarez and—perhaps the best—Carlos Arniches (1866-1943).

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PORTUGUESE DRAMA

The genius of Portuguese literature being essentially subjective, drama is, quite understandably, its weakest genre. Its first great playwright, Gil Vicente (c. 1465-c. 1536), wrote more than 30 plays, either in Portuguese, or in Portuguese mixed with Spanish, notable among them the trilogy of the *Barras* (*Inferno, Purgatorio, Glória*) and the *Farsa de Inês Pereira*. Patronized by King Manuel I, a returnee, he became court dramatist, but, being both poet and musician, he was able to please without having great technical skill. Nevertheless, he fully equals the Spaniards of his day, his episodes and plots are not intricate, he has much broad humour, his characterization is vivid and individual and he represents all Portuguese social types. Portuguese life. But he had no able followers. Antonio Ribeiro Chaves and Afonso Álvares are mere imitators while Jerónimo Ribeira, Balthazar D'Almeida, António Lopes, and Jorge Pinto, writing plays of similar type, seldom equal him. Classical comedy, based on Plautus and Terence and influenced also by Italy, was introduced into Portugal by another talented court poet, Francisco de Sá de Miranda (c. 1485-1553), author

of the *Estrangeiros* and *Vilhalpandos*. Classical tragedy is represented by A. Ferreira's *Inês de Castro* (c. 1557), which, however, though eloquent and poetic, is technically poor. Of Luis de Camões' three early plays (c. 1544-49), *Flodemo* and *El Rei Seno* recall Vicente, and *Os Amphições*, in Portuguese and Spanish, is based on Plautus.

Jorge Ferreira de Vasconcelos' *Eufrosina* and *Aulegrão*, though dramatic in form, are, like the Spanish *Celestina*, not intended for acting.

The 17th century is devoid of drama and the 18th has only a group of frigidly classical plays by António José da Silva, Domíngos dos Reis Quata's tragedy *Inês de Castro*, which inspired a more successful work, João Baptista Gomes' *Nova Castro*, and an anonymous tragedy *Omnia* (1788). The romantic movement, however, produced the best playwright since Vicente, the Visconde de Almeida Garrett, who, after a false start with the classical *Méropé* and *Catóo*, wrote prose plays on national themes, noted equally for technique and power—*Um Auto de Gil Vicente* (1838), *Dona Filipa de Vilhena* (1840), *O Alfama de Santarém* (1842) and—the best—*Frei Lus de Sousa* (1844).

Almeida Garrett, like Vicente, outscored his numerous contemporaries. But toward the end of the century gifted writers created interest in historical drama. João da Camara (1835-1908), known also for his comedies of manners, fantasies and one act plays, Marcelino Mesquita, who wrote moving tragedy, and Henrique Lopes de Mendouça, who depicted contemporary peasant life better than he did history. Greater than any of these are António Patrício, author of *D. João e a Massara*, and Raul Brandão (1867-1930), remarkable for his psycho-logical insight in plays such as *O Dado e a Morte* and *O Gato e a Sombra*. Ernesto Bisser and Cervaio Lobato wrote light sketches of contemporary life, and Eduardo Schwilbach, Augusto de Castro, Augusto Lacerda and Bento Muntua are essentially writers of comedy. João Dantas (1876-), with keen historical insight, sure touch and charm of style, portrays 17th century and 19th century Portugal with equal success.

After World War II the leading playwrights were José Régio, who chose metaphysical themes for his plays *Jacob e o Anjo*, *Benilda ou a Virgem Mãe*, and Miguel Torga, author of *Mar and Sinfonia*.

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ITALIAN DRAMA

In the history of the European theatre after the middle ages, Italian drama occupies an important place, which it owes to individual works of high value written at various periods and to the introduction of theatrical forms with innovations in scenic effects and in the actors' art. In the middle ages the religious theatre represented the aspirations of a whole civilization toward dramatic expression, a fine example of its kind is the dramatic *lauda* or hymn of praise by Jacopone da Todi (c. 1230-1306) entitled *Pianto della Madonna*. The religious dramas still occupied the attention of writers and audiences at the height of the 15th century, and this dramatic form was revived by humanist writers with a new artistic purpose and, in particular, with theatrical effect in view.

The humanist's love of the classical world, for its literary perfection and its promise of a life of dignity and freedom, encouraged the rise of secular drama, the *teatro profano*. The poetic gift of the new writers that the humanist culture brought forth, the stimulus of elegant court life and the research carried out by painters and scholars in the art of perspective led, toward the end of the 15th century and the beginning of the 16th, to the birth of a theatre in the true sense of the word.

From the Renaissance to Romanticism.—Italian tragedy began at the Renaissance, with that feverish outburst of literary and poetic activity which, after a period of culture and study, brought with it the rediscovery of classical forms. And it was in

the form of "imitations" of the Roman and Greek tragic dramatists that the first Italian tragedies appeared. On the other hand the ascendancy of the Aristotelian precepts with their rigid rules of the three unities considerably restricted the freedom of the dramatists, who aspired above all to approach as nearly as possible to that dignity and regularity they attributed to the ancients. Thus G. G. Trissino in the first real tragedy, *Sofonisba* (1515), was cold and solemn in faultless hendecasyllables, so, too, was G. Rucellai with his *Rosmunda*, and even Torquato Tasso himself with his *Torrismondo* (1587), in which a tired lyricism cannot balance the essential lack of tragic spirit, and also G. B. Giraldi Cinzio (or Cynthius), who encouraged a pursuit of the horrific and macabre by imitating Seneca in his *Orbecche* (1541) and of the adventurous and monstrous in *Althia* (1543). Cinzio expounded his poetic theories in his *Discorso sulle commedie e sulle tragedie* (1543). He was imitated by S. Speroni in *Canace* and, in general, by the tragic playwrights of the latter part of the century, such as L. Dolce (*Maramba*, 1565), A. D'Uccio (*Arispaula*, 1591) and M. Manfredi (*Senuramide*, 1592). A greater vigour and freedom of expression can be found in *Orsola* by P. Arlotto (1546) and in the tragedies of P. Torelli (1539-1608), *Merope*, *Tancredi*, *Galatea*, *Vittoria* and *Poldoro*.

During the baroque period the uniformity established in the preceding 16th century (the three unities, the division into five acts, the chorus) remained generally accepted and unchallenged, with a compromise between Greek and Senecan imitation. Nevertheless, new material from the political world, from the conflict between love and duty and from that between religion and individual instinct brought fresh vitality to the tragic theatre of the 17th century, particularly in the noteworthy *Aristodemo* by Carlo Dottori (1657) and in the tragedies of Eudocio della Valle, *Judith* and *Esther* (1637) and *La Regina di Scozia* (1628), in these latter plays compelling language and a genuine dramatic sense combine to express Della Valle's profound personality. An interest in the political world and a pompous, moralistic tone were common to many dramatists when the influence of French classicism and the tragedies of Corneille began to make itself felt, in religious drama a musical tendency, clearly visible in *Maddalena* and *Adamo* by G. B. Andreini, prevailed against attempts to fuse classical style and Christian elements together.

At the beginning of the 18th century a group of *trattatisti*, or didactic writers, sought to apply their theories in order to produce a simpler, less rigidly confined classical style, in reaction against the Aristotelian precepts and the spectacular, grandiose taste of the previous century. These writers included G. V. Gravina, with his treatises *Della ragion poetica* and *Della tragedia* and his five very frigid tragedies, P. J. Martelli, with his dialogue *Della tragedia antica e moderna* and his tragedies in verse imitating the French Alexandrine, and S. Maffei, whose *Merope* (1713), with its straightforward technique and use of simple blank verse, with out chorus, apologies or complicated stage machinery, was a most praiseworthy example of his championing of classicism in the French style, which influenced the theatre of the Arcadian period. Other examples of this influence are the tragedies of A. Conti (1677-1749), who in his *Giulio Cesare* and other works showed also the influence of Shakespearean tragedy.

The writer who in the second half of the 18th century contributed most to Italian drama was Count Vittorio Alfieri (1749-1803). A vigorous, poetical personality, forerunner of romanticism in his aspirations toward unfettered freedom, a lyricist in *Rime* and *Vita* and a political thinker, Alfieri turned to tragedy to express his passion and revolt. The Alfierian drama took for its main theme the struggle between the free man and the tyrant, with the devious intrigues of court life for its setting. His greatest tragedies, *Saul* (1782) and *Mirra* (1784-87), went beyond the boundaries of the merely political. The first named is the tragedy of the Hebrew king, devoured by jealousy of David, consumed by the anger within him, unquiet of spirit and abandoned by God. *Mirra* tells of the unhappy fate of a sensitive feminine soul oppressed by a morbid passion. The concise language and vigorous verse and the feeling of solitude with which Alfieri surrounds his characters make his tragedies the most important poetical expres-

sion of the 18th century.

In his three tragedies Ugo Foscolo closely imitated Alfieri, and the latter's influence is also apparent in the work of the greatest tragic writer of the Italian romantic school, Alessandro Manzoni, who, in *Il Conte di Carmagnola* (1816-20) and *Adelchi* (1820-22), gave personal expression to the romantic theories of historical drama. Religious and national sentiments inspired the Manzonian theatre, primarily political aims, linked with *Risorgimento* ideals, coloured the weak and often rhetorical tragedies of S. Pellico and G. B. Nicolini (*Arnaldo da Brescia*, 1849).

Pastoral Plays and Melodrama.—At the beginning of the 15th century pastoral fables were found, notably at the court of Ferrara, to be much in demand on the stage. *Egle* by Cinzio (1545) and *Sacrificio* by A. Beccan (1554) are the first examples of a dramatic composition in which tragic and comic elements are intermingled and shown against an idyllic background of pastoral life seen through the eyes of courtiers. In 1573 *Aminta*, a masterpiece by Tasso, was produced, *Il Pastor fido* by G. B. Guarini followed in 1590, and to these examples may be added the *Filii di sciro* by Giudobaldo Bonarelli.

Although in tragedy the 16th century had unsuccessfully tried to express deeply tragic subjects in decorous, classical style, in pastoral drama it achieved truly artistic expression in a field all its own. The longing for a natural world freed from impersonal laws and dominated by pleasure, resulted in an emotionally complex plot and a sensitiveness both musical and charming. In a certain sense pastoral drama is the forerunner of melodrama.

At the beginning of the 17th century, the Italian theatre introduced a new type of drama, called *melodrama*, which combined poetry, music and dance. The theory of Vincenzo Galilei (*Dialogo della musica antica e moderna*, 1581) and the collaboration of musicians such as Jacopo Peri and G. Caccini produced the first attempts to adapt the pastoral works of the late 16th century to music and influenced, later, the first true melodramas written by Ottavio Rinuccini (1567-1621), author of *Dafne*, *Euridice* and *Arianna*, and set to music by Peri and Claudio Monteverdi. During the 17th century increasing emphasis was laid on the spectacular elements in melodrama. The art of choreography and the creation of settings prevailed over the poetry.

In the 18th century Apostolo Zeno made an effort to raise the librettos of the melodramas to a higher political level and to rescue them from the vulgarity and extravagances of the 17th century "virtuosos." But it was Metastasio (Pietro Trapassi) (1698-1782) who brought in original, poetic creativeness to melodrama. During his long career as a poetic dramatist and particularly in his capacity as court poet in Vienna, he launched his writings—heroic and solemn in form and almost idyllic and Arcadian in substance—upon the European stage. His original, poetic world, formed of shadowy delicate sentiments, lent itself to song and music and expressed the sensibility of the first half of the 18th century, a period at once classical and "rococo." Outstanding among his numerous works are those of greatest lyrical inspiration, *Olimpiade*, *Didone abbandonata*, *Demofonte* and *Demetrio*.

Comedy.—Comedy, a literary form practised by many writers of the Renaissance, attained dignity in Lodovico Ariosto's plays, which in his day were well known and widely produced, particularly in France. Ariosto began by imitating Plautine and Terentian models (*La Cassaria*, 1508, *I Suppositi*, 1509) but his comic inspiration gradually improved in *Il Negromante* (1520) and in *La Lena* (1528), both of which were lively and richer in the poetry of daily life to which the contemporary scene at Cremona and Ferrara was very much more suited. It cannot, however, be said that any of the comedies in the Ariostan manner reach great artistic heights, not even the famous *La Calandria* by Bernardo Dovizio di Bibbiena (1513), in spite of his spirited superficial wit and gay, carefree sensuality. More vivacious and poetic were the comedies of Pietro Aretino (*Il Marescalco*, *La Cortigiana*, *L'Iporcuto*, *Talanta* and *Filosofo*), written between 1525 and 1542).

The use of material taken from classical and contemporary sources, including the *novelle*, and complicated themes from Plautus and Terence, and the interweaving of these elements with liveliness and wit, was the road indicated by Ariosto and followed

more or less by every playwright. As examples we have *La Gelosia*, *La Spiritata* and *La Puscocchera* by A. F. Graziani ("Il Lasca"), *Il Ragazzo* by L. Dolce, the work of the most able of them all, G. M. Cecchi (1518-87), who, known particularly for his *Assoluto*, enriches his comedies with the most characteristic forms of the spoken Florentine tongue, and the comedies of the Neapolitan G. B. della Porta (c. 1535-1615), *I Fratelli rivali* and *Trapolaria*, which in their merry exuberance seem to be the forerunners of the *commedia dell'arte*. However, the only important comedy of the century is *La Mandragola* (c. 1520) by N. Machiavelli (1469-1527), within the framework of the usual plot of adventure and lawdy intrigue, the author of *Il Principe* created a masterpiece of profound psychological meaning and theatrical competence. Perhaps worthy of special mention are two anonymous comedies *Gli Ingannati* (1531), a theme later used by Shakespeare in *Twelfth Night*, and *Veneziana*, written with an eye to feeling in a mixture of pure Italian and dialect.

It was through actor playwrights such as the Paduan Angelo Beolco, nicknamed "Il Ruzante," and the Venetian Andrea Calmo that in the middle of the 16th century, the *commedia dell'arte* was born, although it was in the following century that it became widely known throughout Europe. This type of drama was entirely dependent upon the skill and inventiveness of the actors, as the "writers" contributed only a brief outline and a summary description of the play, in such a way that it lost the character of a literary work and became predominantly a spectacle relying on scene setting, performance and make-up, it exercised an enormous influence on the European theatre.

In the 18th century, when the *commedia dell'arte* was practically reduced to an uninteresting, outworn fashion, the Italian comic theatre attained a new moment of greatness in the works of the Venetian writer Carlo Goldoni (1707-93), whose instinctive taste and vocation for the theatre was combined with creative originality. He was able to draw upon the small Venetian world to find subjects for his plays, which he invested with poetry of joyous yet tranquil rhythm, set off by characters in harmony with their social background, in a good-tempered, exquisitely 18th century comedy of manners. Goldoni brought a new dignity to comedy and also developed the construction of his plays from that of the *commedia dell'arte*. He abolished the conventional, immobile masks and wrote his plays in full, thus preventing the interposition of vulgar improvisations arising from the actors' whims. Works which stand out among Goldoni's prolific output are those in which the social setting in all its pleasing variety shares the limelight with the characters. Examples range from *La Bottega di caffè* to *Il Campiello* and from *I Rusteghi* to *La Baruffa chiosa sotto*. Count Carlo Gozzi (1720-1806), in competition with Goldoni and in order to demonstrate that public taste could still appreciate the fanciful, traditional form, created the *fiabe drammatiche* or fairy tales (*Turandot* and *L'Angelina beverde*) which so much pleased Goethe and the German romantics by their popular, whimsical tone.

The Modern Theatre—After the romantic period, in which Manzoni's tragic drama was matched by works of civic and patriotic interest, realism and naturalism made their first attempts to assert themselves. Examples of this new movement are *Nerone* (1871) by Pietro Cossa and *I mariti* (1865) by Achille Corelli. At that time the theatre concerned itself with social problems, with dialectical or problem plays of psychological and historical content. Such plays had made their appearance in the comedies of P. Ferrar, *Il Duello* and *La Due dame*.

In the period of *verismo*, the bourgeois plays of G. Rovetta, M. Praga, C. Bertolazzi, G. Antona Traversi and Giacosa (*Tristi amori*, 1887, *Come le foglie*, 1900) alternate with dialectal works in which Vittorio Bersezio of Turin (*Le miserie di Monsù Truetti*), the Venetian G. Gallina (*La Pomegia del santolo*) and, above all, the Neapolitan S. di Giacomo (*O' voto*, *Mese Mariano*, *Assunta spona*) distinguished themselves. In his few dramatic works (*L'avvertenza Russicana*, 1883, *La Lupa*, 1895) Giovanni Verga (1840-1922) revealed his strong sense of theatre and created an intensely poetic world which found its chief expression in his work as a novelist.

In the early 20th century comedy of the bourgeois type seemed, under the influence of the French theatre, in process of being supplanted by a romantic drama which suited the decadent taste of the period. An example of this is the eloquent but weak contribution of Gabriele d'Annunzio (1863-1938), from the plays which glorified the Nietzsche superman (*La città morta*, 1898, *La Gioconda*, 1899, *La Gloria*, 1899) to the rich historical reconstruction of *Francesca da Rimini* (1902), *Pu che l'amore* (1900), *La Nave* (1908), *Le Martyre de Saint Sébastien* and *La Pisanella* (the latter two in French), and the solitary masterpiece, *La Figlia di Jorio* (1904), in which d'Annunzio returned to picturesque pastoral myths for his inspiration. Both Sem Benelli (*La Cena delle Beffe*, 1909) and the more decorous E. L. Morselli, with his *Orione* (1911) and his *Glauco* (1920), in spite of obvious differences, can be considered to have come under d'Annunzio's influence. But the real dramatist of the modern Italian theatre was Luigi Pirandello (1867-1936), who, after a long career as a writer of short stories and novels, met with his greatest success in the theatre. Three plays—*Il Giuoco delle parti*, *Six personaggi in cerca di autore* (1921) and *Enrico IV* (1922)—represent the peak of his dramatic achievement and in one way or another influenced the whole theatre of the time. The torment of his characters, who live in hopeless solitude vainly trying to discover the meaning of their lives, his rapid and violent style and his peculiar dramatic technique, far removed from traditional forms, gave Pirandello's plays a pre eminent position in the Italian theatre.

After Pirandello's contemporaries, Rosso di San Secondo with his *Marionette, che passione!* (1918), L. Antonelli with *L'Uomo che incontrò sé stesso* (1918), L. Chiarelli with *La Maschera e il volto* (1917), mention may also be made of M. Bontempelli, S. Landi, U. Butti and Eduardo de Filippo.

Credit for the vitality and greatness of the modern Italian theatre must also be given to the actors who, in the 19th and 20th centuries, performed on the Italian stage and abroad, among whom were Eleonora Duse, Adelaide Ristori, G. Modena, Ermete Novelli, R. Ruggeri, T. Salvini and E. Zaccari.

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GERMAN DRAMA

The dramatic literature of Germany, in the beginning intimately connected with the Reformation, soon fell under the domination of foreign models. It was not until the middle of the 18th century that Germany developed a national drama of comprehensive character.

As in other European countries, dramatic activity sprang from religious sources and was particularly connected with the Christian holidays. For a long time, Latin and German plays ranged side by side. The former were cultivated by the humanists of whom Jakob Wimpfeling (1450-1528) and Johann Reuchlin (1455-1522) were the most prominent. In the age of the Counter Reformation, the Jesuits developed the Latin drama, particularly in the form of the school drama. The secular German drama, on the other hand, was first cultivated by the civic guilds. It found its first outstanding actor in Hans Sachs (1494-1576), the immortal shoemaker of Nuremberg, whose *Fastnachtsspiele* (Shrove-day plays), which he wrote in addition to numerous tragedies and comedies, abounded with a vigorous, if rather crude, humour.

Toward the close of the 16th and the early years of the 17th century, theatrical activities fell almost entirely into the hands of the "English comedians" who, with their crude representations of Elizabethan dramatists, called forth imitations by native authors. Among them, the most prominent were Jakob Ayer (d. 1605) and, later on, Andreas Gryphus (1616-64), who devoted himself chiefly to the imitation of English or Dutch tragedy and comedy.

The Thirty Years' War and its aftermath proved disastrous to the drama, as to all other cultural activities, and produced a

vacuum of nearly 100 years duration. The German buffoon, known as Hans Wurst, Pickelhering, Harlekin, etc., and modelled on the English fool, ruled the stage, while in serious drama blood curdling and pompous *Haupt- und Staatsaktionen* (high matter of state dramas) were the fashion. From this state, the German drama recovered only at the beginning of the 18th century. The honour is due mainly to the reformatory zeal of the Leipzig professor Johann Christoph Gottsched (1700-66), who, in collaboration with Karoline Neuber (1697-1766), the director of a theatrical company, abolished the Harlekin and put an end to the chaos of the existing stage. These endeavours he modelled on French tragedy and comedy, and himself supplied a tragedy, *Der sterbende Cato* (1731). The Leipzig school exercised a lasting effect on the art of acting, and before long produced in Konrad Ekhof (1720-78) an actor of distinction.

Lessing—Among the authors contributing to Karoline Neuber's enterprise was Gotthold Ephraim Lessing (1729-81), the first eminent figure in the history of the German drama. In his *Hamburgische Dramaturgie*, a running commentary on the efforts of the first national German theatre, established in Hamburg in 1767, he overthrew the domination of French classicism in favour of the English drama, above all, of Shakespeare. His own *Miss Sara Sampson* (1755) introduced the realism of English domestic drama to Germany. Then, in his *Mimna von Bernheim* (1767), he created one of the few great comedies of the German theatre, drawn from real life and appealing to patriotic sentiments. His third major work, the prose tragedy *Emilia Galotti* (1772), reflected the newly awakened pride of the rising middle classes and their struggle against the arbitrary rule of absolutism. In his last drama, *Nathan der Weise* (1779), he turned from prose to blank verse, thus pointing the way to the subsequent classical period of German drama.

The note sounded by Lessing met with a ready response. In Vienna, as in several other cities, national theatres came into being. The great actor Friedrich Ludwig Schröder (1744-1816) was the first to introduce Shakespeare in his true shape to the German stage. The translation of Shakespeare, begun in 1762 by Christoph Martin Wieland (1733-1813), and completed in 1775 by J. J. Eschenburg, though in prose, acted as the most potent stimulus on German dramatic literature. It was under the star of Shakespeare that a new generation of writers, known as *Sturm und Drang*, arose who worshipped their idol as the representative of "nature" in the theatre. The name of this group was derived from a play of one of their leading members, Friedrich Maximilian von Klinger (1752-1831). Beside him, the ill-starred young genius of J. M. R. Lenze (1751-92) was the most significant, other members were H. L. Wagner (1747-79), J. A. Leisewitz (1752-1806) and F. Müller, the "painter" (1749-1825). Though excessive in passion, and chaotic in form, this movement reflected the intellectual upheaval preceding the French Revolution.

Goethe—It was from the midst of *Sturm und Drang* that the greatest of German poets, Johann Wolfgang von Goethe (1749-1832), took his departure with his first play *Goetz von Berlichingen* (1773). Both by its original treatment of a theme from German history, and by its vigour and disregard of form, it destroyed the last remnants of theatrical conventions which Lessing had still respected. Goethe's two succeeding plays, *Clavijo* and *Stella*, are more of biographical interest than they are important contributions to the stage, whereas *Egmont* (1788) stands as a worthy

Schiller—Friedrich von Schiller's (1759-1805) genius, unlike Goethe's, was naturally and consistently suited to the clowns of the theatre. His juvenile works, *Die Rauber*, *Fiesco* and *Kabale und Liebe* (1781-84), vibrating under the influence of an age of social revolution, combined in their prose form the truthful expression of passion with considerable extravagance. But Schiller gradually emancipated himself from his earlier style, and with his earliest tragedy in verse, *Don Carlos* (1787), the first period of his dramatic authorship ends. The works of his maturity, from the *Wallenstein* trilogy (1798) to *Wilhelm Tell* (1804), are the acknowledged masterpieces of the German poetic drama, treating historic themes of various nations and clothing their dialogue in a noble vestment of rhetorical verse.

The joint efforts of Goethe and Schiller for the Weimar stage were important in many respects for the German drama. For a long time, however, popular taste favoured authors of a very different order. It oscillated between imitations of *Goetz*, the so called *Ritterdramen* (plays of chivalry) and *Ruhstucke* (sentimental melodramas). The most successful authors in this field were the actor August Wilhelm Iffland (1750-1814) and the prolific August von Kotzebue (1761-1819), whose production ranged from the domestic drama and comedy to attempts to rival Schiller in verse.

The Romantic Movement—Meanwhile the so called romantic movement of German literature had sprung up. To two of its leaders, Ludwig Tieck (1773-1853) and August Wilhelm von Schlegel (1767-1845), Germany owed its classical translations of Shakespeare and other great foreign dramatists. But their predilection for lyricism prevented them from creating an original drama of their own. Only a feeble outgrowth of the romantics achieved temporary success—the "destiny dramatists," among whom Zacharias Werner (1768-1833) and Adolf Müllner (1774-1829) were the most popular. They were in their turn satirized by August, Graf von Platen Hallermünde (1796-1835). It was with a play of this kind, *Die Ahnfrau* (1817), that the Austrian dramatist Franz Grillparzer (1791-1872) began his career. In his mature works, he carried on the classical tradition, treating themes from ancient Greece and subjects from Austrian history. Three dramatists of great power and promise, loosely connected with the romantic movement, succumbed to a premature death. Heinrich von Kleist (1777-1811), who produced his masterpiece with the Prussian drama *Der Prinz von Homburg* (1810), the extravagant Christian Dietrich Grabbe (1801-36), and Georg Buchner (1813-37), whose tragedy *Woyzeck* anticipated the modern social drama. The latter showed, together with Karl Gutzkow (1811-78), Gustav Freytag (1816-95) and Otto Ludwig (1813-65), a distinct trend toward realism. In Austria, Friedrich Halm (Eligius F. J., Freiherr von Munch-Bellinghausen) (1806-71), Eduard von Bauernfeld (1802-90) and, in the domain of fairy play and farce, Ferdinand Raimund (1790-1836) and J. Nestroy (1801-62) were names of literary mark, and a little later Ludwig Anzengruber (1839-89) imparted a new significance to the Austrian peasant drama. About the middle of the century the drama culminated in Friedrich Hebbel (1813-63), who combined masterly classical form with a psychological insight which pointed to the future.

The 25 years following the death of Hebbel, which saw the establishment of the new German empire, were remarkably poor in original dramatic production. The outstanding events in the theatrical field were the inauguration of Richard Wagner's Bayreuth theatre by his *Der Ring des Nibelungen* in 1876, and the stage of Duke Georg of Saxe-Meiningen (between 1874 and 1890), which reached an unprecedented standard of ensemble play. Finally, the opening of the Deutsches Theater in Berlin (1883), under the direction of Adolf L'Arronge (1838-1908), heralded a new epoch of the German drama.

Naturalism and Symbolism—Under the influence of French and Scandinavian realism, particularly of Ibsen, a new dramatic movement sprang into existence in the 1890s, known as naturalism, which was chiefly devoted to social drama. It was inaugurated by Gerhart Hauptmann (1862-1946) with his first play *Vor Sonnenaufgang*, and by Hermann Sudermann (1857-1928) with his *Die Ehre*, both produced in 1889. With them were associated a

spheres of thought and experience. Though dramatic in form, this truly world-embracing poem transcends the limits of drama in its accepted sense.

number of young playwrights such as Max Halbe (1865-1944), O C Hartleben (1864-1905) and Georg Hirschfeld (1873-1939). While all these had soon spent their forces, Hauptmann held the stage throughout his long life. After his stirring social drama *Die Weber* (1892) and his excellent comedy *Der Biberpelz* (1893), he turned to more poetic themes (*Die versunkene Glocke*, 1896). From then onward, he alternated between realistic plays and poetic drama, maintaining his position as the foremost German dramatist down to his final tetralogy of the *Atrides* (1914-44).

Whereas the naturalistic movement was mainly centred on Berlin, there sprang up in Vienna a reaction which cultivated the poetic and symbolic drama. Its declared leader was Hugo von Hofmannsthal (1874-1929), who earned world fame after World War I through the Salzburg festivals to which he contributed his religious play *Jedermann*. Other Austrian dramatists of distinction were Hermann Bahr (1863-1934), Arthur Schnitzler (1862-1931), Anton Wildgans (1881-1932) and Karl Schönherr (1867-1942), who attained wide popularity with his dramas of peasant life, notably *Glaube und Heimat* (1911).

Wedeckung (1864–1918), with his startling and grotesque plays, and Karl Sternheim (1878–1943), with his caustic satires on bourgeois morality, prepared the way for the so called expressionist movement. It attained its peak, inspired by fervent pacifist views, at the end of World War I. Its foremost representatives were Georg Kaiser (1878–1945) and Ernst Toller (1893–1939). The former, an exceedingly prolific writer, gave the movement such characteristic plays as *Die Burgen von Calais* (1914), *Vom Morgens bis Mitternachts* (1916) and the trilogy *Gaia* (1918–20), while Toller's most significant contributions were the antiwar play *Die Wandlung* (1919) and *Masse Mensch* (1921). Other expressionist dramatists of distinction were Reinhard Seeger (1892–1916), Walter Hasenclever (1890–1941), Reinhard Goering (1887–1936), with his naval drama *Seeschlacht* (1917), and Fritz von Unruh (1885–)

The storm of expressionism soon blew over and gave way to a more solid, realistic form of drama. In the middle of the 1920s, a new set of writers emerged, the most promising of whom were B. Brecht (1898-) and C. Zuckmayer (1896-). After 1933, the ruthless policy of the nazis deprived Germany of most of her best playwrights. The destruction wrought in World War II left German theatrical life in a state of chaos from which it was slow to recover.

The German theatre during the first part of the 20th century attained an unsurpassed standard, largely because of the example of Max Reinhardt (1873-1943), whose productions included the whole range of dramatic literature, both classical and modern. In the early 1900s a new style of production, adapted to expressionist drama, was introduced by L. Jessner (1878-1945), E. Piscator (1893-) and others, who were strongly influenced by, and in their turn influenced the Russian revolutionary theatre. After World War II the numerous court theatres were transformed into state or municipal theatres. In addition, co-operative undertakings, so-called Volkstheatern, sprang up, based on small annual contributions of their members. These subsidies of various types made the German theatres less dependent than those in other countries on the speculative commercial manager and the success or failure of individual plays.

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DUTCH DRAMA

The oldest extant specimens of Dutch mediaeval drama date from the end of the 14th and the beginning of the 15th centuries. The 16th century is the century of the morality or *Spel van Sinnen*, which is the typical rhetoricians' play, and in which all, or nearly all, the characters are allegorical. One of the earliest and most beautiful of these moralities, *Elckerlyc* (*Everyman*), is still performed.

The so called "golden century" was the summit of the Renaissance and a most important period in the history of Dutch drama. Gerbrand Adriaanszoon Bredero (1585-1618) displayed his original talent in comic interludes which he expanded into farces. Pieter Cornelisssens Hoofwrote, mainly under the influence of Seneca, such plays as *Achilles en Polyxena*. The greatest Dutch dramatist, however, is Joost van den Vondel, the author of 32 dramas, of which 24 are tragedies (*Costly Blood*, *Lucifer* and *Gerardus*). His preference was for the treatment of stories from the Bible and his finest play was *Luifer* (1654), which shows a considerable resemblance to Milton's *Paradise Lost*.

At the end of the 17th century there were a few poets who wrote *comédies de mœurs*. Meanwhile the time of the Dichtgenootschappen (poetic societies) had arrived. Their entire theory of art consisted in recommending the imitation of French classical drama. The comedies of Pieter Langendijk, a disciple of Molière, represented something of higher value. After 1760 French middle class drama was extensively translated and copied in the Netherlands. In the 19th century romanticism triumphed on the Dutch stage in the works of Hendrik Jan Schimmell (1823-1906), who wrote, among other plays, *Two Tudors* and some patriotic dramas. A play *Vorstenschol* (*The School for Princes*) by Edward Douwes Dekker, one of the greatest Dutch writers, better known under the pseudonym of 'Multatuli', made a sensation when it appeared in 1872.

Representative of modern drama in the Netherlands are Marcellus Emants, a pessimistic, *fin de siècle* figure, one of whose most satisfying works is *Domheersmacht* (*The Power of Stupidity*), Frederik van Eeden, Henriette Roland Holst, who wrote in 1912 a verse drama *Thomas More* which was first performed in 1949, Mrs J. A. Simons Mees, who brought to the stage of the psychology in conflict of modern life, and Herman Heyermans, a Socialist in revolt against the bourgeoisie, who gained recognition far beyond his native frontiers. Other notable contributions are *De Puisterkerk*, Menno ter Braak's satire on armaments trusts, and Muntz Dekker's later plays. The dramatic work of the best seller writer J. de Hartog attracted attention in Great Britain and the United States. A. Defresne, Ben van Eysseltseyn and Ary den Hertog were among authors who devoted themselves more or less exclusively to writing for the stage.

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DANISH DRAMA

In Danish drama the 16th century was the time of the school comedies, among which the best is H. J. Ransch's *Kørrig Nidding* (c. 1600). In the 18th century Denmark's first and foremost dramatist, Ludvig Holberg, Baron Holberg (see *Norwegian Drama*, below), was influenced by Molière, but his vivacious and witty dialogue and brilliant characterization were highly original. His comedies were performed at the time of the opening of the first Danish theatre (1722). Of Holberg's 33 comedies the first 15 (written 1722–23) are comedies of character, and among them are his masterpieces, *Jeppe on the Hill*, *Erasmus Montanus* and *The Political Tinker*. They are witty social satires, reflecting the life of the peasantry, the undergraduates and the middle classes of Holberg's own time. From 1723 to 1727 Holberg wrote 11 comedies of manners, in which he made use of a set of typical figures corresponding to those of the *commedia dell'arte*.

As a dramatist, Johannes Ewald heralded the new romantic

movement, brought in new subjects and struck a new note in his serious dramas. In *The Death of Balder and Rolf Krage* he introduced subjects from Nordic mythology and from Saxo Grammaticus, and in *The Fishermen* (1778) he struck a new patriotic note and made humble fishermen the heroes of his drama. Adam Oehlenschläger is, however, the most representative figure of Danish romantic drama. Like Ewald he was influenced by Shakespeare, but also by Schiller and Goethe. Among his plays *Sanct Hansaften-Spil* (1802), *Aladdin* (1805), *Hakon Jarl* (1807) and *Baldur hin Gode* (1807) are of great lyric beauty and declamatory power, richly imaged in language. J. L. Heiberg transplanted the French vaudeville into Danish soil and, in addition to his charming musical plays, wrote some serious romantic dramas. Henrik Hertz also wrote entertaining middle class comedies and farces and two important romantic dramas, *Svend Dyrings House* (1837) and *King René's Daughter* (1845). Holger Drachmann, though mainly a lyrical poet, contributed some lyrical dramas of high quality. Toward the end of the 19th century the realistic drama is represented by Gustav Wied, whose bitter and cynical plays were a reaction against the prevalent romantic dramas.

A revival of the modern Danish drama was made by the two most prominent dramatists of the 20th century, Kaj Munk and Kjeld Abell. The dramas of Kaj Munk revive Shakespearean, heroic motives and are mostly religious, as *An Idealist or The Word*, and occasionally also political, as *He Sits at the Melting Pot*. The plays of Kjeld Abell are antinaturalistic and influenced by modern French drama, and discuss the fundamental problems of modern man (*Anna Sophie Hedvig* and *Days on a Cloud*).

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NORWEGIAN DRAMA

The Norwegian drama, which reached a zenith in the plays of Ibsen, is the most vigorous revelation of the mind of a nation that has occurred in recent times. It is no sudden growth, but rather a natural development of the Norwegian genius which first manifested itself in the national folklore. The chief characteristics of both are a spirit of individual independence tempered with good humour and considerable self reliance. For the latter, the natural difficulties of the country, with its secluded community life, must be held responsible.

The drama, as a special branch of art, was unknown in Norway almost up to the 19th century, and there existed none of the elements that are required for the growth and prosperity of a national drama. The country possessed no reigning court and no wealthy nobility, nor was there, with the single exception of Bergen, any town in Norway that possessed sufficient vision to lay the foundations of dramatic art of the future. In Bergen was born Ludvig Holberg, Baron Holberg (q.v.) (1684-1754), one of the greatest dramatists of all time and the founder of modern Norwegian and Danish literature. Because Norway was too impoverished to support a considerable intellectual and cultural life, Holberg took up his abode in Denmark. After Holberg, Johan Herman Wessel (1742-85) should be mentioned. His well known burlesque *Love without Stockings* remained popular, despite the fact that the school of tragedy against which it was originally directed had long since ceased to exist.

Notwithstanding the basis of drama laid by Holberg and Wessel it need hardly be said that a national drama in the true sense of the word could exist only after the dissolution of the union with Denmark in 1814. By this event Norway became once more possessed of the sovereign liberty necessary for the evolution of an independent culture, yet more than a generation had to elapse before the first national theatre was founded in Bergen in 1850. This theatre, which was the result of the initiative of Ole Bull (1810-80), an art enthusiast and one of the foremost violinists of Europe, marked the first step in the direction of an exclusively Norwegian stage. At that time the Christiania theatre, which had opened in

1837, had an entirely Danish personnel. Though the Bergen theatre numbered Ibsen and Bjørnson among its managers, it was eventually forced to close, overburdened with financial difficulties. Despite its defeat, the National Stage of Bergen, still the official name of the Bergen theatre, had proved the possibility of a Norwegian theatre, and after a struggle lasting for a number of years a national theatre was established at both Bergen and Christiania.

Meanwhile Henrik Ibsen (q.v.) (1828-1906) and Bjørnstjerne Bjørnson (q.v.) (1832-1910) had come to the front in Norwegian literature in the late '50s, and within less than ten years they both produced a number of dramatic works of rare value.

From the beginning of the '70s, a change came over Norwegian literature that was to exercise a considerable influence over Ibsen and Bjørnson. The chief characteristic of this period was its pronounced realistic spirit which produced the modern social drama. The dramas of Ibsen and Bjørnson were not only stamped with the keen intellect and the intense sensitiveness of their creators, but they represented the supreme attainment of European culture at the moment.

Next to Ibsen and Bjørnson, Gunar Heiberg (1857-1929) must be mentioned. The chief characteristic of his drama is the sharp and trenchant dialogue, but with the exception of *The Balcony* (1894) and *Love's Tragedy* (1904) his plays can scarcely be considered lasting works of art. These two plays, in which he showed love as a destructive force of nature, overwhelming in its consequences, will always bear witness to his talent. Unfortunately Heiberg did not develop as a dramatic author, and as a whole the Norwegian drama after Ibsen and Bjørnson followed more fortunate lines. This applied, by way of example, to *The Happy Election* (1914) by Niels Kjaer (1870-1924), in which this author, considered one of the most accomplished writers of modern Norwegian prose, dealt with certain contemporary phenomena of Norwegian politics, among them the language question, in a very clever and realistic way. Another example was Oskar Braaten (1881-1939), who scored great success on the stage with his comedies *The Kid* (1911) and *The Wholesome Christening* (1925), written in the characteristic language of the industrial population in the vicinity of Oslo and dealing with its life and manners. A dramatist of an entirely different type was Hans E. Kinck (1865-1926), whose remarkable drama *The Cattle Dealer* (1908) was, in the opinion of many critics, unrivalled in Norwegian literature since Ibsen's *Peer Gynt*.

Prominent among playwrights in the first half of the 20th century were Helge Krog (1886-) and Nordahl Grieg (1902-43). Krog's best-known works, *On the Way* and *Break-Up*, are clearly reminiscent of the Ibsen-Heiberg tradition, with their incisive style and merciless analysis of character. Grieg's haunting dramas, while endeavouring to adapt Russian technique, portray the conflicting national tendencies of the period between World Wars I and II. In *The Defeat* (1938), however, Grieg went back to the days of the Paris commune for his material, a choice obviously influenced by the European crisis.

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SWEDISH DRAMA

The first extant Swedish plays date from the Reformation of the 16th century. The naive biblical drama *Tobias Comedia*, attributed to Olaus Petri (1493-1552) is the best known. A didactic tendency still marks the drama well into the 17th century (for instance, the formless works of Johannes Messenius [1579-1636]), but in Magnus Asterophorus' *Tyske* (first performed in 1609) a desire to entertain is also found. Skill in versification, rather than dramatic quality, is to be found in the masques of Georg Stermhelt (1598-1672). As yet no professional theatre existed. Urban Hiarnes' (1641-1724) *Rosmunda* (first acted in 1665), written for a company of Uppsala students, was the first Swedish attempt at a classical tragedy. Imitations of the latter genre dominated the Swedish drama throughout the 18th century, interest in

the theatre having been stimulated by the establishment of the first professional stage at Lönkyland (Lion's Den) in Stockholm in 1686 and by the increasingly frequent visits of foreign companies. *Brynhilda* by Olof von Dalin (1708-63) rather clumsily reflects the influence of Racine, whereas the works written or planned by King Gustavus III (1746-92) for theatre or opera are modelled on Voltaire. Gustavus' devotion to the stage had a stimulating effect, the dramatic works of the poets Johan Kellgren (1751-95), C. Leopold (1756-1829) and G. Adlerbeth (1751-1818) were largely written for the king. Meanwhile, Count Carl Gyllenborg (1769-1746) with his satire *Svenska Spratteloken* (The Swedish Pop) and Dalin with *Den Avundsjuka* (The Envious Man) had produced the first genuine attempts at native Swedish comedy.

The romantic movement in Sweden produced no living theatre. The poetic masterpiece of P. D. A. Atterberg (1790-1855), *Lycksaligheten* (The Isle of Bliss), the verse plays of E. Stagnelius (1793-1823) and the dramas of Karl J. L. Almqvist (1793-1866) were not suitable for the stage, even the "Schillerian" historical plays of Baron von Beskow (1796-1868) did not reach the theatre until 1862. The less literary historical dramas of Frans Hedberg (1828-1908) were, however, frequently acted, as was *Värmland ingarna* (The Värmland People) by F. A. Dahlgren (1816-95).

No Swedish dramatist can stand comparison with August Strindberg (1849-1912), who enriched not only the Swedish but also the international theatre with a number of outstanding plays, exercising great influence, particularly on the German and U.S. drama. In his hands the drama became a vehicle for modern ideas. In the provocative *Fadren* (The Father) and *Fröken Julie* (Lady Julia), for instance, both from his naturalistic period, he takes up the conflict between the sexes. With *Master Olof* (1874) and *Gustav Vasa* (1899) he infused new life into the historical drama. In the plays written after his spiritual crisis (c. 1894-97), for instance in *Till Damaskus* and *Ett Drömspel* (A Dream Play), he used a fluid, at times visionary, form to embody his own search for a solution to life's mysteries. With the *Kammarspel* (chamber play) he developed in 1907 a technique pointing forward to expressionism but unique in its power and suggestiveness.

Of the realistic dramatists who looked to Strindberg one may mention Anna Charlotte Leffler (1849-92) and Victoria Benedictson (Ernst Ahlgren, 1850-88). P. Lagerkvist (1891-), taking up Strindberg's expressionist manner, produced some very effective plays. H. Bergman (1883-1931) and S. Dagerman (1923-), the latter representative of the '40s movement, both did interesting work.

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POLISH DRAMA

The Dismissal of the Greek Envoys by the great 16th-century poet Jan Kochanowski (1530-84) was Poland's first important drama, but it was not until the 18th century, under the patronage of King Stanislaus II Augustus (Poniatowski) that the theatre found its independent medium. Influenced by visiting Italian and French troupes, a Polish national theatre was founded by Wojciech Boguski (c. 1759-1821) whose play *The Czar's Servants* (*Slugi Czarza*) is still performed. Poland's first poet, Adam Mickiewicz, was one of the romantic poets with *Two Forefathers*. His drama in verse dealing with political problems of the times, is unequalled both for its poetic vision and for the extraordinary variety of its form and conception. His contemporary Juliusz Słowacki (1809-49) gave Poland five creative tragedies (*Przełom*, *Iskra*, *Przełom*, *Przełom*) and major patriotic romantic dramas in the grand style of Schiller and Shakespeare. With the *Polish Comedy* Count Zygmunt Krasiński (1812-91) brought to the theatre themes of social conflict and a forecast of revolution. A Count Alexander Fredro (1793-1876) the father of Polish comedy, wrote many farces and comedies of manner on the life of the gentry in magnificent verse (*The Revenge*, *Maidens' Vow*).

A new epoch, the Cracow period, began in 1890 under Jan Głowacki, manager of the Cracow theatre, and a dominant

personality here was the painter and poet Stanisław Wyspiański (1869-1907), who created his own style in works ranging from tragedy to patriotic symbolism (*The Wedding*, *The Acropolis*, *The Curse*). At the same time Gabriela Zapolska (1860-1921) led the school of realistic conventional drama. Her masterpiece, *The Morality of Mrs. Dulsko*, is a biting satire on contemporary bourgeois morals. Włodzisław Perzyski (1879-1930) with *Luck of Framo* and August Kisielewski (1876-1918) with *The Trapped* worked on similar lines.

The romantic patriotic tradition continued until the rebirth of Poland as a nation in 1918 and was carried over into the 20th century by Poland's greatest novelist Stefan Żeromski (1864-1925) in *Sukowski* and *My Little Quail has Flown Away*. In the years between World Wars I and II, drama broke away from this style and developed psychological and historic themes. Outstanding playwrights of this period were the Catholic Karol Hubert Rostworowski (*Judas*, *Charitas*), Adolf Nowaczyński (*Frederick the Great*) and Jerzy Szaniawski (*The Bird*, *The Lawyer* and *The Roses*). A playwright of comedies and satires on political problems (*The Family*) was the poet Antoni Słonimski. S. Witkiewski, painter and philosopher, created outstanding surrealist dramas. The distinguished novelist Jarosław Iwaszkiewicz dramatized the life of Chopin (*Summer in Nohani*) and Puskin. Zofia Nałkowska and Maria Pawlikowska presented the problem of women in modern society as the theme for a number of excellent plays.

Drama in Poland following World War II was mainly concerned with problems of modern society. Most representative of this trend was the Marxist Leon Kruckiowski (*The Germans*).

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CZECHOSLOVAK DRAMA

Early Czech and Slovak drama had its roots in religious drama, the mystery and morality plays, out of which grew the student drama which reached its culminating point in the baroque period. A second branch growing out of mediaeval farces led to popular drama and peasant comedy. It was this tradition which inspired the beginnings of modern Czech drama early in the 19th century. Plays (often adaptations of foreign works) by V. K. Klicpera (1792-1859) and J. K. Tyl (1808-56) in Bohemia, and by J. Chalupa (1791-1871) in Slovakia, mainly served the aims of the literary revival. A hope prematurely extinguished was E. Bozděch (1841-89), the author of conversation pieces. The first realists, F. V. Jeřábek (1836-93) with *His Master's Servant* and L. Stroupecký (1836-92) with *The Braggarts*, were followed by M. A. Šimacek (1860-1913), the brothers A. Mrštík (1861-1925) and V. Mrštík (1863-1912), the authors of *Maryša*, M. G. Pressová (1862-1946), and, in Slovakia, by J. Palanik (1822-70). Historical and mythological plays by the poets J. Vrchlický (1853-1912) and J. Zeyer (1841-1901), by the novelist A. Jirásek (1851-1930), by F. A. Šubrt (1849-1915) and by the Slovak J. Záborský (1812-76) expressed the political aspirations of the nation.

Mainly as Shakespearean producers should be remembered J. Kvapil (1868-1950) and his expressionist rival K. H. Hilár (1884-1935). Modern Czech drama of a distinctive national character with a universal appeal came into its own only in the second and third decades of the 20th century, with such names as J. Mahen (1882-1919), V. Dyk (1877-1937), F. Šrámek (1877-), Karel Capek (1890-1938) and F. Langer (1888). Modern Slovak drama is represented by a few names only, viz. J. Gregor-Tajovský (1874-1940), I. Stodola (1888-), and, in the younger generation, J. Barč Ivan (1909-). (A, S, K)

RUSSIAN DRAMA

The Russian drama and theatre were for a long time dependent upon foreign examples. At first they were strongly influenced by the religious spirit of the Byzantine theatre. Plays taken from the repertoires of German strolling actors, the mysteries and morabates after the Jesuit school model which came through Poland, were first introduced in the second half of the 17th century

In a European sense the theatre began during the reign of Alexey Mikhailovich under a certain Gregory, whose productions on biblical themes took place in Moscow in 1672. The real father of the Russian theatre proper was Fedor Volkov (1729-63). The continuous output of original drama begins with the production of the first tragedy in the French style by Alexander Sumarokov (1717-74) in the Russian court theatre, established by Elizaveta Petrovna in 1747. This style dominated tragedy as well as comedy, with playwrights such as Yakov Knyazhin (1742-93) and Alexey Khomyakov (1804-60). Catherine II herself wrote plays.

From classicism the theatre moved through the melodrama to realism, as seen in the work of Denis Fonvisin (1744-92, *The Brigadier*, *Nedorosli*), the first significant comedy writer. Fonvisin's realistic satire culminated in the great comedy of Alexander Griboyedov (*q v*) (*Woe from Wit*) and the still greater plays of Nikolai Gogol (*q v*) (*The Inspector General*, 1836). Gogol was the first playwright to introduce plot as well as character driving, he was also a master of dramatic construction and the first to lend more importance to the producer's task. His tradition was continued by Alexander Sukhovo-Kobylin (1817-1903) (*Wedding of Krechinsky*, *Death of Tarelkin*) and Alexey Psemsky (*q v*), whose *A Bitter Fate* is a realistic tragedy of great power. The historical drama in verse after the Shakespearean model as introduced by Alexander Pushkin (*q v*) and Mikhail Lermontov (*q v*)—strongly influenced by Schiller—and had a good exponent in Alexei Konstantinovich, Count Tolstoy (*q v*), whose work, however, is reminiscent of operatic pageants. The great Alexander Ostrovsky (*q v*) devoted himself exclusively to the drama, his best plays being *The Storm* (1860) and *The Forest* (1871). Because of his efforts the Russian drama alone in Europe was free from the dictatorship of Augustin Scribe. He symbolizes the Russian theatre's coming of age, but, like most Russian playwrights, he neglects the plot and concentrates on character. To this same period belongs Ivan Turgenev's (*q v*) *A Month in the Country* (1866), a psychological comedy. Count Leo Tolstoy (*q v*) wrote plays in his later years, but the *Power of Darkness* (1889), *The Fruits of Enlightenment* (1891) and *The Living Corpse* (1911) are dramatized novels more than plays. After Tolstoy naturalistic realism was continued by Maxim Gorky, as in his masterpiece *No Dne* (*The Lower Depths*, 1903), *Yegor Bulachev* and *The Others*, produced 30 years later, is composed on a different, less fatalistic, formula. Mikhail Artsybashev (*q v*), made an attempt to bring eroticism to the stage in *Jealousy* (1913), but had not much success. Ilya Surguchev (1882-) tried in 1914 to revive the psychological drama in *Autumn Visions*.

Anton Chekhov (*q v*) started writing for the theatre in 1884, but his fame reached its peak with the production of *The Seagull* by the Moscow Art theatre in 1898. His real strength comes from his mastery of laughter, though sadness is also an inherent part of his being. His one-act plays are essential for the understanding of his full-length dramas, *Ivanov*, *Uncle Vanya*, *The Seagull*, *The Three Sisters* and *The Cherry Orchard*. He wrote his plays in prose, yet the epithet "poetic" applies to them more. He continued the tradition of Turgenev in eliminating the element of plot and removing all theatrical effect. Stanislavsky's (Constantine Sergeevich Alexeev, 1863-1938) (*q v*) absolute subordination of the actor to the producer was well suited to Chekhov's theatre. Chekhov marks the decline of Russian realistic drama, essentially static and lacking in logical unity.

Leonid Andreyev (*q v*) and Nikolai N. Yevreinov (1879-) both tried to release the stage from the incubus of realism. Andreyev was the first to introduce symbolism on the stage in *The Life of Man* (1907), *Days of Our Life* (1908) and *He Who Gets Slapped*, but too much sentiment enters into the would-be tragedy. Yevreinov exploited the theatrical and was inclined toward the comic, even if the comedy was often bitter. Even more clearly is that mirrored in the poetic dramas of Alexander Blok (*q v*), where the play of imagination mingles with satirical laughter and ironic fancies (*Balaganchik*, 1906, *The Stranger*, 1907, *The Rose and the Cross*). Fedor Sologub (*q v*) belongs to the same school.

The main movement after that was represented by the producers Vsevolod Meyerhold (*q v*), Alexander Tairov (1892-

1923?), Evgheny Vakhtangov (1880-1922) (the Hebrew theatre) and Alexander Granovsky (1877-1915?) (the Yiddish theatre), and consisted in the desire to "deliteralize" the stage. The play tended to become a matter of pure show. After 1917 the revolutionary ideas at first allied themselves with literary futurism, but the futurist drama produced only the excellent *Mystery Bouffe* of Vladimir Mayakovsky (1883-1930) and the propaganda plays of Sergey Tretyakov (1893-7), *Row China*. The official bolshevik drama was represented by Anatoly Lunacharsky (*q v*) but soon approached the true spirit of tragedy in the plays of pure action of Leo Lunts (1901-24) (*Outlawed*, 1921). There followed a series of plays about the Red army during the civil wars—*The Armoured Train* by Vsevolod Ivnov (1895-1949), *Chapayev* by Dimitry Furmanov (1891-1926), Mikhail Bulgakov's (1891-1940) *Days of the Turbines*, Alexander Korneychuk's (1905-) *Wreck of a Squadron*, Alexey Nikolayevich Tolstoy's (1882-1945) *Path to Victory* and L. Rakhmanov's *Professor Polzheyshev*. As Stanislavsky said, it was an overhauling of the old, a seeking for new paths. A new "Socialist realism" began to creep in as seen in a play by Nikolay E. Virla (1906-), *Earth—conflict* between a peasant and a partisan. The vogue for the historical drama became marked and K. Trenev (1877-1945), a playwright whose work formed a bridge between past and contemporary drama, wrote *The Pugachev Rebellion*. In the early 1930s there was a return to the individual and his inner conflicts, of which the better exponents are Leonid Leonov (1899-) (*The Wolf, Orchards of the Polovtsy*), Alexander Afanogenov (1904-41) (*Fear*, showing the deep influence of Chekhov), Valentin Katayev (1897-) (*Squaring the Circle*) and, later, Nikolay Pogodin (1900-) (*q v*), with a strong tendency to farce (*My Friend*). But though experimental forms found their freest scope in the U.S.S.R., drama had to be informative and propagandist, as shown in the work of Konstantin Simonov (1915-) (*The Russian People*). Labour, not love, becomes the central subject and beauty is seen within the limits of ideological struggle.

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UNITED STATES DRAMA

The first specimens of dramatic writing in the United States, reflecting the tastes and tendencies of colonial and revolutionary life, showed definite English, with now and then suggestions of Teutonic influences. They were all imitative and have no interest today except as curios. Only two plays written by Americans were actually presented on the stage before the Revolution. *The Prince of Parthia*, a blank verse tragedy by Thomas Godfrey the younger, and *The Conquest of Canada, or the Siege of Quebec*, an attempt at historical drama by George Cocking. Neither contained a symptom of promise so far as native drama was concerned, nor was any discernible in the plays written by Americans in the period immediately after. Among these we have as outstanding examples the recreant Maj. Robert Rogers' blank verse tragedy *Pontiac*, or *The Savages of America*, a blank verse lampoon of certain Boston celebrities of the day, under the title *The Group*, written by Mrs. Mercy Warren (wife of Gen. James Warren), who had gained a measure of partisan notoriety previously with a play called *The Blockheads*, an answer to Gen. John Burgoyne's satiric farce, *The Blockade of Boston*, a patriotic play in blank verse, *The Battle of Bunker's Hill*, by Hugh Henry Brackenridge, another patriotic affair, *The Fall of British Tyranny*, by John Leacock, incidentally the first example of an American chronicle play and the first in which George Washington appeared as a character, and a comedy reflecting the political spirit of the time (c. 1798) called *The Politician Out Witted*, by Samuel Low, in which we have the earliest known instance of the local theatrical use of Negro dialect.

The beginning of what, though still somewhat euphemistically, may be termed the real American drama was synchronous with the active appearance on the American scene of William Dunlap, in many respects the father of the American stage, and Royall

Idea The latter's comedy *The Contrast* (the second play written by an American to be produced in America by a professional company of actors, *The Prince of Parthia* being the first) was acted in 1787 and was the first dramatic work to introduce the character that has since become known as the stage Yankee. Written under the inspiration of *The School for Scandal*, it was also the first American play to achieve a box office success. Dunlap wrote or adapted about 60 plays, of which the best known is his blank verse tragedy, *André*, produced in 1798.

Among the more significant of their successors, at least in a historical sense, were James Nelson Barker, author of *The Indian Princess*, or *La Belle Sauvage*, the earliest play on the Pocahontas theme, converted into a libretto for a so called "operatic melodrama," and produced in 1803; Mordecai M. Noah, whose *She Would Be a Soldier*, or *The Plains of Chippewa*, a historical drama, was shown in 1819; Joseph Hutton, actor and playwright, author of *Fashionable Follies*, or *The Fall of Tarquin* and *Charles the Second*; and Richard Penn Smith, author of the historical play dealing with the War of 1812, *The Triumph of Plattsburg*.

In the '30s of the 19th century there was much dramatic activity. Such things as George Washington Parke Custis' *Pocahontas*, or *The Settlers of Virginia*, Robert Montgomery Bird's *The Gladiator*, and *The Broker of Bogota*, John Augustus Stone's *Metamora*—all ranting opera written under the inspiration of the actor Edwin Forrest, Nathaniel P. Willis' *Torresia the Usurer*, written under the eye of James Wallack, for his own use, Joseph Stevens Jones' *The People's Lawyer* (with the unforgotten character "Solon Shingle"), and Robert F. Conrad's *Jack Cade*, another machine made Edwin Forrest vehicle, cleared the way for what may fairly be called the first American play of social manners—*The Contrast*, though a social satire, may be dismissed as negligible—and the first native comedy of even mild merit, namely, Anna Cora Ogden Mowatt's *Fashion*, written under the strong influence of Sheridan, and produced in 1845. This *Fashion*, which enjoyed success in England as well, marks what is practically the birth of a native drama, however modest, worth critical consideration. In the years following its presentation there came into being *Uncle Tom's Cabin*, dramatized from Harriet Beecher Stowe's novel by George L. Aiken, Mrs. Sidney F. Bateman's *Self*, Clifton W. Taylour's *Horseshoe Robinson*, the transplanted Dion Boucault's *The Octoroon*, dealing with the slavery question, in 1859, Frank Mayo's *Davy Crockett*, the dramatization of Washington Irving's *Rip Van Winkle* by Joseph Jefferson, and, finally, Steele MacKaye's *Hazel Kirke* and *Paul Kupper*.

Gradually, now, the U.S. drama began to move on feet of its own, instead of relying almost entirely upon foreign crutches. MacKaye revolutionized the mechanics of the American stage as he had found it and, with them, certain phases of dramaturgy, at least as it had been practised. A new order of playwrights grew up. Among these, the first was Bronson Howard, the dominant dramatist in the U.S. theatre of his day. Howard is best known for his military melodrama, *Shenandoah*, based upon a work written 20 years before, subjected to several revisions and produced in the late '80s. Among his other plays were *Saratoga* (produced as early as 1870), *The Young Mrs. Winthrop*, *The Henrietta* and *Aristocracy*. Foreign influences were clearly discernible in some of these, as well as in others that he wrote, but above them sounded a distinctly native note that was not lost upon U.S. audiences. The last decade of the century witnessed the abandonment of the European crutches to an even greater degree. William Gillette with his melodramas, *Held by the Enemy* and *Secret Service*, established U.S. drama as a thing of itself. James A. Herne, with his pioneer realism in *Shore Acres*, *Griffith Davenport* and *Sag Harbor*—to say nothing of *Margaret Fleming*—brought the U.S. drama even more positively into its own. Charles H. Hoyt, with his farces and comedies, brought American types and phases of American life bodily into the theatre. The movement was furthered by Clyde Fitch, with his commentaries on the lighter side of U.S. society, and by Augustus Thomas, with his series of so called "state plays," beginning with *In Mesure*. Langdon Mitchell appeared with *The New York*

Idea George M. Cohan, whose influence was to colour much of American dramatic writing for many years afterward, began to write musical pieces and later farces and comedies that were genuinely American, as also were George Ade's *The College Widow* and *The County Chairman*. William Vaughn Moody, with *The Great Divide* and *The Faith Healer*, took the drama into higher literary reaches. A half dozen artistically inferior but theatrically skillful playwrights such as Charles Klein, Eugene Walter and Edward Sheldon busied themselves with American types and themes and completed the divorce from European drama.

The foremost figure in U.S. drama during the first half of the 20th century was Eugene O'Neill, whose more notable works, such as *Strange Interlude*, *Mourning Becomes Electra*, *The Emperor Jones*, *The Great God Brown*, *Desire under the Elms*, *Beyond the Horizon* and *The Iceman Cometh*, show genuine dramatic force and literary merit. Among his contemporaries were men and women who were rursing U.S. dramatic writing to a distinguished level. Maxwell Anderson and Laurence Stallings in *What Price Glory?* contributed to the stage a war drama of sweeping fire and devastating irony. George Kelly's *Craig's Wife* and to a lesser degree *The Show off*, Paul Green's *In Abraham's Bosom*, Rita Wellman's *The Gentle Wife*, the comedies of Vincent Lawrence, Zoe Akens' *A Texas Nightingale*, S. N. Behrman's *Ross from Heaven*, Maurine Watkins' *Chicago*, Maxwell Anderson's *Saturday's Children*, Sidney Howard's *Lucky Sam McCarver*, Frank Craven's *The First Year*, Arthur Richman's *Amush*, Elmer Rice's *Street Scene*, Hecht and MacArthur's *The Front Page*, John Wesley's *The Last Mile* were other examples of American playwrighting that called for the scrutiny of serious criticism. On a lower level, but rich in illumination of the American scene, there was a procession of comedies, farces and melodramas of striking originality and suggestive humour.

General economic depression reduced patronage of the legitimate theatre for several years in the 1930s and consequently, perhaps the incentive to writers of good plays. There continued, nevertheless, to be produced each year at least a few noteworthy additions to the national dramatic record. Among those deserving of mention were *The Green Pastures*, adapted by Marc Connelly from D. H. Lawrence's book of sketches, *Tobacco Road*, adapted from Erskine Caldwell's novel by Jack Kirkland, *The Children's Hour* by Lillian Hellman, and Maxwell Anderson's drama in verse, *Winterset*.

A reflection of political and social disillusionment appeared in a new type of satirical musical show, *Of Thee I Sing*, by George Kaufman, Morrie Ryskind and George Gershwin.

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DRAMA AND THE STAGE, ARTICLES ON DRAMA as a whole is divided into the following sections: *Greek Drama*, *Roman Drama*, *Downfall of the Classical Drama*, *Chinese Drama*, *Japanese Drama*, *Indian Drama*, *Persian Drama*, *Medieval Drama*, *English Drama*, *French Drama*, *Spanish Drama*, *Portuguese Drama*, *Italian Drama*, *German Drama*, *Dutch Drama*, *Danish Drama*, *Norwegian Drama*, *Swedish Drama*, *Polish Drama*, *Czechoslovak Drama*, *Russian Drama*, *United States Drama*. In addition there are articles on subdivisions of the dramatic arts which will be found under their own headings. An article on STAGE DESIGN embodies the latest ideas on the subject, and other special articles worthy of mention are COSTUME DESIGN, THEATRICAL, NO DRAMA, THEATRE, THEATRES, LAW RELATING TO

DRAMATIC CRITICISM extends from dramatic theory on the one hand to theatrical criticism on the other. Its founder was Aristotle, whose *Poetics* (c. 335 B.C.) laid down miraculously for its time, the basis of all dramatic theory. His definition of tragedy as 'an imitation of an action that is serious, complete, and of a certain magnitude . . . in the form of action, not of narrative, through pity and fear affecting the proper purgation of these emotions' lies behind all subsequent discussion. For comedy the *Tractatus Coislinianus*, conjecturally related to Aristotle gives an analysis that can be supported from Aristophanes, Shkspere and Moliere. Roman theory is represented by Horace's *Ars Poetica* (c. 10 B.C.), a clever and superficial work suggesting 'good sense' entertainment combined with instruction and a five act division, as the road to success. Horace first, and Aristotle when he was accessible, formed the basis of Renaissance criticism, and ultimately of modern theory. Ancient dramatic criticism in action may be seen at its most amusing in Aristophanes' *Frogs*. Mediaeval theory was in the main concerned with the still popular formal distinction between tragedy with its unhappy, and comedy with its happy ending. Dante calls his epic a *Divine Comedy* because "in its beginning it is horrible and foul, because it is Hell, in its ending, fortunate, desirable, and joyful, because it is Paradise."

With the Renaissance the rediscovery of Aristotle's *Poetics* gave a new and hence life to dramatic discussion. A Latin translation by Giorgio Valla appeared in 1498, the *editio princeps* of the Greek text in 1508. Robertelli's critical edition in 1548, and an Italian translation, the first in any modern tongue, in 1549. Aristotle's cryptic lecture notes needed clarifying, and most commentators loyally interpreted, altered and expanded in accordance with contemporary theatrical conditions. Plays were composed on Aristotelian principles. Ludovico Castelvetro was the powerful and individual founder of the Renaissance neoclassical doctrine which survived until the Romantic movements of the mid 18th century. In his Aristotelian commentary of 1570 he insisted that plays must be acted and not read, that tragedy is concerned with kings and public characters, and comedy with low and private people that tragedy might have either a happy or miserable end, as well as comedy, and in so doing he looked back, unwittingly, to Plato's concluding comment in his *Symposium* "that the genus of comedy was the same with that of tragedy." His farthest reaching contribution was the formulation of the doctrine of the three unities. Aristotle has only the unity of *action*, and a part of that of *time*. Castelvetro gave definite shape to the unities of *action*, *time* and *place*.

The Age of Shakespeare—On the threshold of the great national dramas of England and Spain, Renaissance theory was epitomized in Sir Philip Sidney's *Defence of Poesie* (1595) and in Cervantes' *Don Quixote* (1605). But the world of practice became insistent, and Shakespeare's point of view in England was matched by Lope de Vega's *New Art of Writing Plays* (1609) in which, on the experience gained from writing 483 plays, he put forward the first classic of box office criticism. "Since the crowd pays for the comedies, it is fitting to talk foolishly to it to satisfy its taste", give plenty of variety, let women wear men's costumes, keep up the suspense and mystery to the last scene, and don't bore your audience with pregnant silences. There is surprisingly little new criticism in the Elizabethans. Ben Jonson's is largely secondhand, and Shakespeare's advice on acting, bold and vivid as it is, has Italian forerunners.

With the 17th century, the age of criticism, important changes occur. In France, Jean Chapelain, the abbe D'Aubignac, Jean Racine, and above all Pierre Corneille, contributed to serious theory. Corneille, in his *Discours and Examen* of 1660, for which he claimed "50 years of practical experience of the theatre," took up the problems of decorum, versimilitude and the three unities, which had already occupied Castelvetro, and gave them new and live interpretation. It was Corneille's alertness of mind and not his dull position, to please according to the rules, that stimulated John Dryden to write his *Essay of Dramatic Poesie* (1668) and his prefaces modelled after Corneille's *Examen*. Dryden, as befits an individual Englishman, was torn between the formalist

or "good sense" view continued by Nicolas Boileau Despreaux and René Rapin in France, and John Milton and Thomas Rymer in England, and the sinner view based on practice of which he was perhaps the only representative. His views on tragedy and comedy on character drawing by giving chapter and verse laid the foundation of modern criticism in England, and his definition of action forced shrouded something of Henrik Ibsen's attitude. For comedy, Moliere in his scanty utterances and William Congreve in his *Concerning Humour in Comedy* (1696) express urbanely what can be more robustly gathered from their works.

The 18th and 19th Centuries—With the decline of drama, adjacent criticism largely of morals and of theatrical art, becomes more insistent. Jeremy Collier's *Immorality and Profaneness of the English Stage* (1698) is an important landmark, and Colley Cibber's *Apology* (1740) contains some of our earliest and finest descriptions of acting. The 17th century was the age of the fashionable baroque theatre, the 18th the age of great or much applauded actors. Denis Diderot's *Paradoxe sur le comédien* (not published till 1830) and G. C. Lichtenberg's descriptions of David Garrick not only exemplify the interest in acting but together with G. E. Lessing's *Hamburgische Dramaturgie* (1767-68), give proof of the growing international interest already shown by Saint Evremond and Voltaire. The chief contributions of the 18th century are the flood of Shksperean criticism and the spread of the theatrical periodical. In Germany alone 133 periodicals were tried between the *Hamburgische Dramaturgie* and the end of the 18th century. Lessing leaning heavily on English example, did much to overthrow French post Cartesian standards in favour of Shksperean grandeur and liberty.

The Romantic rejection of neoclassical dogma in favour of a misty and grandiose Nature, and a grotesque mediaevalism, gave a new dignity to the emotions and their representation. Lessing, Diderot and A. W. and F. von Schlegel on the continent, Samuel Johnson (in one outburst against the unities), Charles Lamb, William Hazlitt and above all S. T. Coleridge in England, expressed more or less fully, the doctrines of the individual, and from their utterances emerged principles which unfortunately were not exemplified in the new drama. The chief materialization of this activity was the new conception of Hamlet as an amalgam of Byron, Prometheus and Werther. In France alone, with the theory and practice of Victor Hugo (Prefaces to *Cromwell*, 1827, and *Hernani*, 1830), was there a satisfactory Romantic drama.

The 19th century was dominated by the "well made play" of Augustin Eugène Scribe and Victorien Sardou, and Francisque Sarcey was its critical prophet. His *Essai d'une esthétique de théâtre* (1876) discusses the principles by which, for the average audience, reality is replaced by illusion. The newer schools of naturalism and realism endeavoured to restore reality to the stage, and criticism followed in their wake. Émile Zola wrote much on the theatre and wished his characters to live rather than perform. Ferdinand Brunetiere's *La Loi du théâtre* (1894) introduced a new topic of discussion. "In drama or farce what we ask of the theatre is the spectacle of a will striving towards a goal and conscious of the means which it employs." In Germany F. Hebbel and Gustav Freytag contributed to non-European movements. Ibsen's practice rendered theory unnecessary. The best comments for English readers can be found in C. E. Montague's *Dramatic Values* (1911) and the prefaces and writings of Bernard Shaw. Expressionism has not yet found its critic. Its theory must be sought in Friedrich Nietzsche's *Birth of Tragedy* (1877) and in the writings of Johan August Strindberg and Frank Wedekind.

The 20th Century—The chief contribution of the 20th century is the remarkable advance in Shksperean criticism. The pioneer in the 19th century was Coleridge, but nothing really important followed until A. C. Bradley's *Shksperean Tragedy* (1904), a penetrating analysis of character and its dramatic significance. It held the field until the emergence of the new criticism based on practical knowledge of the theatre, with its insistence on the function and importance of the "producer," a concept which crystallized about 1889. The pioneer productions of William Poel in the Elizabethan manner influenced the practice of Harley Granville-Barker at the Savoy theatre (1912-14), and

from their practice emerged Granville Barker's brilliant series of *Prefaces to Shakespeare* (1927-47). Edward Gordon Craig's *The Art of the Theatre* (1905) and *Towards a New Theatre* (1913) directly affected Max Reinhardt's Deutsches theatre in Germany, C Stanislavsky's Moscow Art theatre in Russia and Jacques Copeau's Vieux Colombe in France, and influenced the English theatre through Michel St Denis' work at the Compagnie des Quinze and at the Old Vic. From Russia the psychological theories of acting and production of Stanislavsky radiated throughout the world and particularly influenced the serious theatre of the United States. Stanislavsky's pupils V Meyerhold and E Vakhtangov, as well as A Turov of the Moscow Kamerny theatre, by their writings and their productions at home and abroad materially deepened the foundations of dramatic criticism. Unfortunately the Moscow Art theatre never visited England but Vakhtangov's production of *The Dybbuk* was performed in London by the Habima theatre in 1929.

A new element in criticism emerged from the French theatre in the plays and theories of Jean Cocteau, J P Sartre and Albert Camus a new concept of dramatic myth embedded in prose recreations of Greek drama. The re-emergence of poetic drama produced searching explorations of the fundamentals of drama in the writings of T S Eliot culminating in his *Poetry and Drama* (1951), and in Francis Fergusson's comprehensive and profound *The Idea of a Theater* (1949). Allied to this movement is the critical approach to Shakespeare which gives special emphasis on the dramatic function of poetic imagery, leading to W H Clemens' *Shakespeare's Bilder* (1936, revised and translated as *The Development of Shakespeare's Imagery*, 1951). A new dimension was added to dramatic criticism by the more serious advances in the art of the cinema, and, particularly in the U S S R, the critical and theoretical writings of S M Eisenstein deepened and enriched the criticism of the theatre.

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DRAMBURG, town, province of Pomerania Prussia Germany, on the Drage, a tributary of the Oder, 50 mi east of Stettin on the railway Ruhnow-Neukettin. Population (1946) 3,504. After 1945 the name was changed to Drawsko when it became part of Koszalin province in Poland. Its main industry is wool milling.

DRAMMEN, a town in the county of Buskerud, Norway, at the junction of the Drammen river with the Drammen fjord, the western branch of the Oslofjord. Pop. (1950) 27,297. The town is divided into two sections, Bragernes north of the river and Stormsø and Tangen to the south. A fishing village existed there in the 13th century. In 1615 Bragernes and Stormsø were incorporated and in 1811 they were united into a municipal town under the name of Drammen. The town is an important railway junction and the export centre for one of the richest forest districts of Norway. Along the Drammen watercourse is centred much of the Norwegian wood pulp, cellulose and paper industry. The town has several engineering works and saw mills. Wood pulp, cellulose, paper, timber, frames and mouldings are ordinarily exported, while coal is the most important import.

DRAPER, JOHN WILLIAM (1811-1882), US scientist, was born in St Helen's, near Liverpool, Eng, on May 5, 1811. He studied at Woodhouse Grove, at the University of London, and again, after removing to America in 1832, at the medical school

of the University of Pennsylvania (1835-36). In 1837 he was elected to a medical professorship in the New York university, but, as its medical school was not organized at once he began his work in its college as professor of chemistry (1839), and was a professor in its school of medicine (1840-50), president of that school (1850-73), and professor of chemistry until 1881. He died in Hastings, N Y, on Jan 4, 1882. Draper made important researches in photochemistry and was among the first to take the human portrait by light.

His son, HENRY DRAPER (1837-1882), graduated from the medical school of the New York university in 1858. He was professor of natural science in New York university in 1860, professor of physiology (in the medical school), and dean of the faculty in 1866-73. He succeeded his father as professor of chemistry, but only for part of a year as he died in New York on Nov 20, 1882. Henry Draper's most important contributions to science were made in spectroscopy, he ruled metal gratings in 1869-70, made spectrum photographs after 1871 and proved the presence of oxygen in the sun in 1877.

DRAPER One who deals in cloth or textiles generally. The Drapers' Company is one of the great livery companies of the City of London. The fraternity is of very early origin. Henry Fitz Alwyn (d. 1212?), the first mayor of London, is said to have been a draper. The first charter was granted in 1364. The Drapers' guild was one of many subdivisions of the clothing trade, and apparently was confined to the retailing of woollen cloths the linen drapers forming in the 15th century a separate fraternity, which disappeared or was merged in the greater company.

DRAUGHT, the act or action of drawing extending, pulling, etc. (from the common Teutonic word "to draw", cf. Ger *Tracht*, load, the pronunciation led to the variant form "draft", *qv*, now confined to certain specific meanings). It is thus applied to animals used for drawing vehicles or loads, "draught oxen", etc., to the quantity of fish taken by one "drag" of a net, to a quantity of liquid taken or "drawn in" to the mouth and to a current of air in a chimney, a room or other confined space. In furnaces the "draught" is "natural" when not increased artificially, or "forced" when increased by mechanical methods (see *BOLLERS*). The water a ship "draws", or her "draught" is the depth to which she sinks in the water as measured from her keel. For the use of the term "draft" or "draught" in masonry and architecture see *DRAFTED MASONRY*.

DRAUGHTS or **CHECKERS** Checkers is a game of mental skill played by two persons on a board graduated into 64 light and dark squares, identical to the chessboard. At the start each participant is allotted 12 disk shaped men or pieces comprising his side. They are usually constructed of wood or plastic material finished in contrasting colours. Known as draughts in Great Britain the game is played under virtually the same rules throughout the English speaking world.

The equipment is inexpensive, the rudiments childishly simple,

yet so profound are its labyrinthine intricacies that absolute mastery is beyond the grasp of human endeavour. A multitude of devotees are well aware of this fact and it but whets their appetite for the silent pastime. It is the inherent desire to combat against opposing forces, whether they be physical or intellectual, that makes the battle of checkers fascinating. Educators

see in it a ready medium for developing the faculties needed for life's rigours and organize clubs at school. Physicians recommend it as a therapeutic to nervous patients and convalescents. Clergymen like to see the game played, knowing that the urge to gamble which debases so many amusements, gets little impetus here. Civic leaders recognize this popularity and foster activity at recreation centres and play areas.

Rules and General Instructions—The board and men are arranged as illustrated in fig 1 with the Single Corner to the left. Fig 2 shows the standard system of numbering the board for recording games and positions. To begin, the Black men always

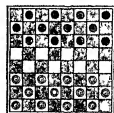


FIG 1—CHECKER BOARD
OR DRAUGHTS BOARD
FOR PLAY

occupy squares 1 to 12 and White men invariably rest on squares 21 to 32. All action occurs on the network of 32 dark squares, the reversed diagram is a concession to the printer, facilitating the use of matrices slotted to receive any combination of symbols. The men are designated Black and White, regardless of actual colour. In the United States the official is red and white men, dark green and buff board. This colour scheme is suitable for prolonged study, in sharp contrast to the red and black toy sets in common use.

The first move must be made by the party having the Black men, the second by White, and thus continuing in rotation to the end of the game. After each game the players exchange colours.

| | | | |
|----|----|----|----|
| 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | 32 |

FIG. 2.—CHECKERBOARD
NOTATION. BLACK OCCU-
PIES SQUARES 1 TO 12
AND WHITE 21 TO 32

Mechanically, the play consists of advancing a man diagonally forward to an adjoining vacant square. If an opponent's piece is in the next square ahead with a vacant space beyond, it must be captured and removed by jumping over it to the empty square. Successive jumps in a straight or zigzag direction must be simultaneously completed. When there is more than one way to jump the player has his choice. When a man first enters the king row (squares 29, 30, 31, 32 for Black and 1, 2, 3, 4 for White) he must be crowned by the opponent who places another piece of the same colour over it. A man reaching the king row via a capture, has finished his move and rests there to be crowned, before reentering the fray. As the king has the added privilege of moving and jumping backward, this rule has an effect on strategy.

Touch and move is the rule and if an eligible piece is played over the angle of the square on which it is stationed, the play must be completed in that direction. Not only is there a code of conduct for the contestants prohibiting anything which may tend to annoy or distract the attention of a player but the spectator is also bound to silence and non interference.

A win is scored when an opponent's men are all captured or barricaded so that he cannot move. When neither side can force a win and the trend of play becomes repetitious a draw is declared.

One rule that has been a source of controversy among the uninitiated is about the jumping of pieces. According to the Anderson laws (drafted in 1852) if a player fails to jump or complete a jump his opponent may impose a penalty. He has the option of compelling the take, letting the oversight abide, or he can "huff" (remove) the man which should have captured. The huff does not in itself constitute a move. American tournament regulations outlaw the huff and require all jumps to be performed, but outside the United States it is still permitted by some organizations. In serious competition such lapses are infrequent and few masters have troubled to make an issue of it. Children delight in huffing less alert playmates.

History—There is good evidence of the game's ancient origin, both factual and circumstantial. That checkers was played in the days of the earlier Pharaohs is well authenticated by Egyptian history and the British museum contains specimens of primitive boards quite similar to our present ones. Intertwined with the roots of chess, a sister game, there is some conjecture over priority. Checkers being simplest in form it is reasonable to presume it was devised first, and that chess followed as an elaboration. Plato and Homer mentioned the game in their works and the Romans are believed to have imported it from the Greeks. Comparison of these games of antiquity with the modern pastime may be speculative, nevertheless the earliest publications on record manifest the 12 men on each side and our conventional board.

Antonia Torquemada, of Valencia, published the first book on checkers in 1547. Other Spanish issues followed and in 1650 Juan Garcia Canalejas published a notable volume containing games and traps still proving dependable. The Spaniards may have received their knowledge from older sources in Arabia through the Moors.

William Payne, a mathematician, is the pioneer of English draughts literature and his book, *Guide To The Game Of*

Draughts, appeared in 1756. A striking feature of Payne's book is the dedication by Dr Samuel Johnson, who was exceedingly fond of the game. In 1800 Joshua Sturges brought out a treatise that served as a textbook for nearly half a century until the advent of Andrew Anderson's elaborate compilation in 1848. Thereafter the literature multiplied at a rapid pace and by 1900 the books counted up in the hundreds. In newspaper columns and periodicals a student could find games and problems, analyses by critics, reports on tournaments, matches and correspondence play, together with notices of simultaneous and blindfold entertainments by itinerant champions.

The roster of modern champions begins with Anderson, who retired about 1850 after playing five matches (four of which he won) with the celebrated James Wyllie, another Scotsman. Wyllie the "Herd Laddie," then claimed the title and held it for some 40 years, playing matches all over the world. He lost and regained the honour in encounters with Robert Martins, a Cornishman, and was defeated in 1856 by Robert D. Yates, a young Boston medical student, who retired to finish his education. James Ferrie, of Glasgow, ended Wyllie's reign in 1894. Two years later Ferrie bowed to Richard Jordan, of Edinburgh, and the latter died unbeaten in 1909. However, Charles F. Barker, the American champion, held him even in 40 games in 1900. Robert Stewart, of Blairadam, Fifeshire, Scotland, outpointed Newell W. Banks, Detroit master, by a score of 2 to 1 and 37 draws in 1922 to fill the vacancy. Stewart had several challengers in Britain and America but never defended the title after his match with Banks. In 1934 the American Checker association sanctioned a match between Banks and Asa A. Long, of Toledo, Ohio, for the championship and Long won by a score of 7 to 3, and 27 draws. He defended it against Edwin F. Hunt, of Nashville, Tennessee, in 1937, winning 3 to 1, and 35 draws. The leading British player, Samuel Levy, planned to meet Long for the title but he died in 1939.

Since 1900 the growth of scientific play has been stepped up by the advancement of American players, who made rapid progress, spurred on by their first team match with a representative British group in 1905. The contest was on the two-move restriction style of play, at which the U.S. aggregation was no match for the more seasoned Scotch masters, the greatest of their day, and they were defeated by a score of 75 to 34 and 28 draws. A second international match in 1927, staged in New York city, found the Yankees in front by 96 wins to 20 and 364 drawn games, indicative of the strides made in the new world.

Opening Restrictions—At first all expert play was unrestricted or "go-as-you-please," the opening moves left entirely to the discretion of the individual. But during one of the Wyllie Martins matches in 1863 an episode occurred which crystallized the need for widening the game's scope. A variation of the Glasgow opening (since dubbed Martins' Rest) was repeated 21 times. This act was attributed to the fear each player had of the other and paved the way for gradually introducing the two move restriction, where the first move on each side is balloted, compelling the handling of 43 openings and tremendously increasing the sweep of the game. Three-move, or the American restriction, was adopted in the United States in 1929, raising the playable openings to 137. Launched explicitly to forestall lengthy heats of drawn games in tournaments between overcautious experts whose forte was safely first lines of published play, it was expected the plurality of openings would nullify the advantages of "book" and produce pure crossboard checkers, long the ideal of many players. This assumption quickly proved erroneous for the newest restriction presented many unbalanced games, structurally feeble at the start, requiring still greater efforts of study and private research. Three move is handicap checkers and has trebled the professional's labour. Eleven-mnn ballot, removing one piece by 10 from each side at the start, increases the openings into the thousands and is a generator of originality. But aside from a few proponents it has failed to gain favour.

Theory and Tactics—The initial step in becoming a scientific player, after learning the rules, is the cultivation of simple tricks and catches that bear fruit immediately or within a few

moves These minor manoeuvres are abundant in variety and effective at all stages of the game, but more so with fewer pieces on the board They can be considered as the "good moves" that laymen always request experts to reveal Actually, good and bad moves are relative terms, pertinent to any given situation and not amenable to a broad application A move that works perfectly in one instance will fail utterly in another almost identical position In a sense mathematical exactness is the soul of the game and an error is irrefragable Still the combinations are infinite and longstanding lines of play are constantly being corrected and outmoded by a host of busy analysts probing new twists and turns Playing faultlessly through an entire game requires an understanding of the techniques peculiar to the opening, midgame and ending

The early acquisition of kings is a tactical factor of obvious simplicity Skillfully handled to extract the maximum of power the first king on the board decides many contests by prompt action, preventing a similar breakthrough by the opposition or rendering it costly in material and position When possible it is usually a wise plan to sacrifice a man in order to crown and attack from the rear, especially if one's own king row is firmly shielded

Most sacrifices, squeeze plays, waiting moves and compound strokes are tactics of a major character, the effects of which may not be instantly apparent to the beginner Master play involves long, accurate reaches where the small tactics serve as threats and stumbling blocks en route while the grand tactics are poised as *coups de grace* This ability to calculate at play is called 'crossboard' and among first class players is developed to a fine degree whereby they can visualize the pieces in action through many subsequent moves Although crossboard is an important weapon it is outweighed two to one by memorized knowledge Thus the strongest player is at a disadvantage if manoeuvred into a 'cook' (privately analyzed departure from established play) and has to find the right moves across the board However, crossboard is not guesswork or the hopeful anticipation of blunders but a methodical process likewise based on a repertoire of memorized data The time limit governing official contests is five minutes and one minute grace Seemingly an eternity to the uninitiated it is insufficient to cope with the ramifications of a new position which an opponent may have explored for several hours It is deemed good policy to run for a draw in a strange position if a definite weakness cannot be located in the adversary's game

If checkers can be said to have a master key it is in the application of forcing play, a principle experts endeavour to exercise at all times Of course it is necessary to be well schooled in the fundamentals to know how to put it into practice and a fund of reliable published games, properly classified and arranged in the storehouse of the mind, is most essential Also one must understand the influence of the "move" (a later lesson) For the self-taught student it is a difficult task to formulate a high grade forcing system out of the vast number of book games available Best results are had through the guidance of experienced players

In the opening and midgame phases of play, an essential technique is transposition, to divert the game into desired channels, and to exclude unwanted variations The famous Canalejas (or Montero) stroke is used as an example Ensured at Black's 3rd move it is the quickest win on the board As originally published it springs from the Bristol-Cross opening, 11-16, 23-18, 16-20, 24-19, 8-11, and White wins by 19-15, 10-19, 18-14, 9-18, 22-8, 4-11, 27-24, etc Note the alternate ways of forming the same trap, like going to the theatre by different routes

11-16, 24-19, 16-20, 23-18, 8-11
12-16, 23-18, 16-20, 24-19, 8-11
12-16, 24-19, 16-20, 23-18, 8-11

Among masters the use of transposition is an art and the switch into good of play is uncanny

Strokes or "shots" are a joy to all players and usually the chief resource of the amateur as he depends on them for the gain of material The expert finds them a valuable foil but he will not try to entice his opponent into a shot which, if parried, will leave him with an inferior position He uses the shot tactically to re-

strict the movement of his opponent's forces, threatening pieces that may be at the extremes of the board

The 19th century leaders found certain patterns or formations appeared regularly in their contests, sometimes from different openings Searching analyses and crossboard experimentation tested the soundness and formidability of these positions and they have remained as the foundation for all good play They created a huge compilation of play, much of which was substantial, but a large proportion of the games had the drawback of not being forceful, and keen students of the board by passed many variations in the early stages of games to eliminate countless lines Soon the better players were confining their games to forcing lines and the result was a high percentage of drawn games

Their system of controlling the openings is a good one for the beginner to adopt Black has a choice of seven starting moves and analysis, especially that worked up during the two-move restriction period, has proven all of them when perfectly played will draw One of the moves, 11-15, definitely gives Black the superior game Its advantage seems to be that with it Black occupies the centre of the board and he makes the development with the piece on the single corner side, where he is least vulnerable In the middle of the board a piece has its greatest mobility, having two directions to move in, while at the edge there is only one A piece at the side is secure against attack but the centre man is preferred since it is better to be aggressive With 11-15 he has a good choice of moves against any of White's replies and continues to be the aggressor if he wishes Because of its known advantages 11-15 has been more extensively played and analyzed than any of the other openings

The Double Corner, 9-14, is an equal game when White replies 22-18 or 24-20 10-15, 11-16 and 12-16 tend to give White the better game but in no case is it enough to cause any problem 9-13, however, is weak when White counters 22-18, the counter-part move to 11-15 The advantages gained are the same as mentioned above plus the fact that Black has cramped himself by his opening side move After 22-18 Black must thoroughly understand the defense if he is to maintain a sound game against an adept

The 9-13 move is known as the Edinburgh opening, while the others are 10-14, Denny, 10-15, Kelso, 11-16, Bristol, 12-16 Dundee The 11-15 openings are known by the White reply in several cases 21-17, Switcher, 22-18, Single Corner, 23-18, Cross, 24-19, Second Double Corner, 24-20, Ayrshire Lassie 11-15, 22-17 and 11-15, 23-19 have a number of distinctive formations labelled with quaint names Several of these follow Old Fourteenth—11-15, 23-19, 8-11, 22-17, 4-8 Glasgow—11-15, 23-19, 8-11, 22-17, 11-16, 24-20, 16-23 Laird and Lady—11-15, 23-19, 8-11, 22-17, 9-13, 17-14 File—11-15, 23-19, 9-14, 22-17, 5-9 Souther—11-15, 23-19, 9-14, 22-17, 6-9 Whither—11-15, 23-19, 9-14, 21-17, 7-11 Dyke—11-15, 22-17, 15-19 Maid of the Mill—11-15, 22-17, 8-11, 17-13, 15-18

In the two move restriction the openings are, generally speaking, evenly balanced 9-13, 23-18, 10-14, 22-17, and 12-16, 24-20 being considered most difficult for Black While 9-13, 21-17 and its twin 11-15, 21-17 when followed by 9-13 is hardest for White The three-move restriction, however, has a field of openings unfavourable to Black Most of them were seldom ventured in the earlier modes of play

The midgame is vast and complex Skill here comes largely from memorizing games Novices customarily begin by learning a variation of the Old Fourteenth, so called because it was the fourteenth game in the guide published by Sturges Following is the play, the soundness of which is beyond dispute

| | | | | | |
|-------|-------|-------|-------|-------|-------|
| 11-15 | 28-24 | 1-6 | 17-14 | 26-30 | 28-19 |
| 23-19 | 8-11 | 22-17 | 10-17 | 19-15 | 13-17 |
| 8-11 | 26-33 | 18-22 | 21-14 | 30-26 | 8-4 |
| 22-17 | 9-14 | 15-18 | 6-10 | 15-8 | 17-22 |
| 4-8 | 31-26 | 15-22 | 30-25 | 26-22 | 4-8 |
| 17-13 | 6-9 | 21-18 | 10-17 | 32-28 | 22-26 |
| 15-18 | 13-6 | 14-23 | 25-21 | 22-15 | 19-15 |
| 24-20 | 2-9 | 27-18 | 22-26 | 24-19 | 26-30 |
| 11-15 | 16-22 | 9-13 | 21-14 | 15-24 | |

Drawn—Sturges, 1800

Obviously other moves are possible. Some are beaten quickly because they lose a man or run the position but many will draw. The student can become familiar with all of them since the opening has been analyzed almost to exhaustion.

Two characteristic midgame formations are illustrated in the above game. Black is developing his men in the centre with the object of spreading the opposing forces to the sides where they may become a liability in the endgame. The White pieces demonstrate the side game which, though less desirable, also has advantages. Pieces at the sides are more immune to attack and require less material for making exchanges. It takes three men to make trades in the middle of the board and only two at the sides. Sometimes this is an important matter because the exchange is the principal means of removing the barriers to an advance. The theory of the side game is to flank the centre pieces and undermine them. This happens infrequently except against the novice who makes the mistake of cramping his men in the centre. The short game that follows is an exposition of the point: 11-15, 23-19, 8-11, 22-17, 4-8, 17-13, 9-14 (defendable but tends to overdevelop the centre), 25-22, 5-9 (fatal), 26-23, 1-5, 22-17, and Black must lose a man.

Another common formation is the Dyke, deriving its name from the Dutch word meaning wall, and is made by fixing pieces on 19, 15, 10 and 14. The term is sometimes applied when the piece is located on 19 only early in the game, where the full development is not possible or in line with the player's strategy. Dykes are strongest when a larger number of men remain on the board after their formation. Ten man dykes particularly when the Double Corner remains intact, are formidable. Nine man dykes are even, eight man dykes are unfavourable to the dyking player. Newell Banks' *Scientific Checkers* published first in 1923 contains studies of the dyke principle whose use he advocates in a number of openings. Some of them are weak and frowned upon by authorities.

The Pioneer is a midgame pattern of great frequency. It tends to be a counterpart game, both sides building up a side game against the opponent's Double Corner, following up with centre attacks. A typical run-up is 9-14, 22-17, 11-16, 24-19, 8-11, 25-22, 11-15, 17-13, 15-24, 28-19, etc. This game, then, is a cramp and an attack on the Double Corner as part of the same strategy. Oftentimes the Pioneer and the Dyke are rival games since in several openings a player must choose between them. Since some experts are partial to one or the other of the formations they are known as Dyke players or Pioneer players. The Pioneer is said to get its preference because its principle formations may be developed from numerous openings, thereby eliminating the need to study a lot of additional play. Arthur Reisman in *Championship Checkers* (1942) gives a complete list of openings that transpose into the Pioneer with games and theory on the formation.

Two defense schemes receive attention in the books on the game. The bridge defense, which the amateur is prone to overemphasize, consists of maintaining pieces on 1 and 3. If it can be sustained for the endplay the bridge is a strong position. The opponent trying to make a crown against this defense must have the use of a piece on 10 before any of his men can cross into the king row. In most cases the bridge can only be cracked by using three men to trade off one of the bridge pieces. The man on 10 is in jeopardy if Black can muster two kings to attack it. Should the opponent place a man on 5 or 12 the bridge increases in strength.

The triangle theory of defense consists of keeping men on 2, 3 and 7. As it stands the position does not prevent White from entering the king row via 13-9, although the newly-made king could be exchanged by 2-6. The virtue of the triangle is mobility which allows the pieces to assist in many types of strategy late in the game. Of all the pieces on the board at the start, 2 (or White's 31) is the potential occupant of more squares in its journey to the king row than any other piece. It may occupy 26 squares. Three is next in power, being capable of holding 25. Seven, which is known as the apex piece, may cover 22. This is one less than the man on 1, but it has the advantage of being

centrally located and able to co-operate closely with 2 and 3. It is interesting to note that 7 can potentially occupy two more spaces than the king row piece on 4.

The Move—An elemental force in checkers is the move or opposition. Simply stated it means having the last legal move to pin down the rival pieces. As the move fluctuates with almost every exchange it is not significant until the ending looms and the trades can be controlled. The move in itself is not vital, more important is the manoeuvring to govern its shifting influence to advantage. A number of standard endings are won from settings where initially the move is adverse.

Veteran players generally calculate the move by visualization at times finding the use of a formula helpful. To determine who has the move when the sides are equal in number, the one whose turn it is to play counts all the pieces within the columns having black squares at the bottom. If the sum is odd he has the move, and if even his opponent has it. If a White piece on 5 is blocked by a Black piece on 1, or a Black man on 28 by a White one on 32, these pieces are cancelled from the calculation. With uneven sides each player has the move in one wing and some man down draws can be obtained by erecting a defense in the favourable sector.

Endgame efficiency is predicated on the knowledge of precise ending problems that constitute a beautiful branch of the game's science. The forcing play principle is a potent factor and the possibility of reducing any given position to an absolutely certain conclusion nears reality. Endgame play requires timing and exactitude, and yet it offers the chance to display creative ingenuity. In addition, it permits the use of many midgame manoeuvres while having a fund peculiar to its own stage. The move is an important factor in bringing out many scientific wins, but it is often secondary as the position may contain 1 manoeuvre that will accomplish the desired result.

It takes two kings to oust and corral one sheltered in the Double Corner. Therefore, an advantage of one piece is usually enough to win. But two kings caught together in the Single Corner can be held there by one opponent. In the position Black on 29 and 25, White on 26, Black playing cannot release himself. One piece can bottle up three in the Single Corner in a few situations.

When a player has the advantage of the man, judicious exchanges are advisable in completing the win. The question of ethics is not involved as it is pointless to drag out a game to give the opponent a chance and perhaps make an error which will alter the result. In diagram 3, where White has three kings attempting to overcome a Black king lodged in each Double Corner, White must compel an exchange to win. Though puzzling to many the solution is easy. A sequence of correct moves is necessary and one wrong play retards the win by several moves. Play from the illustrated setting, 18-15, 24-28, 23-27, 6-1, 14-10, 28-32, 27-24, 1-5 (or 32-28, 24-19, 28-32, 10-6, White wins). Every move executed by a skillful player is carefully planned with a definite objective, nothing is left to luck.

As analysis of the midgame helped overcome many of the difficulties, so studies of positions that appear regularly have given players a knowledge of endings. These fundamental positions are of a high order and thought to be the most marvelous discoveries made in the game. Banks chose 12 which he called the great master pieces, but others usually think of them as comprising about a score of critical situations. In general, the terms given under them seem to contradict the appearance. Positions which seem equal can be won, while those in which there is a numerical superiority draw. Oftentimes the play to fulfill the terms is long and exacting, and usually they illustrate the weakness of pieces pinned at the sides of the board. The fundamental positions serve as a background that enables the cross-board expert to determine the outcome of a midgame when he can foresee one of them arising, which would be impossible without that knowledge. First Position has been known for two centuries, and it appears in Pavane's work. Most of the others have been developed since Anderson's day. Joseph M. Duff's *Standard Positions* is the best work on the subject extant. The attacking side must have the move or the position will draw. From the diagrammed setting the play continues 27-32, 28-24, 23-18 (avoiding the 24-19 swap which would

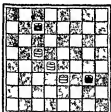


FIG. 3—WHITE TO PLAY AND WIN

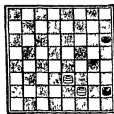


FIG 4—FIRST POSITION
WHITE TO PLAY AND WIN

Black man on 13, Black kings on 14 and 15, and White kings on 22 and 16. White has the move and plays 26-13, 14-17, 23-26, 15-10, 22-18, 17-21, 18-22, 10-14, 26-30, 21-17, 30-26, draw.

The following two move restriction game is a sample of modern play. Although it was a practice or "skittles" encounter it teems with brilliant sacrifice manoeuvres and has been named the Eternal Sacrifice.

| | | | | | |
|-------|-------|-------|-------|-------|-------|
| 10-14 | 13-19 | 10-15 | 23-27 | 15-24 | 30-24 |
| 22-17 | 23-7 | 17-10 | 31-24 | 28-30 | 11-16 |
| 7-10 | 2-11 | 15-19 | 1-6 | 27-31 | 24-28 |
| 24-19 | 26-23 | 23-16 | 15-10 | 19-15 | 16-19 |
| 9-13 | 11-15 | 6-15 | 6-15 | 31-27 | 22-25 |
| 25-22 | 20-16 | 11-7 | 15-10 | 15-10 | 21-17 |
| 11-15 | 4-8 | 19-19 | 9-14 | 3-8 | 27-24 |
| 27-24 | 22-18 | 7-2 | 6-10 | 10-7 | 30-21 |
| 5-9 | 15-22 | 19-23 | 14-17 | 8-11 | 24-15 |
| 24-20 | 32-28 | 21-17 | 10-14 | 7-3 | 17-14 |
| 15-24 | 8-12 | 15-19 | 19-23 | 11-16 | Drawn |
| 28-19 | 16-11 | 22-18 | 14-17 | 11-16 | |
| 8-11 | 23-25 | 11-22 | 23-27 | 16-20 | |
| 19-16 | 29-22 | 18-15 | 24-19 | 8-11 | |

Louis T. DeBeauvoir v Nathaniel H. Rubin

An idea of what the three-move player is up against can be had by examining a game played in the Ninth American tournament (1937). The Octopus is one of the most dreaded openings, and the qualified opinion marks it as untenable, or at best a hairline draw.

| | | | | | |
|-------|-------|-------|-------|-------|-------|
| 11-16 | 22-13 | 6-15 | 29-25 | 11-16 | 30-26 |
| 22-17 | 11-15 | 13-6 | 4-8 | 23-28 | 27-23 |
| 7-11 | 21-19 | 1-30 | 25-21 | 8-21 | 32-27 |
| 17-14 | 16-23 | 25-22 | 3-7 | 21-17 | 16-20 |
| 10-27 | 26-10 | 8-11 | 27-23 | 5-9 | 26-23 |

White wins—Walter Hallman v Asa A. Long

A. Black's forces are left badly arrayed by this move.

B. This position also comes up from the 10-15 21-17 7-10 opening by continuing 17-14, 10-27, 21-23, 11-16.

Spanish Checkers.—In the Spanish game the board is turned so that the Single Corner is to the players' right. A king can move over any number of empty squares on the same diagonal. It is compulsory to jump the largest number of pieces. Otherwise, the rules are the same as in the British game.

Italian Checkers.—The Italian game varies from the Spanish (its probable ancestor) in the scope of the king, which has the same move as in the British game. The board is placed as in Spanish checkers. It is similar to our game, except that the king is immune to capture by a man.

Polish Checkers.—This is the most popular form on the continent, and acquired its name from an early Polish exponent in Paris. The board has 100 squares, 50 being used in play. It is played with the light coloured and squares to the players' right. Each player has 20 men which move forward but capture forward or backward. A crowned man, called dame or queen, has the same move as the Spanish king. The maximum capture is compulsory. When a man jumps into the king row he continues capturing without being crowned if further pieces remain to be taken. The huff has been abolished.

Turkish Checkers.—All 64 squares are used in this game, the men move to the sides or straight forward, but not backward. There are 16 men to a side, 8 each in the second and third rows to commence. Captures are made either to the side or forward, the maximum take is enforced. Pieces are removed one by one when captured. The king has a sweep of any number of squares.

Losing Checkers.—As the name implies the object of this game (applicable to any game of checkers) is the reverse of the regular play. The first one succeeding in giving away his men or immobilizing them wins.

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(A R V)

DRAUPADI, in Hindu legend daughter of Drupada, King

of Panchāla, and wife of the five Pāndava heroes in the *Mahābhārata*.

DRAVE or **DRAVA** (Ger *Drau*), one of the principal right-bank affluents of the Danube. It rises below the Innchener Eck in Tirol, at an altitude of over 4,000 ft., runs eastward, and forms the longest longitudinal valley of the Alps, the Drau Thal. The Drave is 450 m long, near Zakany it is joined by the Mur. The valley of the Drave was the chief road through which the invading peoples of the East, such as the Huns, the Slavs and the Turks, penetrated the Alpine countries. The Drave flows through Carinthia and Styria, and forms the boundary between Hungary and Yugoslavia from Varaždin to near Osijek. At its mouth the Drave attains a breadth of 1,055 ft. and a depth of 20 ft. The Drave is navigable for rafts only from Villach, and for river steamers from Bärce, a distance of 95 m. The principal towns on the Drave and its affluents are Klagenfurt, Graz, Maribor and Osijek. (See DANUBE.)

DRAVIDIAN, a name only applied in Indian usage to the "Southern" group of the Brahmins *q v*. But "Dravidian" is applied, unfortunately, to the indigenous peoples of India south of the Vindhya and the northern half of Ceylon, it should be confined to the languages of this area. At least four different stocks have contributed elements in their population. The earliest is dark, short, with wavy hair, broad noses and long heads, so that some have detected affinities with Negroids. This stock, represented by Kadirs and Kurumbas, is akin to the Veddas and to Australian peoples and to the Semang and Sakai (see *ASIA Anthropology and Ethnology*). Other elements are physically distinct and we have in the Nambutiri Brahmins the purest Aryan stock. The range of culture is equally wide. The Dravidians occupy the oldest geological formation in India, the medley of forested ranges, terraced plateaus, and undulating plains, from the Vindhya to Cape Comorin, and among them we find the construction of dolmens, the use of the boomerang, kinship in the female line, totemism and many primitive usages. But in the same are found a high degree of civilization, with a remarkable literature and evidence of artistic skill.

E. Thurston, *Castes and Tribes of Southern India*, vol. 1 (exhaustive introduction), 1909, *Cambridge History of India* vol. 1 (1923), R. D. Dixon, *Racial History of Mankind* (1927).

DRAVIDIAN LANGUAGES, the name given to a collection of Indian languages comprising all the principal forms of speech of Southern India (Sanskrit *Dravida*). Their territory, which includes the northern half of Ceylon, extends northwards up to an irregular line drawn from a point on the Arabian sea about room below Goa along the Western Ghats as far as Kolhapur, thence north east through Hyderabad, and farther eastwards to the Bay of Bengal. Farther to the north, Dravidian dialects are spoken by small tribes in the Central Provinces and Chota Nagpur, and up to the banks of the Ganges in the Rajmahal hills. A Dravidian dialect is, finally, spoken by the Brāhūis of Baluchistan in the far north-west.

Classification.—Tamil and Malayalam can be considered as two dialects of one and the same language, which is, in its turn, closely related to Kanarese, Tulu, Kodagu, Toda, and Kōta lie between Tamil Malayalam and Kanarese, though more nearly related to the latter than to the former. The same is the case with Kurukh and Malto, while Kui and Gondi gradually approach Telugu, which latter language seems to have branched off from the common stock at an early date. Finally, the Brāhūi dialect of Baluchistan has been so much influenced by other languages that it is no longer a pure Dravidian form of speech.

The Dravidian languages are gradually losing ground in the north, where they meet with Aryan forms of speech. This process has been going on from time immemorial, but it is still possible to trace a Dravidian element in the Aryan languages of North India.

The Dravidian languages form an isolated group, and it has not been possible to prove a connection with any other family of languages. Such attempts have been made with reference to the Munda family, the Tibeto Burman languages, the Ural-Altaic languages, and the dialects spoken by the aborigines of the Australian

continent. The arguments adduced have not, however, proved to be sufficient. The Dravidian family has several characteristic features of its own. The phonetic systems of the smaller dialects deserve close study and analysis. In general the pronunciation is soft and melodious.

Main Features.—In Dravidian words a line above a vowel shows that it is long. The dotted consonants *t*, *d*, and *n* are pronounced by striking the tip of the tongue against the centre of the hard palate. The dotted *l* is distinguished from *l* in a similar way. Its sound, however, differs in the different districts. A Greek χ marks the sound of *ch* in "loch", ξ is the English *sh*, *c* the *ch* in "church", and *r* is an *r* which is used as a vowel. Abruptness and hard combinations of sounds are avoided. There is a distinct tendency to avoid pronouncing a short consonant at the end of a word, a very short vowel being often added after it. Thus the pronoun of the third person singular, which is *avan*, "he," in Tamil, is pronounced *avanu* in Kanarese, the Sanskrit word *vak*, "speech," is borrowed in the form *vaku* in Tamil, the word *guram*, "horse," is commonly pronounced *guramu* in Telugu, and so on. Combinations of consonants are further avoided in many cases. This tendency is illustrated by the changes undergone by some borrowed words. Thus the Sanskrit word *brahmana*, "a Brahman," becomes *barāmana* in Kanarese and *paramana* in Tamil, the Sanskrit *Draṇḍa*, "Dravidian," is borrowed by Tamil under the form *Traṇḍa*. *Draṇḍa* which also occurs as *Dravida* is in its turn derived from an older *Damila* which is identical with the word *Tamiṛ*, Tamil.

The forms *paramana* and *Traṇḍa* in Tamil illustrate another feature of Dravidian enunciation. There is a tendency in all of them, and in Tamil and Malayālam it has become a law, against any word being permitted to begin with a stopped voice consonant (*g, j, d, d, b*), the corresponding voiceless sounds (*k, c, t, t, p*, respectively) being substituted. In the middle of a word or compound on the other hand, every consonant must be voiced. Thus the Sanskrit word *danta*, "tooth," has been borrowed by Tamil in the form *tandam*, and the Telugu *anna*, "elder brother," *tammulu*, "younger brother," become when compounded *annadamulu*, "elder and younger brothers."

There is no strongly marked accent on any one syllable, though there is a slight stress upon the first one. In some dialects this equilibrium between the different parts of a word is accompanied by a tendency to approach to each other the sound of vowels in consecutive syllables. This tendency, which has been called the "law of harmonic sequence," is most apparent in Telugu, where the short *u* of certain suffixes is replaced by *i* when the preceding syllable contains one of the vowels *i* (short and long) and *ei*. Compare the dative suffix *ku*, *hi*, in *guramu-ku*, "to a horse", but *tammuni hi* "to a younger brother." This tendency does not, however, play a prominent role in the Dravidian languages.

Words are formed from roots and bases by means of suffixed formative additions. The root itself generally remains unchanged throughout. Thus from the Tamil base *per*, "great," we can form adjectives such as *per iya* and *per um*, "great," verbs such as *per u gu*, "to become increased", *per-u-ku* "to cause to increase," and so on.

Many bases can be used at will as nouns, as adjectives, and as verbs. Thus the Tamil *kaḍu* can mean "sharpness," "sharp," and "to be sharp." Other bases are, of course, more restricted in their respective spheres.

The inflexion of words is effected by agglutination, *i.e.*, various additions are suffixed to the base in order to form what we would call cases and tenses. Such additions probably once were separate words. Most of them are, however, now only used as suffixes. Thus from the Tamil base *kōn*, "king," we can form an accusative *kōn-en*, a verb *kōn-en*, "I am king," and so on.

Dravidian nouns are divided into two classes, which Tamil grammarians called high-caste and casteless respectively. The former includes those nouns which denote beings endowed with reason, the latter all others. Gender is only distinguished in the former class, while all casteless nouns are neuter. The gender of animals (which are irrational) must accordingly be distinguished by using different words for the male and the female,

or else by adding words meaning male, female, respectively, to the name of the animal—processes which do not, strictly speaking, fall under the head of grammar.

There are two numbers, the singular and the plural. The latter is formed by adding suffixes. It, however, often remains unmarked in the case of casteless nouns.

Cases are formed by adding postpositions and suffixes, usually to a modified form of the noun which is commonly called the oblique base. Thus we have the Tamil *maram*, "tree," *marai-ai*, "from a tree," *marait-u-ku*, "to a tree," *vidu*, "a house," *vut-ai*, "from a house." The case terminations are the same in the singular and in the plural. The genitive, which precedes the governing noun, is often identical with the oblique base, or else it is formed by adding suffixes.

The numeral system is decimal and higher numbers are counted in tens, thus Tamil *pattu*, "ten," *ru badu*, "two-tens," "twenty."

The personal pronoun of the first person in most dialects has a double form in the plural, one including and the other excluding the person addressed. Thus, Tamil *nām*, "we," *se*, *i* and you, *nangal*, "we," *se*, *i* and they.

There is no relative pronoun. Relative clauses are effected by using relative participles. Thus in Telugu the sentence "the book which you gave to me" must be translated *mira nāku ucma pustakamu*, *se*, "you me-to given book." There are several such participles in use. Thus from the Telugu verb *kotta* "to strike," are formed *kott ut-una*, "that strikes," *kott-i-na*, "that struck," *kotte*, "that would strike," "that usually strikes." By adding pronouns, or the terminations of pronouns, to such forms, nouns are derived which denote the person who performs the action. Thus from Telugu *kotte* and *vādu*, "he," is formed *kotte vādu*, "one who usually strikes." Such forms are used as ordinary verbs, and the usual verbal forms of Dravidian languages can broadly be described as such nouns of agency. Thus, the Telugu *kottimadu*, "he struck," can be translated literally "a striker in the past."

Verbal tenses distinguish the person and number of the subject by adding abbreviated forms of the personal pronouns. Thus in Kanarese we have *mādd-em*, "I did," *mādd-i*, "thou didst," *mādd-eva*, "we did," *mādd-aru*, "they did."

One of the most characteristic features of the Dravidian verb is the separate negative conjugation. It usually has only one tense and is formed by adding the personal terminations to a negative base. Thus, Kanarese *maḍ-enu*, "I did not," *māḍ-eva*, "we did not," *māḍ-aru*, "they did not."

The vocabulary has adopted numerous Aryan loan-words. This was a necessary consequence of the early connection with the superior Aryan civilization.

The oldest Dravidian literature is largely indebted to the Aryans, though it goes back to a very early date. Tamil, Malayālam, Kanarese, and Telugu are the principal literary languages. The language of literature in all of them differs considerably from the colloquial. The oldest known specimen of a Dravidian language occurs in a Greek play which is preserved in a papyrus of the 2nd century A.D. The exact period to which the indigenous literature can be traced back, on the other hand, has not been fixed with certainty.

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DRAWBACK, the repayment of a duty, previously exacted, when exposable goods are exported or foreign goods re-exported. The object of a drawback is to enable commodities which are subject to taxation to be exported and sold in a foreign country on the same terms as goods from countries where they are untaxed. It differs from a bounty in that the latter enables commodities to be sold abroad at less than their cost price, under certain conditions, however, the giving of a drawback has an

effect equivalent to that of a bounty. The tariffs of many countries contained tables of the drawbacks allowed on the exportation or re-exportation of commodities, but so far as the United Kingdom is concerned the system of "bonded warehouses" practically abolished drawbacks, as commodities can be warehoused (placed "in bond") until required for subsequent exportation. (See BONDING WAREHOUSE.)

DRAWING.—The art of delineation or of portrayal by means of lines, is so primitive that its history is practically that of man. That it was practised 50,000 years ago we know but for how long before that, it is difficult to establish. Its beginnings, however, must have been early, for one of the first things a child will busy its hands with is the making of marks in the dirt, and the walls of many a schoolhouse or home stand as mute witnesses to the inherent tendency of man to draw. It is a deep-rooted instinct whose satisfaction gives great pleasure.

Early Art.—In the beginning the primitive mind with its groping for essentials was satisfied with simple structural lines and, at times, outlines of those objects wherein the structure was less evident. The cave-man drew his pictures of men just as the child does—with the inverted Y for the body and legs, a cross-piece for the arms and a circle for the head, part of his drawing showing structure and part outline. The first of these drawings of the natural development of



FIG 1—CHILD'S DRAWING SHOWING NATURAL DEVELOPMENT OF MOTION

of the child are always without consideration of motion but it does not take long before with the addition of feet, the figure is walking and soon the arms are brought to the front. Thus we see the early beginnings of the three elements which are essential to all drawing, if it is to please man who has for thousands of generations and from childhood up been trained to expect them: structure, outline and motion. (See fig 1.)

In order to draw the human figure successfully the artist must first learn about its bony structure. He must master the knowledge of the lengths of the various units and of their possibilities for movement (See DRAWING, ANATOMICAL). But his work does not cease in this study of structure. Trees spread their branches in certain characteristic ways each of which is slightly different, and in fact each type of leaf has its own anatomy as has every animal, bird and flower. Rocks must be closely examined and their origin understood or they cannot be given the proper structure. The artist cannot slight this work or his drawing will be unconvincing. He must spend much time in finding out how things were put together or how they grew and why.

In speaking of outline we should think first of line itself. It has been contended that "It cannot be reasonably held that one purely abstract line or curve is more beautiful than another, for the simple reason that people have no common ground upon which to establish the nature of abstract beauty." This is, of course, false, for if there were no common ground in beauty there would be very little incentive to draw other than as a simple record. But to put into words just what this beauty consists of, is a difficult task. Fig 2 illustrates two lines. It will be agreed that one is more beautiful than the other. One has a sureness and sensitive taper while the other wanders in a hesitant and aimless manner without object, without character. Perhaps that is it. Perhaps a line can have character and therefore can show those beauties and weaknesses which we see in the characters of our fellows. This is undoubtedly possible, for no two men can draw a line exactly alike and certainly into the lines of each must creep something of the man himself (see TECHNIQUE IN ART). Therefore, beauty of line does exist but is difficult to analyze, as it is dependent upon the person

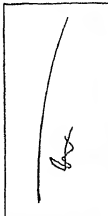


FIG 2—LINES WHICH ARE ESSENTIALLY BEAUTIFUL AND UNBEAUTIFUL

ality of the artist. It may be as difficult to tell why you like one line better than another as why you like one friend better than another, nevertheless, there is no doubt of your preference in the matter.

Besides this beauty of abstract line we find the age-old necessity for outlining objects, and when asked to describe a thing our minds at once turn to its shape. Its consistency, its structure, its movement are all often secondary unless they assert

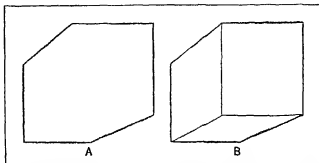


FIG 3—DIAGRAM SHOWING (A) DEFICIENCY OF OUTLINE ALONE (B) NECESSITY FOR STRUCTURE IN ORDER TO MAKE FORM UNDERSTANDABLE

themselves strongly. The artist has only his eyes to help him in this work but knowledge of what lies within is also an aid to him. The author on drawing in the eleventh edition makes use of an illustration given herewith, to show how hard it often is to guess the shape of an object by its silhouette alone. (See fig 3.) As soon as the three lines are added which indicate its structure it is obvious in shape.

It is sometimes possible to erect an imaginary structure which is of assistance and artists frequently resort to this method. For instance, in the drawing of a vase (see fig 5) the straight lines might be sketched in lightly and would be of some assistance in judging both curves and proportions. In other words a sort of scaffolding is first erected and then the outline drawn upon it. After a little practice the scaffolding need not be drawn for the artist can visualize it without the aid of actual lines. Another help

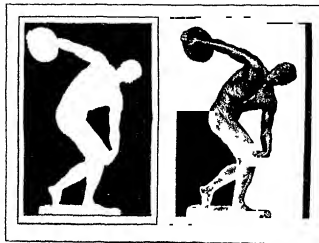


FIG 4—TWO REPRESENTATIONS OF THE SAME STATUE ILLUSTRATING THE VALUE OF A SILHOUETTE FIGURE (LEFT) OVER A STRAIGHT RENDERING (RIGHT) IN OBSERVING FORM

in drawing the silhouette of an object is to reverse the idea and look at the silhouette of the background instead. This process is often employed by sculptors in their work and is undoubtedly of some assistance to them. But all of these are simply suggested aids to seeing, and it takes practice to be able to draw what one sees. (See fig 4.)

THE REQUIREMENTS OF A DRAWING

Even more practice and observation are necessary to catch the movement which is also one of the fundamental appeals of good draughtsmanship. First it must be understood that there

is movement in everything. Trees, when well drawn, seem to show how through years they have twisted and grown up out of the ground. Rocks show the bending of their hot masses by volcanic eruptions and the splitting and eroding of their surfaces. Just as each thing has characteristic structure and outline so too has it characteristic movement, and this movement must be caught in the drawing and should be emulated to a degree in the very movement of the lines. One does not draw the placid sea of a summer night with the same quality of line and movement as one would use to portray its raging strength in a storm. Without typical movement a drawing lacks life and therefore interest. The savage all over the world typifies a snake by a simple wavy line showing its motion, and he feels that an animal is "not him self" in a drawing, if not shown in typical movement.

Composition—Closely related to these three fundamental requirements in good drawing is a fourth which came into the consciousness of man undoubtedly at a later date, but thousands of years ago, that is, composition. No doubt the first artists drew without any consideration of a boundary or limitation to their work, but at some time in the dim past, in the decoration of a clay vase or some other object, a discovery was made that the design was related to the space in which it was executed. Slowly through thousands of years drawings were developed which seemed to be a part of the structure of the limitations or borders themselves, outlines were so related that the eye of the observer was held within the limited area and led from one important detail to another, and it was found that movement was somewhat assisted by the proper placing of figures in the surrounding border.

Much has been written about composition. The Far Eastern artist is perhaps its greatest master. After observing carefully the object to be drawn, he sits and looks at the piece of silk or paper upon which he is to work and plans where he is to place the main features. He does not start at once to sketch as do many of our western artists, for he has found that once the pencil or brush is touched to paper one's ideas crystallize and it is difficult to get away from the slightest commitment. It is, therefore, much better to keep the mind at first in a fluid state so that the final arrangement can be unhampered and things can take their proper relationship.

Simple proportions in composition are easy to grasp and have more meaning than have those proportions which the eye does not understand. Rhythmical or parallel movements are interesting methods of accentuating what seem to be the most typical lines and are often used. Perfect symmetry is tiring. It is as though one were to sit upright in a chair for a long time. The balance should then be thrown to a greater or lesser degree away from the centre to indicate the movement of the picture and give it ease. The story is told of a famous artist in Japan who was asked to paint a screen for the emperor, showing crows in flight. He at length painted one crow just disappearing off of the fourth panel, leaving the other three untouched. This composition helped the movement of the drawing, and the finished work is famous.

If these four simple laws of drawing are observed, it is possible that the finished work will be excellent, but, if any one be omitted, this is impossible. Man has for so long learned to observe structure, outline, movement and composition that the most casual observer feels a lack, if the work does not show them all. Good modelling, perspective and all other considerations can be neglected, and yet a drawing may be a masterpiece aesthetically, though there is no doubt that these do add to its appeal. But these four elements do not in themselves make a great work of art but rather their proper balancing and expression, which may be called taste.

Good Taste—In considering taste it is first necessary to understand what enters into a good drawing, or any outstanding work of art. The personality of the artist or his style is a great part of it and this may be dashing and strong or delicate and sensitive, it may be keen and light, or ponderous and powerful. There are as many styles as there are artists and much of the love that people have for some works of famous artists is due

to the fact that these works give some idea of the man himself. There is also the medium used, be it drypoint, graphite, etching, lithographic crayon or brush, and each medium has advantages and disadvantages. The drypoint line is strong and delicate without much flexibility but with a burr which is distinctive. The etched line has a sure clean cut quality, but neither admit the soft shading possible with the pencil and the crayon or the flexibility of the brush. The appropriateness of the medium and its adaptation to the subject expressed are considerations often neglected, for artists sometimes become used to one medium alone and never find out the possibilities of the others. Finally there are the mood and character of the subject to be expressed. The woodlands which Corot chose to paint seemed to be a part of an enchanted world. The jagged rocks crashing into heaven which Li Lung Mien so deftly rendered with his brush are like flames cracking against the sky. These artists added much of their own imagination to what already existed, but it is nevertheless necessary to have something to start with, and without having seen the elms of France Corot would have found it difficult to paint, as would Li Lung Mien without the rough mountains of China.

Good taste is the perfect fusion of the personality of the artist through long years of practice into a skilful wielding of the tool, which in turn expresses the vital and inner meaning of the object portrayed with all due attention to its structure, its typical silhouette and motion, with appropriate and reasonable composition. When a thing is drawn in good taste one can see what the artist felt while drawing and what his reactions were to the subject shown. Each mark on the paper not only tells how he felt and what his mood was, but what he saw in the mood of the subject. If his subject be a gladiator he may have felt the glory of battle, the vigorous strength, the cruel beauty of the contest, or on the other hand he may have felt the pity and pathos of the inevitable destruction of so beautiful a body. In the one case his strokes would be sharp and vigorous, in the other heavy and dull. Moreover the composition, structure and movement would also reflect both the artist's feelings and those of the subject, both the artist's soul and that of the subject for it is only in this dual expression finely balanced that we ever find the really great works of art.

Some artists fail in good taste because they are so self-centred that they portray everything with too much of themselves and too little of the subject in the work. Others fail because they are so weak that they attempt a totally different treatment for each subject and have nothing to say about any. A drawing may also be in good taste in its expression of line, in its balance of the subjective and objective, but fail because the composition has not been studied to express this condition and is therefore not appropriate. Drawing is like music. It has tempo, key, pitch and many other elements, all of which, when perfectly handled by a master, make for beauty, but which, in the hands of one untrained or unfeeling, may prove terrible pitfalls.

Three Dimensions—In this discussion nothing has been said of the attempt to portray three dimensions on a two dimensional surface (see PERSPECTIVE). It is the consensus of opinion that a work of fine drawing can be just as great in two as in three dimensions. Nay, it has often been pointed out that drawing is fundamentally two dimensional art and that the introduction of the third dimension savours of trickeries, and either builds lumps on the two dimensional surface or pushes holes into it. However, since the discovery of perspective, such superb trickery is it that a great vogue for its use has sprung up, and in the development of realistic painting which found its apex in the early 19th century much was done to make man expect the third dimension in drawing. Others, led perhaps by Cezanne, have attempted to give an even greater feeling of solidity to objects by the use of exaggeration and distortion. This is all interesting and may, in thousands of years to come, grow so into the consciousness of man that children drawing in the sand with a stick will spontaneously depict the third dimension, but at present it is a comparatively new development and has not yet penetrated deeply enough to make it one of the fundamental requisites. A

work of art can be a masterpiece if drawn in only two dimensions and does not gain an appreciable aesthetic advantage, if drawn in three.

The Teaching of Drawing.—Owing to a faulty understanding of terms and a general misunderstanding of the underlying principles of art there has been a great effort in the last generation to teach "originality" and individual expression in all the arts. One might as well try to teach character or soul. These are things which grow through the years and which cannot be taught. The result is a chaotic condition hampered by the belief that artists are born, and that they express their "gifts" suddenly and without the work which a careful study of the lives of all great masters proves to be necessary. Some schools do not feel it is necessary to teach the pupils the fundamentals of art, so cautious are they in the foolish effort to protect their pupils' freedom. Therefore it seems necessary to consider the sane and proper method which should be followed in the instruction of others or of self.

First of all, become friendly with a ruler. A large part of the artist's work consists in measuring with the eye, and it is imperative that the eye be trained to accuracy. Only by judging distances and proportions and then checking one's judgment by measurement can this accuracy be obtained. A good plan for the beginner is to purchase a drawing board, T square, triangles, compasses and pair of medium size clippers. With these instruments an attempt should be made to draw vases of simple form so that the eye may be trained to see curves and proportions. For example (see fig. 5) after the piece of paper is fixed to the board with thumb-tacks (drawing pins) so that its lower edge is in line with the T square when pressed in place at the left side of the board, a line is drawn near the bottom to act as base line and upon this line a portion is measured off with a ruler, equal to the diameter of the base. This line is then divided in half and a perpendicular is erected at its centre, upon which the height of the vase is laid off, at this point another horizontal line is drawn, upon which is laid off the diameter of the lip centred immediately above the base. The ruler is then stood perpendicular to the table upon which the vase stands and moved until it touches the side of the vase at a point where it is widest, and another horizontal line is drawn with the T square, the same distance from the base line as this point is from the table. With the calipers this widest diameter is found and it is laid off on this line. Similar measurements are taken of the narrowest diameters and of their height from the table, and finally the curves are drawn in, touching those points which have been established.

It will be surprising to the beginner to find how accurate his first drawing is, if done in this manner. It will also be surprising to find how quickly he can grasp the amount of concavity or convexity of a curve no matter in what position it may occur, and to grasp its changes into another curve after he has drawn a number of vases. He will begin to see where one curve becomes more abrupt and another more gentle in its course. Looking back upon his first drawing, he will see all the slight delicacies of line which he missed, and will begin to appreciate the fine innuendoes the potter had put into the vase, which had at first completely escaped his eye.

The modernist may criticize this method and say that it will make the student a slave to the ruler. This is not true, for as time goes on the student needs fewer and fewer actual measurements, until at length he can draw a vase on any scale accurately. It is then time to attempt more complicated forms and these too should be measured at first. The greatest sculptors do not entirely trust their eyes for this work, and it is only by long

training and much hard though interesting work that real efficiency can be accomplished, but new beauties will reward the student at every turn as he begins to train his eye to see. There is time enough later to try certain distortions or caricatures of the objects, to gain points which it is wished to stress. These distortions must be based upon correct drawing, or they will not be convincing. During this training the student should constantly observe masterpieces of various kinds, and remember that masterpieces are not only paintings which hang in museums but vases, sculpture, furniture and all of the thousand and one other things which show the touch of real art. The East should be studied as well as the West and every thing which especially appeals should be copied, for it will be found that one sees into a thing much more if it is actually copied, than one can by any amount of mere looking at it. Through all of this study, the principles which were first pointed out should be kept in mind and an attempt should be made at all times to incorporate them in the actual work as it goes along. (W E Cx)

DRAWING, ANATOMICAL. The study of the anatomy of the human body is approached by the artist and the anatomist from different points of view. The former, by a process of artistic selection, seeks the ideal and adopts the proportions which give the most pleasing effect, while the latter desires to know only the mean, or average, of a large series of measurements. (See COMPARATIVE ANATOMY.)

ARTISTIC ANATOMY

The representation of the anatomical form of man as applied to the Graphic Arts may be called *Artistic Anatomy*. This form of illustration may be divided into three groups: (1) The schematic, (2) That which represents the subject exactly, (3) The ideal conception or the ideal figure, constructed from the mean proportion of several types.

The schematic drawing is one which represents in outline the main characteristics of the object. It may be drawn with little or no regard as to the exact knowledge of the form. It has been of use in setting forth certain physiologic principles by the general form and location of the organs of the body, and especially used in post mortem and zoologic comparisons.

The true drawings occur particularly in pathologic anatomy, where various and unknown forms are sought and where certain organs have to be shown in the individual, as in the case of human embryology and comparative anatomy.

The representation of the ideal is the only form suitable for teaching—and the very development of this figurative corresponds with the growth of the science of anatomy in all its periods. This type of drawing presupposes a vast amount of previous study of the human figure. It cannot come out of a period in which the artistic development overshadows that of the science of anatomy. This vague feeling for beauty, with a corresponding neglect of the real, was evidenced in an early period of anatomical illustration, when conditions favoured an artistic point of view, as was the case in the first half of the 16th century. This, however, changed as the cold scientific and extensive dissection was practised during the 17th and 18th centuries. It is only the combination of these two tendencies which can satisfactorily serve the advanced science of anatomy and the modern art of drawing, bringing to perfection through exactness of detail and ceaseless observation a comprehension of beauty in the entire figure.

In artistic anatomy, nothing else is of value to the artist but the idealized drawing. The more he eliminates the unnecessary, the better, the keener his eye for the unnecessary, the bigger his vision of the true needs of the artist. The unnecessary is harmful, and the artist's presentation of too much anatomy makes of him a professional anatomist. Of immediate necessity is the study of the antique, or the older plaster models of Greek figures, for in drawing the nude the young artist visualizes the actual healthy form in all its fullness of life and movement, thus adding an element which can never be supplied by purely anatomic delineation.

HISTORY

The development of artistic anatomy was not of outstanding consequence before the 16th century. Only a few anatomical en-

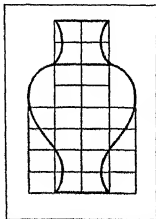


FIG. 5.—DRAWING OF VASE SHOWING METHOD OF TAKING MEASUREMENTS

gravings and woodcuts are found to that date. Even the drawings that Aristotle used in supplementing his works on anatomy have been lost. Figurations of skeletons and representations of bodies on cameos, seals and bronzes were common, but these delineations never served the purpose of anatomic instruction, they were rather of an emblematic nature—symbols of death, magic amulets, references to the fable of Prometheus, etc. In view of this, artistic anatomy may be divided into the following periods.

To the 16th Century.—Anatomical drawings of the Classic Period and the Middle Ages were known, and even mentioned by Aristotle, but so few have come to us for study that the subject cannot be adequately covered. Before the time of Berengario, commonly called Berenguer of Carpi, about 1521, most of the attempts were schematic drawings for medical observation, artistic anatomy remaining in the background as a private study and depending largely upon professional anatomists for its development.

The 16th Century.—Although the name Berengario belongs only to the annals of medicine and will be remembered as the most zealous and eminent in cultivating the anatomy of the human body, it was his day, and that of Vesalius (1514-64), that marked the beginning of the attempt to free the anatomical drawing from schematic and arbitrary features and recognized its place in art. This artistic anatomy, was promoted by both artist and anatomist for the sole purpose of instruction. It was during this period that the Italian School of Anatomy reached its height of interest in the woodcut, it was during this period that sculpture and painting adopted proportions of the human body never before developed, it was during this period that Michelangelo lived. Other 16th century artists who contributed to the study of anatomical figures were Leonardo da Vinci, Raphael, Titian and Dürer.

The 17th Century.—A comparative study of the antique, a clinging to Vesalian patterns, and the advent of independent publications on artistic anatomy mark the development of the study in the 17th century. A closer training in details and an effort toward the artistically perfect reproduction may also be included.

18th-19th Century.—Albinus (1669-1770) was one of the most famous teachers of anatomy in Europe, his classroom at the Leyden School of Anatomy being frequented not only by students but by many practising physicians. The Leyden school exerted untold influence in creating a greater exactness in all details. The styles of both Vesalius and Albinus were used as patterns in anatomical drawing, many independent attempts proving unsuccessful.

About 1778 combinations of utmost anatomic truths with artistically beautiful reproductions were brought out. The adoption of the steel engraving, lithography, the daguerreotype, as well as the revival of the woodcut in an improved form, meant an advance in the art, the exclusive use of the Albinian patterns gave rise to a greater independence. In fact, 1778 may be given as the beginning of the period in which the most valuable material on artistic anatomy was produced. Modern scientific medicine had gained its stride and was already moving swiftly toward the goal of a well-organized body of real knowledge capable of continuous growth. And this development may be shown in the bibliographic list as given below, the chain running from the first half of the 18th century to the present day. This bibliographic account gives the distinctive examples of anatomic illustration, including the modern work in both the technical and the artistic.

TECHNIQUE

For the young student of anatomy as applied to art the simple drawing is the most effective in learning to construct the human figure. The eye must follow a line or a plane or a mass, which in construction becomes a moving line, a moving plane, a moving mass. But the mental construction must precede the physical, and in this the concept of mass must come first, that of the plane second, that of line last.

Certain laws enter into the functioning of the various organs of the body, just as pronounced as they are in controlling any other machinery. To the bones, for example, which make up the

pressure system, belong the laws of architecture, as in the dome of the head, the arches of the foot, the pillars of the legs, etc., also the laws of mechanics, such as the hinges of the elbows, the levers of the limbs, etc. Ligaments constitute the retaining or tension system, and express other laws of mechanics. Muscles produce action by their contraction or shortening and are expressed in the laws of dynamics and power, as well as the laws of leverage.

In giving herewith only an outline of the construction of the main parts of the body, the author presupposes a rudimentary knowledge of drawing, on the part of the student, and offers the following, in connection with the illustrations only as a further guide in studying the elements of anatomy and becoming more adept in the art of drawing.

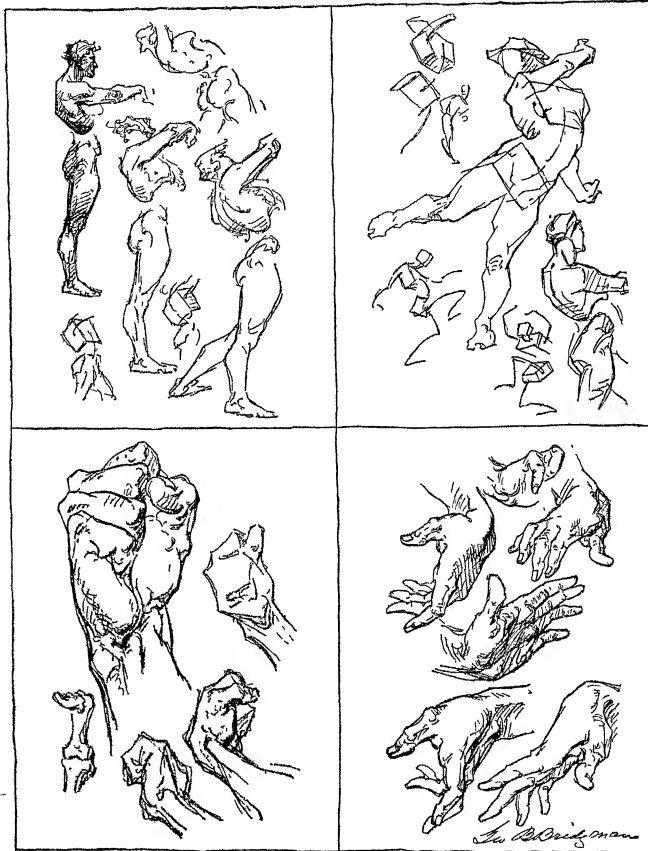
The Hand.—In drawing the hand the artist must realize that, as in the human figure, there is an action and inaction side. When the thumb side is the action side the little finger is the inaction side. The inaction construction line runs straight down the arm to the base of the little finger. The action construction line runs down the arm to the base of the thumb at the wrist, from there out to the middle of the joint, at the widest part of the hand, thence to the knuckle of the first finger, then to that of the second finger, and then joins the inaction line at the little finger. However, with the hand still prone, when it is drawn from the body the thumb side becomes the inaction side and is straight with the arm, while the little finger, corresponding previously to the thumb, is at almost right angles with it. The inaction construction line now runs straight to the middle joint of the thumb, while the action line runs to the wrist on the little finger side, thence to the first joint.

The Fingers.—Each of the four fingers has three bones. The middle finger is the longest and largest, because in the clasped hand it is opposite the thumb and with it bears the chief burden. The little finger is the smallest and shortest and most freely movable for the opposite reason. The middle joint of each finger is the largest, and, like all the bones of the body, the bones of the finger are narrower in the shaft than at the ends. In the clenched fist it is the end of the bone of the hand that is exposed to make the knuckle. Each of the three joints moves about one right angle except the last, which moves slightly less. The movements of the joints are also limited to one plane, except the lower one, which has also a slight lateral movement, as shown when the fingers are spread.

The Thumb.—The centre of all the activities of the fingers, the hand, and the forearm, is the thumb. The fingers, gathered together, form a corona around its tip. Spread out, they radiate from a common centre at its base, and a line connecting their tips forms a curve whose centre is the same point. This is true of the rows of joints also. The thumb has three joints, and its bones are heavier and its joints more rugged than those of the fingers. It is pyramidal at the base, narrow in the middle, pear-shaped at the end. The ball faces to the front more than sideways. The thumb reaches to the middle joint of the first finger. The last segment bends sharply back, its joint having about one right angle of movement, and only in one plane. The middle segment is square with rounded edges, smaller than the other two, with a small pad. Its joint is also limited to one plane. The basal segment is rounded and bulged on all sides. The joint of its base is a saddle joint, with the free and easy movement of one in a saddle.

The Arm.—The forearm has two bones, lying side by side. One, the radius, is large at the wrist and the other, the ulna, is large at the elbow. Diagonally opposite the thumb, on the ulna, is a bump of bone which is the pivot for both the radius and also the thumb. Muscles must be above the joint they move, so the muscles that bulge the forearm are mainly the flexors and extensors of the wrist and hand. The flexors and pronators form the inner mass at the elbow, the extensors and supinators form the outer mass.

Both the above masses arise from the condyles of the humerus, which is the bone of the upper arm. The part of the humerus near the shoulder is rounded and enlarged, where it joins the shoulder blade. The lower end is flattened out sideways to give



FROM BRIDMAN CONSTRUCTIVE ANATOMY

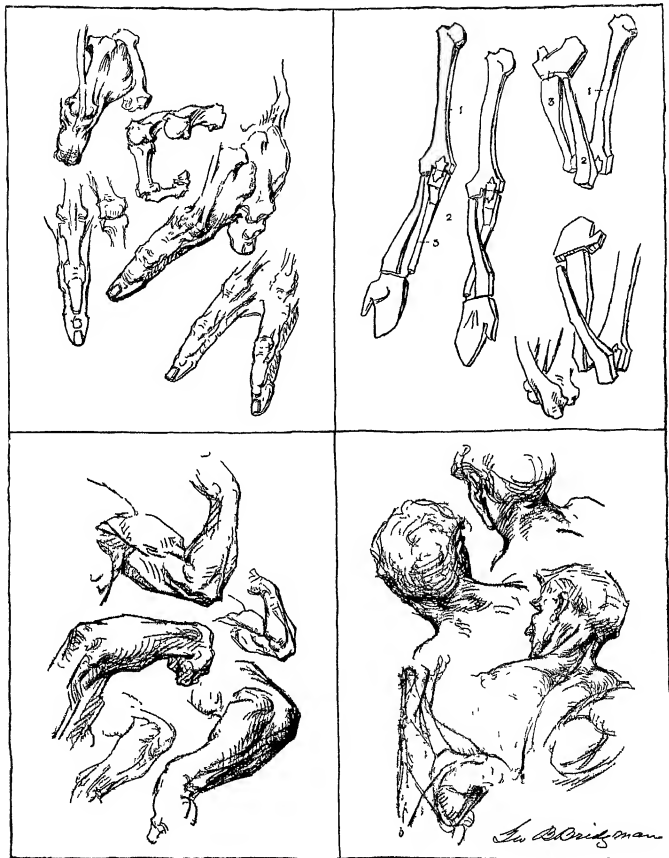
DRAWINGS OF THE FIGURE IN MOVEMENT AND STUDIES OF THE HAND

Upper left Unchanging masses of the head, torso and pelvis to be conceived as blocks, and the turning or twisting of these blocks or masses

Lower left Studies of the hand on the wrist indicating power or force

Upper right Blocked movements of the figure, showing lifting of the masses

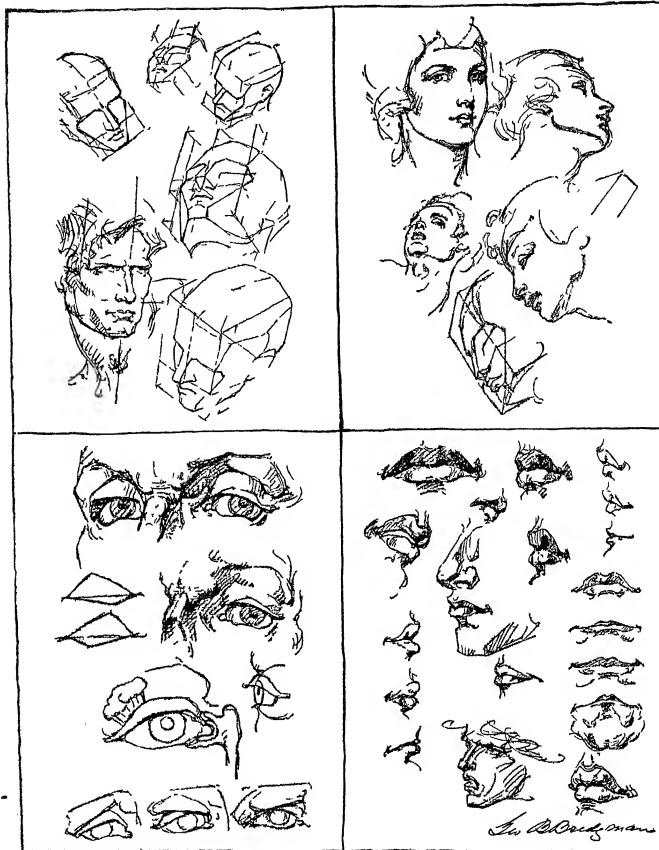
Lower right Studies of the hand showing rhythm



FROM BRIDGMAN "CONSTRUCTIVE ANATOMY"

MECHANISM OF ARM AND FINGER JOINTS AND DIAGRAM OF THE BACK OF THE NECK

Upper left: Mechanism of finger joints and knuckles. Upper right: Wooden device used to illustrate the crossing of radius over ulna. (1) Humerus, arm bones. (2) Ulna, forearm, little finger side. (3) Radius, forearm, thumb side. Lower left: Flexing of forearm on arm. Lower right: Diagram of muscles of back of neck.

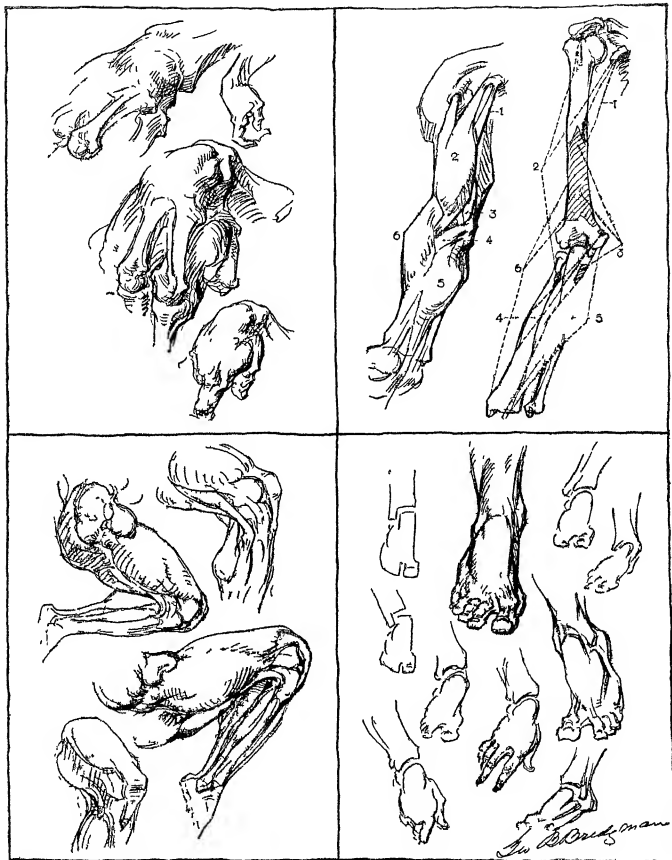


FROM BRIDGMAN CONSTRUCTIVE ANATOMY

STUDIES IN CONSTRUCTION OF THE HEAD, EYE, NOSE AND MOUTH

Upper left Blocked construction of the head
 Upper right Heads seen in different perspectives

Lower left Construction of the eye
 Lower right Construction of the mouth



FROM BRIDGMAN CONSTRUCTIVE ANATOMY

DRAWINGS ILLUSTRATING THE MECHANISM OF MOVEMENT

Upper left Back of hand showing movement of the hand on the wrist Upper right The muscles of the arm and forearm: (1) Coraco brachialis, (2) Biceps, (3) Brachialis anticus, (4) Pronator radii teres, (5) Flexors grouped, (6) Supinator longus Lower left Flexing of leg on thigh Lower right Comparative movements of hands and feet

attachment to the ulna and radius, forming the condyles. The shaft itself is straight and nearly round, and is entirely covered with muscles except at the condyles.

The Shoulder—The deltoid muscle, triangular in shape, gives form to the shoulder. Just below the base is a ripple which marks the head of the arm bone. The masses of the shoulder, arm, fore arm and hand do not join directly end to end with each other, but overlap and lie at various angles. They are joined by wedges and wedging movements. Constructing these masses first as blocks, we will have the mass of the shoulder, or deltoid muscle, with its long diameter sloping down and out, leveled off at the end, its broad side facing up and out, its narrow edge straight forward. The mass of the forearm overlaps the end of the arm on the outside by a wedge that rises a third of the way up the arm, reaches a broad apex at the broadest part of the forearm and tapers to the wrist, pointing always to the thumb, and on the inside by a wedge that rises back of the arm and points to the little finger. In the lower half of the forearm, the thin edge of the mass, toward the thumb, is made by a continuation of this wedge from the outside. In the back view of the arm, the mass of the shoulder sits across its top as in the front view.

The Neck—Curving slightly forward, the neck rises from the sloping platform of the shoulders. The strength of the neck is at the back of the head, this portion being somewhat flat and overhung by the base of the skull. The sternomastoid muscles descend from the bony prominences back of the ears to meet almost at the root of the neck, forming a triangle whose base is the cany of the chin. In this triangle below is the thyroid gland, larger in women, and above it the angular cartilage of the larynx, or Adam's apple, larger in men.

The Head—Both the oval and the cube have been used by artists as a basis for drawing the head, but the cube seems preferable in that the oval is too indefinite and offers no points for comparison, no basis for measurement, and the eye does not fix on any point in a curved line. The block not only carries the sense of mass, but provides a ground plan on which any form may be built, as well as its perspective and foreshortening. The element of bilateral symmetry enters the drawing of the head. A vertical line in the centre divides the head or the trunk into parts equal, opposite and complementary. The right eye is the counterpart of the left, the two halves of the nose are symmetrical, the limbs, except for changes of position, are nearly exact though reversed duplicates of each other.

The cranium, the skeleton of the face, and the jaw constitute the masses of the head. Into the rounded mass of the cranium sets the narrower mass of the forehead bounded by the temples at the sides and by the brows below. From the lower outer corners of the forehead the wedge of the cheek bones curves, moves outward and downward until it just passes the curve of the cranium, then down and in, in a long sweep, to the corner of the chin. The two cheek bones together form the central mass of the face, in the middle of which rises the nose.

The planes of the head are those of the forehead, sloping upward and backward to become the cranium. The sides turn sharply to the plane of the temples. The plane of the face, divided by the nose, is broken on each side by a line from the outer corner of the cheek bone to the centre of the upper lip, making two smaller planes. The outer of these tends to become the plane of the jaw, which is again divided, etc. The relations of these masses and planes is to the moulding of a head what architecture is to a house. They vary in proportion with each individual and now must be carefully compared with a mental standard.

The Eye—Below the eyebrow, on the lid, are three planes, wedging into each other at different angles. The first is from the bridge of the nose to the eye. The second is from the brow to the cheek bone, which is again divided into two smaller planes, one sloping toward the root of the nose, the other directed toward and joining with the cheek bone. The lower lid is stable, it is the upper lid that moves. It may be wrinkled and slightly lifted inward, bulging below the inner end of the lid. The cornea is always curtained by the upper lid, in part. The immovable masses of the forehead, nose and cheek bones form a strong setting for

the most variant and expressive of the features.

The Nose—The bony part of the nose is a very clear wedge, its ridge only half the length of the nose. The cartilaginous portion is quite flexible, the wings being raised in laughter, dilated in heavy breathing, narrowed in distaste, and wings and tips are raised in scorn, wrinkling the skin over the nose.

The ears, the mouth, the lips, and the chin, all offer variations in construction, and it is through comparison with others that the art of drawing them can best be acquired.

The Trunk—The upper part of the body is built around a bony cage called the thorax, conical in shape, and flattened in front. The walls of this cage are the ribs, twelve on each side, fastening to the spine behind and to the sternum or breast bone in front. The first seven are called true ribs, the next three false, and the last two floating ribs. The masses of the torso are the chest, the abdomen or pelvis, and between them the epigastrum, the first two comparatively stable, the middle one quite movable. The shoulders are also movable, changing the lines of the first mass and bulging the pectoral muscles, but the mass itself changes little except the slight change in respiration. The mass of the abdomen is even more unchanging.

The Torso—In profile the torso presents three masses: the chest, the waist and the abdomen. The mass of the chest is bounded above by the line of the collar bones, below, by a line following the cartilages of the ribs. This mass is widened by the expansion of the chest in breathing, and the shoulder moves freely over it, carrying the shoulder blade, collar bone and muscles. The back view of the torso presents numerous depressions and prominences, due to its bony structure and the crossing and recrossing of a number of thin layers of muscles. The outside layers manifest themselves only when in action, and for this reason the spine, the shoulder-blade, and the hip bone are the landmarks of this region.

The Lower Limbs—The thigh, the leg, and the foot constitute the lower limb. The thigh bone is the longest and strongest bone of the body, and the mass of the thigh is inclined inward from hip to knee, and is slightly beveled toward the knee from front, back and outside. Below the knee is the shin bone, the ridge of which descends straight down the front of the leg, a sharp edge toward the outside, a flat surface toward the inside, which at the ankle bends in to become the inner ankle bone. The outer bone of the foreleg soon overlies by a gracefully bulging muscular mass, emerges again to become the outer ankle bone. Two large muscles form the mass on the back of the leg.

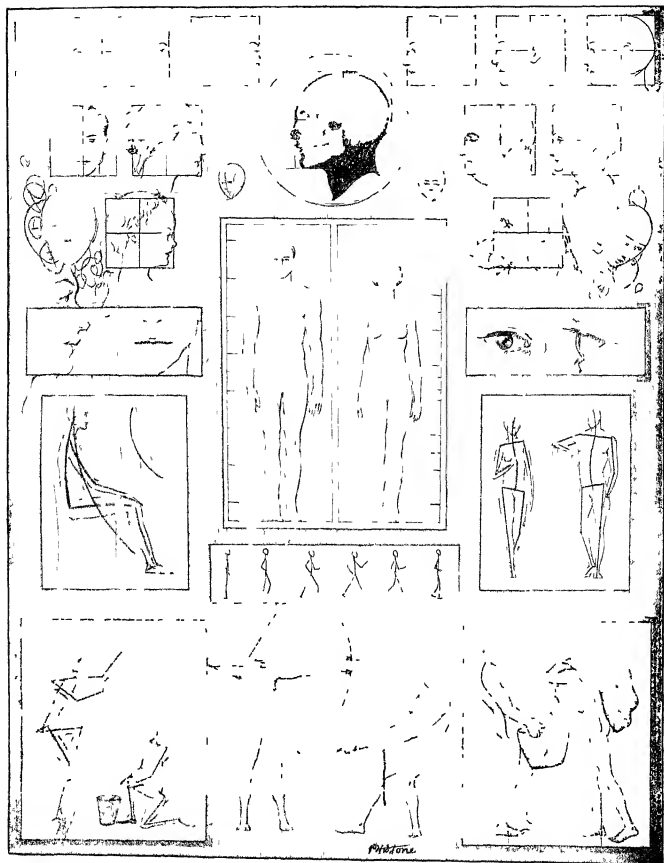
The Foot—In action, the foot comes almost into straight line with the leg, but when setting upon the ground it bends to keep flat with the ground. A series of arches form the symmetry of the foot, the function of these arches being that of weight-bearing. The five arches of the foot converge on the heel, the toes being flying buttresses to them. The balls of the foot form a transverse arch. The inner arches of the foot are successively higher, forming half of a transverse arch whose completion is in the opposite foot. (See COMPARATIVE ANATOMY, ILLUSTRATION, SCULPTURE.)

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LITHOGRAPHIC CRAYON DRAWING BY WARREN E. COX

This drawing was especially prepared by the author of this article to show the appeal which is obtainable through the proper observance of the fundamental laws of structure movement and composition. The structure of the old tree clearly suggests its struggle against the prevailing winds. The movement of the foliage and grasses is immediate and vital. This movement is aided by the slower movement of the clouds and the even slower movement of the sand dunes and is opposed by that of the tree branch to the right, the dead stick in the sand and the boulder to the left, all of which only help to indicate the strength of the wind. The composition is well balanced but made dynamic by the small tree placed at the extreme left just disappearing off the picture as does the crow described on the Japanese screen in the text. By the use of these elements the artist has attempted to give the feeling that the sea is just out of sight over the dunes.



ANATOMICAL STUDIES FOR ELEMENTARY DRAWING

1-6 Illustrate the method of applying the egg shape to a profile by means of a square
 7-13 Are variations controlled by the principle of the egg shape and square

14-15 Show the construction of nose and eye
 16 Shows the proportional measurements of male and female forms
 17 Shows six stages in a single step illustrating balance in walking
 18-22 Illustrate distribution of weight in figure at rest and in action

d'Ethnographie Appliquées aux Beaux-Arts Paris Renouard, 1886 xii+276 pp. Illustrated by pen drawings (in black and white and colours) by G. L. Rochet.

Paul Richer (1849-), *Anatomie Artistique* Description des formes extérieures du corps humain au repos et dans les principaux mouvements Paris E. Plon, Nourrit & Co, 1890, fol. viii, 110 pl. *Physiologie Artistique de l'Homme en Mouvement* Paris O. Douin, 1895, 8 335 pp., 6 pl.

Paul Richer (1840-), *Nouvelle Anatomie Artistique du Corps Humain* Paris Plon 1906 sm 4 vi+177 pp.

Ernst Wilhelm Brücke (1850-92), *Schönheit und Fehler der menschlichen Gestalt* Wien W. Braumüller, 1891, 8 2 p. 1, 151 pp. By the professor of physiology at Vienna. A book of unusually attractive and informing character, illustrated with 29 small woodcuts of singular beauty by Hermann Puar. English translation 1891.

Charles Roth, *The Student's Atlas of Artistic Anatomy* Edited with introduction by C. E. Fitzgerald London H. Grevel & Co, 1891, 10 viii+50, 34 pl.

Arthur Thomson *A Handbook on Anatomy for Art Students* Oxford Clarendon Press, 1896 8 A work of solid merit which has reached its fourth edition. Illustrated with superb photographic plates of the nude in brown tone, each plate having opposite a schema of the underlying muscles, with legends. The male and female models were chosen not for excessive muscularity, but for all round symmetry and proportion. Fair and away, the best model treatise on the subject in English.

Carl Heinrich Stratz, *Die Schönheit des weiblichen Körpers*, Stuttgart F. Enke, 1898 A treatise on artistic anatomy, based upon direct photography of female models.

Der Körper des Kindes Fur Eltern, Erzieher, Aertze und Kunstler Stuttgart F. Enke, 1903, 8 vii+250 pp., 2 pl. An admirable study of surface anatomy of the female body in children, illustrated by photographs from the nude.

James M. Dunlop *Anatomical Diagrams in the Use of Art Students*, arranged with analytical notes, and with introductory preface by John Cleland London George Bell & Sons, 1899, rev. 8 4 p. 1, 72 pp. Illustrated with partly coloured drawings and photographs.

George McClelland *Anatomy in Its Relation to Art*, an exposition of the bones and muscles of the human body, with special reference to their influence upon its actions and external forms Philadelphia A. M. Slocum Co., 1906, 4 142 pp., 41 i., 126 pl. Illustrated by 338 original drawings and photographs made by the author. The drawings are mostly rude diagrammatic sketches. The photographs are elegant, well selected album pictures of the nude, many of them duplicating the poses and thus demonstrating the excellent anatomy of many antique and modern statues.

Robert J. Colenso *Landmarks in Artistic Anatomy* London Baillière, Tindall and Cox, 1902, sm 4 vi (1-1)+56 pp. 6 outlines pl.

Robert Wilson Shufeldt (1850-) *Studies of the Human Form*, for Artists, Sculptors and Scientists Philadelphia F. A. Davis Co., 1908, roy. 8 xvi+664 pp. Illustrated by photographs of nude models.

Sir Alfred D. Fripp and Ralph Thompson *Human Anatomy for Art Students*, with drawings by Innes Fripp and an appendix on comparative anatomy by Harry Dixon Philadelphia J. B. Lippincott Co., 1911, 12 296 pp. Contains 151 illustrations, among which are 23 effective photographs from the nude.

John Henry Vanderpool (1857-1911) *The Human Figure* London, 1913, 8.

Edwin George Lutz *Practical Art Anatomy* New York Charles Scribner's Sons, 1918, 8 vii+254 pp. Illustrated with very rudimentary outline drawings by the author.

George B. Bridgman *Constructive Anatomy* Pelham, New York Bridgman Publishers 1919-213 pp. 11 400 bds.

George B. Bridgman *The Book of One Hundred Hands* Pelham, New York Bridgman Publishers 1921-172 pp. 11 400 bds.

George B. Bridgman *Bridgman's Life Drawing* Pelham, New York Bridgman Publishers 1924-172 pp. 2 11 300 bds. Edward C. Bridgman, Geo. B. Bridgman (Pelham, N.Y.)

(E. C. Br., G. B. Br.)

Elementary—The young artist is primarily interested in making drawings of people, faces and particularly, profiles. A series of charts giving the simple and fundamental rules of proportion is shown as a practical means of starting him in this art.

For the profile, a square is drawn and divided into four equal squares, and the eyes, nose, mouth, chin and ear are placed upon this chart as shown in the progressive illustrations. When the head is complete, the student will discern the egg shape, which is his first and constant principle, and which should be practised constantly until an egg can be drawn perfectly with one sweep of the hand. Proportions can soon be found on an egg shape without the aid of a square. Next, the full face is attempted, following the same principles of proportion. It will be observed that the eyes divide the width of the egg-shape into approximately five equal spaces. The two-thirds view and all other variations of the

human head should be drawn by means of the egg. With the profile the beginner will discover that all types of heads, fat, thin and old, may be drawn over the square chart with only minor variations in line. The baby and the gorilla are opposite extremes and present exceptions to the rule for placing the eye on the half way point.

The "Greek Ideal" divided the human figure into eight divisions, each equal to one head in height, but actually it is seven and one half heads high. The woman's head is smaller, but the divisions of the body are in similar proportion. Note that in the figure of the man the shoulders are wider than the hips, and the woman's hips are wider than her shoulders.

Taking up these two figures in action, the young artist must learn to look at the figure as a whole, he must consider the one line which expresses the motion he desires, and forget that the figure is made of arms and legs and torso.

The young artist must also consider balance. The distribution of weight is directly over the feet, no matter how heavy the load. Without carrying a weight, the chin of the figure is directly over the foot which sustains the weight.

DRAWING, ENGINEERING, the general term for the drawing used in the industrial world by engineers and designers, mechanical, architectural, structural, etc., is the formula in which is expressed and recorded the ideas and information necessary for the building of machines and structures. It is distinguished from drawing as a fine art in that it is not pictorial representation but a complete graphical language in which exact and positive information is given regarding every detail of the structure or machine to be built. Since it describes the object as it actually is to be and does not show it in pictorial form as it would appear to the eye it can be read and understood only by one trained in its use. When this language is written exactly and accurately it is done with the aid of mathematical instruments and is called *mechanical drawing*. When done freehand it is known as *technical sketching*. As it cannot be read aloud like a written language it must be interpreted by forming a mental image of the subject represented, and the engineer in reading a drawing that would appear to be only a complicated mass of lines has as clear a picture of the structure standing in space as if it were actually before him. Apart from its practical utility, the value of teaching drawing in the schools is in the training of this constructive imagination, the perceptive ability to think in three dimensions, to visualize quickly and accurately, to build up a clear mental image, a training useful not only to professional designers but to all who may be interested in technical industries.

The basis of engineering drawing is orthographic projection, which may be defined as the method of representing the exact shape of an object by two or more views on planes at right angles to each other, by dropping perpendiculars from the object to the planes. There are two systems in use, the first and older is

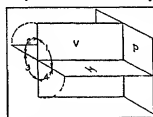


FIG. 1—THE THEORETICAL PLANES OF PROJECTION SHOWING THE FOUR ANGLES

first angle projection, in which the object is assumed to be placed in the first quadrant of the four dihedral angles formed by the intersection of two reference planes called the coordinate planes or planes of projection, fig. 1 (cf. DESCRIPTIVE GEOMETRY), and its points projected to these planes, the horizontal plane (*H*) then revolved to coincide with the vertical plane (*V*), the two being represented by the plane of the drawing paper. A third or profile plane (*P*) perpendicular to the *H* and *V* planes is used for a third view if necessary. Fig. 2 shows an object in the first angle and fig. 3 the resulting arrangement of views when the planes are opened. This is the system in present use in Great Britain and other European countries except the Netherlands. It was used in the United States until about 1890 when the industrial works began to change to the newer system of *third angle projection* which in a few years entirely replaced the former method. It is significant that this movement originated in the shops instead,

of in the colleges, after experiments with workmen demonstrated that they could read third angle drawings much more easily than those made in the first angle

Third angle, or, as it is called in Europe, American projection, assumes the object to be placed in the third quadrant of the co ordinate planes, and the observer to be looking through the planes at the object, as shown in fig 4. These planes when opened into one plane give an arrangement of views as in fig 5. Thus the object may be thought of as surrounded by a glass box with its sides hinged to each other (fig 6), the object projected to these sides and the box opened up into one plane. In both systems the projection on the front plane is known as the *front view*, *elevation or vertical projection*, that on the top plane the *top view*, *plan or horizontal projection*, that on the side plane as the *side view* or *end view*, *side or end elevation or profile projection*. For a simple object two views are often sufficient, others may require three or more. Sometimes the left side view can be used to better advantage than the right side. In some cases the bottom view, and more rarely the back view will be required. Fig 7 shows the box as it opens and indicates the positions of these different views.

It is a growing practice in the United States to teach elementary projection drawing without reference to the planes of projection, by explaining that the problem is to represent a solid, with three dimensions, on a flat sheet of paper having only two dimensions, in such a way as to tell its exact shape, and that this is done by drawing a system of "views" of the object as seen from different positions and arranging these views in a definite manner, each view showing two of the three dimensions. Taking, for example, the block shown in pictorial form in fig 8, if the observer imagine himself as in a position directly in front (theoretically at an infinite distance, practically at a reasonable seeing distance but imagining the rays of light from each point to his eye as parallel) its front view would appear as in fig 9a. This view tells the length and height but not the width of the block nor the depth of the notch. Then let the observer change his position so as to look down from directly above the block. He will see the top view (fig 9b), giving the length and width, and the shape of the notch. It is necessary to have another view from the side in this case to show the shape of the triangular part. Fig 9c is the right side view. These three views arranged in their natural position with the top view directly above the front view and the right side view to the right of the front view, completely describe the shape of the block. Note that in the top and side views the front of the block always faces toward the front view.

The argument for this teaching method is that the student visualizes the object itself without being confused in trying to visualize the projections. Its success is indicated in that some engineering schools are now teaching the whole subject of descriptive geometry without using the reference planes.

Reading a Drawing—A line on a drawing always indicates either an intersection of two surfaces, as in the projection of a prism, or a contour, as in the projection of a cylinder (fig 10), a visible edge being represented by a full line and an invisible one

by a "dotted" line, *i. e.*, a line made up of short dashes. One can not read a drawing by looking at one view. Each line on the view (except a contour line) denotes an abrupt change in direction, but the corresponding part of another view must be con-
sulted to tell what the change is. For example, a circle on a front view might mean either a hole or a projecting boss. A glance at the side view or top view will tell immediately which it is. In reading a drawing one should first gain a general idea of the shape of the object by a rapid survey of all the views given, then should select for more careful study the view that best shows the characteristic shape, and by referring back and forth to the adjacent views see what each line represents. In looking at any view one should always imagine that it is the object itself, not a flat projection of it, that is seen, and in glancing from one view to another the reader should imagine himself as moving around the object and looking at it from the direction the view was taken.

Auxiliary Views—A surface is shown in its true shape when projected on a plane parallel to it. In the majority of cases an object may be placed with its principal faces parallel to the three reference planes and be fully described by the regular views. Sometimes however the object may have one or more inclined faces whose true shape it is desirable or necessary to show, especially if irregular in outline. This is done by making an auxiliary view looking straight against the surface, that is, imagining a projection on an extra or auxiliary plane parallel to the inclined

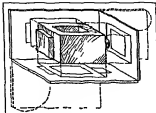


FIG 2—AN OBJECT IN THE FIRST ANGLE PROJECTED TO THE PLANES

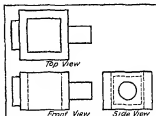


FIG 5—POSITION OF VIEWS IN THIRD ANGLE PROJECTION

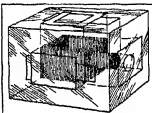


FIG 6—TRANSPARENT BOX ILLUSTRATING THE THEORY OF THIRD ANGLE PROJECTION

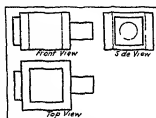


FIG 3—POSITION OF VIEWS IN FIRST ANGLE PROJECTION

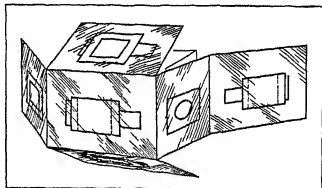


FIG 7—THE BOX PARTLY OPENED INTO THE PLANE OF THE PAPER SHOWING THE RELATIVE POSITIONS OF TOP FRONT LEFT RIGHT REAR AND BOTTOM VIEWS

surface, therefore perpendicular to the same reference plane to which the inclined surface is perpendicular, and revolving it into the plane of the paper. There are three kinds of auxiliary views, first *auxiliary elevations* (fig 11), made on planes which are perpendicular to the horizontal plane but at an angle with the vertical plane, or in other words the kind of views that would be seen if one walked around the object starting from the position at which the front view is seen. Thus an auxiliary elevation would have the same height as the front view. The second kind, called sometimes *left and right auxiliary views*, are used much more frequently. They are made on planes perpendicular to *V* but inclined to *H*. Fig 12 is an example, showing that the width of the auxiliary view is the same as the width of the top view. Third, *front and rear auxiliary views*, on planes perpendicular



FIG 8—DIRECTION OF VIEWS

lar to the profile plane but inclined to H and V , in which the width of the auxiliary view is the same as the width of the front view (fig. 13). Often an auxiliary view will save making one or more of the regular views and at the same time show the shape or construction of the object to better advantage. They are used extensively in the drawing of machine parts and usually are only partial views showing the inclined surface alone. In fig. 14 a front

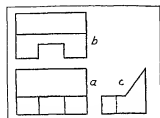


FIG 9—FRONT, TOP, AND RIGHT SIDE VIEWS OF BLOCK

view, partial top view and two partial auxiliary views, describe the shape of the piece in the simplest way.

Sectional Views—When an object is solid or the interior simple the invisible parts can be represented satisfactorily by dotted lines, but if there is much interior detail, especially if the object is made in more than one piece, the dotted lines become confusing and hard to read. In such cases a view is made "in section," as if for that particular view a part of the object were supposed to be cut away and removed, exposing the interior. This view is known as a sectional view or simply a *section*. If the object is symmetrical the cutting plane is usually passed through one of the main axes and the front half imagined as removed. The exposed cut surface of the material is indicated by "section-lining" or "cross hatching" with uniformly spaced fine lines. It must be understood clearly that in thus removing the

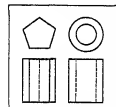


FIG 10—INTERSECTION LINES AND CONTOUR LINES

front portion in order to show the sectional view this portion is not removed from the other views. Fig. 15 shows in pictorial form a casting intersected by a cutting plane and its appearance when the front half is removed, fig. 16 shows the two views of the casting, the front view in section. The edge of the cutting plane is indicated by the line symbol of a dash and two dots, with reference letters and arrows showing the direction in which the view is taken. The cutting plane need not be in a single continuous plane but may be offset in any part of its length to go through some detail. Shafts, bolts, nuts, keys, rods, rivets and the like whose axes occur in the plane of the section are left in full and not sectioned. Adjacent pieces are section lined in opposite directions, and are often brought out more clearly by varying the pitch, using closer spacing for smaller pieces. The same piece in different views or in different parts of the same view should always be section lined identically in direction and

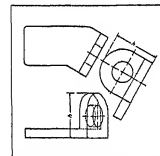


FIG 11—AUXILIARY ELEVATION PROJECTED FROM TOP VIEW

spacing. A common and economical way of showing an object which is symmetrical about a centre line is by making what is called a *half section*, drawing one side in section and the other in full. In such a view dotted lines are unnecessary. *Revolved sections*, made by passing a cutting plane through some detail such as a rib or the arm of a wheel and turning it in place are often used (fig. 17). *Detail sections* are for the same purpose but in

stead of being drawn on the view they are set off to some adjacent place on the paper. The cutting plane, with reference letters, should always be indicated. *Phantom sections* are exterior views with the interior construction brought out by dotted cross hatching.

A *working drawing* is a drawing that gives all the information necessary for the complete construction of the object represented. It includes (1) The full representation of the *shape* of every part of the object (orthographic projection). (2) The *size* of every part, in figures (dimensioning). (3) Explanatory notes giving

specifications as to materials, finish, etc. (4) A descriptive title. Often as in architectural and structural drawing the notes of materials and workmanship are too extensive to be lettered on the drawings so are made up separately in typewritten or printed form and are called the *specifications*, hence the term "drawings and specifications." Working drawings are divided into two general classes, *assembly drawings* and *detail drawings*. An assembly drawing is, as its name implies, a drawing of the machine or structure put together, showing the relative positions of the different parts (fig. 18). Its particular use is in the erection of the structure. It may give the all-over dimensions and distances from centre to centre or part to part of the different pieces, showing their relation to each other, usually indicating the different parts by "piece numbers," often enclosed in circles. It frequently includes a "bill of materials," a tabulated statement of all the parts used, including stock parts such as bolts, screws, cotter pins, etc. Classified under the general term of assembly drawings would be other forms, as the *design drawing*, the preliminary layout, full size if possible, on which the scheming, inventing and designing are worked out accurately after freehand sketches and calculations have determined the general idea. From it the detail drawings of each piece are made. Sometimes the finished assembly drawing is traced from the design drawing, more often it is redrawn, perhaps to smaller scale to fit a standard sheet, using the detail drawings to work from, thereby checking their correctness. An *outline assembly* is used to show the appearance of the machine, sometimes for catalogue or other illustrative purposes. Piping, wiring and oiling diagrams are also forms of assembly drawings. An *assembly working drawing* showing fully the dimensions and construction of each piece as well as their relative positions, so that no separate detail drawings are needed, may be made for a simple machine. A *unit assembly drawing* is a drawing of a related group of parts, in a complicated machine or structure.

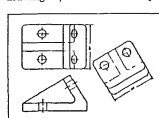


FIG 12—RIGHT AUXILIARY VIEW PROJECTED FROM THE FRONT VIEW

A *detail drawing* is a complete description of each separate piece, giving its shape, size, material and finish, what shop operations are necessary, what limits of accuracy are demanded and how many of each are wanted (fig. 19). Sometimes smaller parts of the same material or character are grouped together, as forgings on one sheet, special bolts and screws on another, etc., but in large production the accepted practice in a set of drawings is to have each piece, no matter how small, on a separate sheet.

In commercial drafting, accuracy and speed are the two requirements. The drafting room is an expensive department. There are therefore many conventional methods or idioms and abbreviations of the language, with which the draftsman must be familiar. There are also allowable violations of the strict principles of projection when added clearness may be gained. One of the time-saving conventions is in the representation of screw threads. The helical curves are never drawn except on screws of very large diameter, but are conventionalized into straight lines, and on screws less than perhaps an inch in diameter the thread contours are omitted, the threaded portion of a shaft being represented by one of a number of conventional symbols, of which three are shown in fig. 20, 4 being the commonest. As another example, in making working drawings of gears and toothed wheels the

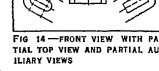
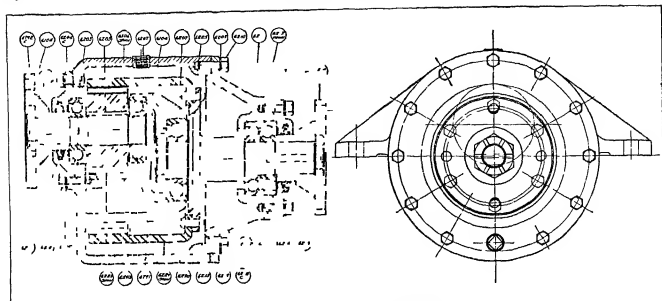


FIG 13—FRONT VIEW WITH PARTIAL TOP VIEW AND PARTIAL AUXILIARY VIEWS

in making working drawings of gears and toothed wheels the



the drawing as a working drawing lies in the dimensions, *i.e.*, telling the size. Successful dimensioning requires not only a knowledge of the principles and conventions but an acquaintance with the shop processes which enter into the construction. A dimension line is usually made as a fine full line terminated by carefully made arrow heads which indicate exactly the points to which the dimension is taken. Some use a dash line and some a red line for dimension lines. On machine drawings a space for the

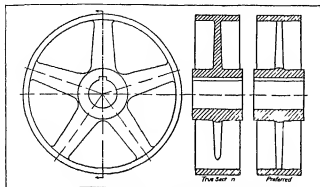


FIG. 21—TRUE SECTION AND ITS PRACTICAL MODIFICATION

figures is left in the dimension line, in structural and much architectural practice the figure is placed above a continuous dimension line. Extension or witness lines not touching the outline, indicate the distance measured when the dimension is placed outside the figure.

In dimensioning there are some conventional practices which have come to represent good form to such an extent as to have the force of rules.

1. Dimensions on horizontal and inclined dimension lines should read from left to right, those on vertical lines from bottom to top, *i.e.*, so as to be read from the right hand side of the sheet.
2. Preferably keep dimensions outside the view unless added clearness, simplicity and ease of reading will result from placing them inside. They should for appearance's sake be kept off the cut surfaces of sections. When necessary to be placed there the section lining is omitted around the numbers.
3. Feet and inches are designated thus, 5'-3". When a dimension is in even feet it is indicated thus 5'-0".
4. Fractions are always made with horizontal division lines.
5. Dimensions should generally be placed between views.
6. Do not repeat dimensions unless there is a special reason for it.
7. Do not crowd dimensions.
8. In general give dimensions from or about centre lines. Never locate holes or other machine operations from the edge of unfinished castings.
9. Never give dimensions to the edge of a circular part but always from centre to centre.
10. If it is practicable to locate a point by dimensioning from two centre lines do not give an angular dimension.
11. Never use a centre line as a dimension line.
12. Never use a line of the drawing as a dimension line.
13. Do not allow a dimension line to cross an extension line unless unavoidable.
14. The diameter of the "bolt circle" of holes in circular flanges is given, with the number and size of holes.
15. Give the diameter of a circle, not the radius.
16. Give the radius of an arc, marking it *R* or *Rad*.
17. Never place a dimension so that it is crossed by a line.

Fits and Tolerances.—With the demand for interchangeability and quantity production the exact size in decimals is specified for "essential dimensions" with the amount of "tolerance" over and under which will be allowed by the inspector, since it is not possible to work to an absolutely accurate dimension. These limits are set by the engineering department and placed on the drawing, and the shop follows orders explicitly. In fitting one piece with another, as a shaft and hub, the diameters in decimals with allowed tolerances are given for each, superseding the older practice of leaving the amount of allowance for different kinds of fits to the machine shop. Much experience in manufacturing is needed as well as a study of the particular mechanism involved before the draughtsman is able to know just the accuracy necessary and to specify proper tolerance. When unnecessarily small tolerances are set the cost of manufacture is greatly increased. The

general tolerance is often stated in a note near the title.

Checking.—Before being sent to the shop a working drawing is carefully checked for errors and omissions. A first check of the pencil drawing is made by the chief designer, who knows the price at which the machine is to be made and checks the design and its mechanism for soundness and economy, sees if existing patterns for any parts can be used, checks for correct representation, *e.g.*, adequate lubrication. He sees that every piece is correctly described, checks all dimensions by scaling and computation, checks for tolerances, checks for finishes, checks for specifications of material, looks for interferences and clearances, sees that small

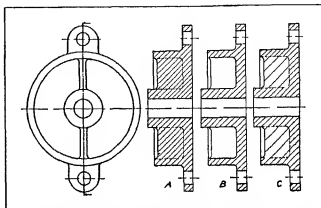


FIG. 22—A, TRUE SECTION THROUGH A RIB; B, THE USUAL METHOD OF DRAWING SUCH SECTION; C, AN ALTERNATE METHOD

details are standard and stock sizes where possible, checks the title and bill of material.

Working drawings are always duplicated for shop use by some printing process, and the original is not allowed to be taken out of the office. The great majority are blueprinted. Photostat prints, and reproductions made by various forms of gelatine, stencil and lithographic processes are also used. Drawings are usually made in pencil on cream or buff detail paper and traced, either for economy on tracing paper, or on tracing cloth, a transparentized cotton fabric which gives a better print and is much more durable.

One plane Projection.—Orthographic projection with its two or more views describes an object completely, but requires an effort of the geometrical imagination to visualize its appearance. On the other hand, a picture of the object showing it as it would appear to the eye can be made by perspective drawing, but is not useful as a working drawing as its lines cannot be measured directly. To obtain the pictorial effect of perspective drawing with the possibility of measuring the principal lines several kinds of one plane projection or conventional picture methods have been devised.

With the combined advantages are some serious disadvantages which limit their usefulness. They are distorted until the appearance is often unpleasant, only certain lines can be measured, the execution requires more time, and it is difficult to add many figured dimensions, but with all this, a knowledge of these methods and facility in their use is of great value to the draughtsman. Mechanical or structural details not clear in orthographic projection may be drawn pictorially or illustrated by supplementary pictorial views. Technical illustrations, patent office drawings, layouts, piping and wiring diagrams, preliminary free-hand sketches, etc., can all be done advantageously in one plane projection. Aside from perspective drawing there are two general divisions of pictorial projection, *axonometric projection* with its divisions into isometric, dimetric and trimetric, and *oblique projection* with several variations.

Axonometric projection theoretically, is simply a form of orthographic projection in which only one plane is used, so placed with relation to the object that a rectangular solid projected on it would show three faces. Usually the object is considered as turned from

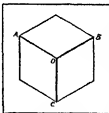


FIG. 23—ISOMETRIC PROJECTION OF A CUBE

its natural position and the vertical plane taken as the plane of projection. Imagine a vertical plane with a cube behind (or in front) of it, having one face parallel to the plane. Its projection will be a square. Rotate the cube about its vertical axis through any angle less than 90° , the projection will now show two faces, foreshortened. From this position tilt the cube forward any amount and three faces will show on the projection. There are

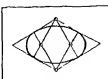


FIG 24—ISOMETRIC CIRCLE FOUR CENTRED APPROXIMATION

thus an infinite number of axonometric positions, only a few of which are ever used as a basis for drawing. The simplest of these is the "isometric" (equal measures) position, where the three faces are foreshortened equally, as would occur if the cube were rotated about the vertical axis through 45° then tilted forward until the edge OC (fig 23) is foreshortened equally with OA and OB thus making the body diagonal from O perpendicular to the plane of projection. (This makes the top face slope $35^\circ-16'$ approx.) The three lines of the front corner, OA , OB , OC , make equal angles with each other and are called the isometric axes. Since parallel lines have their projections parallel, the other edges of the cube will be respectively parallel to these axes. Any line parallel to an isometric axis is called an isometric line. The planes of the faces of the cube and all planes parallel to them are called isometric planes. It will thus be noticed that any line or plane which in its regular orthographic projection is perpendicular to either of the reference planes, will be an isometric line or plane.

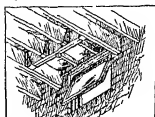


FIG 25—ISOMETRIC SKETCH ON REVERSED AXES

As the effect of increased size is usually of no consequence and the advantage of measuring the lines with standard scales is of such great convenience, isometric drawing is used almost exclusively instead of isometric projection. In making an isometric drawing the axes are first drawn, 120° apart, drawing one vertical and the other two with the 30° triangle. On these three lines are measured the length, breadth and thickness of the object. Lines not parallel to one of the isometric axes are called non isometric lines. The one important rule is, measurements can be made only on isometric lines. Since a non isometric line does not appear in its true length as it is drawn, it is drawn by isometric construction. A circle on any isometric plane will appear as an ellipse, and is usually drawn as a four centred approximation with the construction of fig 24. It is sometimes desirable

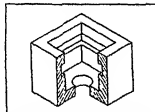


FIG 26—ISOMETRIC HALF SECTION

to show the lower face of an object, by tilting it back instead of forward, and drawing it on reversed axes. Fig 25 shows a sketch on reversed axes. Isometric drawings are from their pictorial nature usually outside views but sometimes an isometric section or half-section can be employed to good advantage. The cutting planes are taken as isometric planes. Fig 26 is a half section, made by outlining the figure, then cutting out the front quarter.

The reference cube can be tilted into any number of positions where two edges would be equally foreshortened and the third to a different length, and any one of these positions might be taken as a basis for a system of *dimetric drawing*. A simple dimetric position is one with the ratios $1 \frac{1}{2}$. In this position the tangents of the angles of the axes are $\frac{1}{2}$ and $\frac{1}{2}$ making the angles approximately

7 and 41 degrees. Fig 27 is a drawing in this system. *Trimetric drawing*, with three unequal axes, has little if any practical value.

Oblique Projection is a one plane method in which the projecting lines are parallel but make an angle other than 90° with the picture plane. Suppose the reference cube to be set with one face parallel to the picture plane and the projectors to make an angle of 45° with the plane, in any direction.

The face parallel to the picture plane would be projected in its true size and the edges perpendicular to the plane would be projected in their true length. This system with 45° projectors is sometimes called *cavalier projection*. It is similar to isometric drawing in having three axes representing three mutually perpendicular lines, upon which measurements can be made. Two of the axes are always at right angles to each other, being in a plane parallel to the picture plane. The third or cross axis may be at any angle, 30° or 45° being generally used. Any face parallel to the picture plane will evidently be projected without distortion, an advantage over isometric of particular value in the representation of objects with circular or irregular outline, thus objects should always be placed with their characteristic contour parallel to the picture plane (fig 28). Oblique drawing always gives the distorted effect of excessive thickness. A variation called *cabinet drawing* devised to overcome this effect is an oblique projection, with the projectors assumed at such an angle that all measurements in the direction of the cross axis are reduced one half (fig 29), which makes easy measurement but the effect is often too thin. Other ratios such as $\frac{2}{3}$ or $\frac{3}{4}$ may be used with more pleasing effect. The cross axes may be at any angle, but are usually made either 30° or 45° . A special system of oblique projection called *clinographic projection*, used in drawing mineral crystals in crystallography, is based on the axes of a cube first revolved about a vertical axis through an angle whose tangent is $\frac{1}{2}$, then projected obliquely to the vertical plane with the eye (at an infinite distance) elevated through an angle whose tangent is $\frac{1}{2}$.

Execution.—As drawing instruments are used for all accurate work, the first requirement in making a drawing is the ability to use them with facility and in good form with softwood top or carrying a softwood drawing board, should be set so that the light comes from the left, the paper held in place with thumb tacks, and a hard pencil selected, sharpened to a long sharp point. A T-square, 45° and $30^\circ-60^\circ$ triangles, compasses, dividers, scale, pencil eraser and sandpaper pad should be at hand. Horizontal lines are drawn with the T-square guided by the left edge of the drawing board, and vertical lines are drawn with the triangle set against the T-square, always with the perpendicular edge nearest the head of the square and toward the light (fig 30). These lines are always drawn up from the bottom to top, consequently their location points should be made at the bottom. With the triangles against the T-square, lines at 30° , 45° and 60° may be drawn, and the two triangles may be used in combination for angles of 15° and 75° , directly (fig 31). Thus any multiple of 15° may be drawn and a circle may be divided with the 45° triangle into 4 or 8 parts, with the 60° triangle into 6 or 12 parts and with both into 24 parts. The *dividers*, used for transferring distances, etc., are manipulated with one hand, and opened by pinching at the chamfer with the thumb



FIG 27—DIMETRIC DRAWING

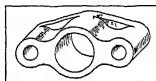


FIG 28

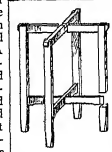


FIG 29—CABINET DRAWING

and second finger. This puts them in correct position with the thumb and forefinger on the outside of the legs and the second and third fingers on the inside (fig 32). The compasses are manipulated in the same way, adjusting to the radius marked on the paper, then raising the hand to the handle and drawing the circle (clockwise) in one sweep by rolling the handle with the thumb and forefinger, inclining the compasses slightly in the direction of the line (fig 33). In making a working diagram the order of pencilling should be somewhat as follows: first, make a preliminary freehand layout sketch, estimating the position and space required for each view, second, decide the scale to be used, third, draw the centre lines for each view and block in the views with the principal outlines, fourth, finish the projections, carrying them on together, fifth draw all dimension lines, then put in the dimensions, sixth, lay out the title, seventh, check the

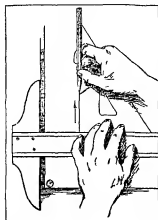


FIG 30—DRAWING A VERTICAL LINE

drawing as carefully as possible.

After being made in pencil, drawings, except when inked on the paper, as patent drawings or, as display drawings, are traced for reproduction. When intended to be used perhaps only once, as tool-room drawings, architectural details, etc., they are very commonly traced in firm pencil lines on tracing paper. Production drawings and works of permanent value are traced in ink on tracing cloth. The ruling pen is always used with drawing ink and guiding edge, either T-square or triangle. To fill it touch the quill filler of the ink bottle between the nibs, being careful not to get any ink on the outside of the blades.

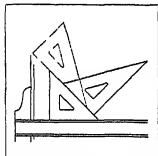


FIG 31—COMBINATION FOR 15° AND 75° ANGLES

The pen is held as in fig 34 and the width of line adjusted by turning the screw. The pen is held against the straight edge with the blades parallel to it and in a plane perpendicular to the paper. If the ink refuses to flow it is because it has dried and clogged in the point of the pen. If pinching the blades slightly or touching the pen on the finger does not start it, it should be wiped out and fresh ink supplied. Faulty lines may occur by pressing the pen too hard against the T-square, by sloping the pen away from the T-square, or by having it too close to the blade, when the ink will run under, by having ink on the outside of the blade, by not keeping the blades parallel to the line, or by letting the triangle slip into the wet line. Visible outlines should be strong full lines, invisible lines much lighter lines made with short dashes. Centre lines of long dash and dot, and dimension lines are made either of the same weight as invisible lines or still finer. Inking should be done in a systematic order, first, all visible circles, beginning with the smallest, second, full lines, horizontal, vertical, inclined, third, dotted circles and lines, fourth, centre lines, fifth, extension and dimension lines, sixth, arrow heads and dimensions, seventh, section lines, eighth, notes and title, ninth, border, tenth, check the tracing.

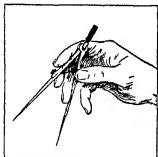


FIG 32—HANDLING THE DIVIDERS

In lettering a working drawing the two requirements are

legibility and speed. Lettering is not mechanical drawing and the use of "geometrical" letters, "block" letters, etc., made of straight lines and ruled with T-square and triangles is not approved in good practice. The "commercial gothic" or "sans serif" letter made freehand in a single stroke, either vertical or inclined is the style almost universally used.

Technical Sketching—From its use in connection with art the word sketch suggests a free or incomplete or careless rendering of some idea. This is not its meaning in engineering drawing. A sketch is a working drawing made freehand, a quick expression of graphic language, but complete in its information. In all mechanical thinking in invention, all preliminary designing, all explanation and instruction of the designer to the draftsman, sketching is the mode of expression. It represents the mastery of the language, gained only after proficiency in mechanical execution. Sketches of machine parts would be made in orthographic projection, explanatory of illustrative sketches either in orthographic or in one of the pictorial methods. Design sketches are often made on co-ordinate paper. The memory for form may be strengthened and the capacity for "stored observation" greatly increased by systematic practice in sketching from memory, studying a drawing or casting with close concentration until every detail is stored for future visualization, then making an accurate sketch without further reference to the original and comparing it when finished. See also ENGINEERING, RENDERING, ARCHITECTURAL, DESCRIPTIVE GEOMETRY, SUN COPYING, BLUE-PRINT.

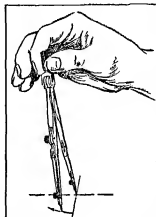


FIG 33—DRAWING A CIRCLE WITH THE COMPASSES

often made on co-ordinate paper. The memory for form may be strengthened and the capacity for "stored observation" greatly increased by systematic practice in sketching from memory, studying a drawing or casting with close concentration until every detail is stored for future visualization, then making an accurate sketch without further reference to the original and comparing it when finished. See also ENGINEERING, RENDERING, ARCHITECTURAL, DESCRIPTIVE GEOMETRY, SUN COPYING, BLUE-PRINT.

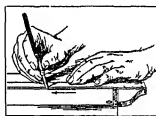


FIG 34—POSITION OF THE RULING PEN

(T E F)
DRAWING AND QUARTERING, part of the penalty anciently ordained in England for treason. Until 1870 the full punishment for the crime was that the culprit be dragged on a hurdle to the place of execution, that he be hanged by the neck but not till he was dead, that he should be disembowelled or drawn and his entrails burned before his eyes, that his head be cut off and his body divided into four parts or quartered. This brutal penalty was first inflicted in 1284 on the Welsh prince David, and a few years later on Sir William Wallace. Edward Marcus Despard and his six accomplices were in 1803 hanged, drawn and quartered for conspiring to assassinate George III. The sentence was last passed (though not carried out) upon the Fenians Burke and O'Brien in 1867.

DRAWING-ROOM, the English name generally employed for a room used in a dwelling-house for the reception of company. It is a shortened form of the 16th and 17th century "withdrawing room," and originated in the setting apart of a room for the ladies of the household, to which they withdrew from the dining room.

DRAW-PLATE, a plate of hardened steel with a series of holes, with converging sides, graded in size and of similar shape, through which metal is drawn in manufacturing wire (q.v.).

DRAYTON, MICHAEL (1563-1631), English poet, was born at Hartshill, Warwickshire, and settled in London about 1590. His first volume of poems *The Harmony of the Church*, appeared in 1597, the whole edition, with the exception of 40 copies seized by the archbishop of Canterbury, was destroyed by public order. In *Idea, the Shepherd's Garland* (1593), a collection of nine pastorals, and *Idea's Mirror* (1594), a cycle of 64 sonnets, he celebrated his love for a Warwickshire lady. *The Legend of*

Purs Gaveston (1593) is the first of Drayton's historical poems, it was followed by *Mortimeriad* (1596), written in ottava rima and afterwards enlarged as *The Barons' Wars* (1603), *The Legend of Robert, Duke of Normandy* (1596), and *England's Heroical Epistles* (1597), modelled on Ovid.

Drayton had been in high favour with Elizabeth, but his overtures to James I were rejected, and his pique found expression in *The Owl* (1604), an unsuccessful satire. In 1606 he made a collection of poems entitled *Poems Lyric and Pastoral*, including among other hitherto unpublished works his famous "Ballad of Agincourt."

As early as 1598 he had formed the plan of celebrating all the points of topographical or antiquarian interest in the island of Great Britain. In 1612 the first part of this vast work was published under the title of *Poly Olbion*, 18 books being produced, to which John Selden supplied notes. The success of this, his most famous work, was at first small, and the 12 more books of the second part appeared only in 1622. This completed the survey of England, and the poet, who had hoped "to crown Scotland with flowers," and arrive at last at the Orcaades, never crossed the Tweed. In 1627 he published another of his miscellaneous volumes and this contains some of his most characteristic and exquisite writing. It consists of the following pieces: *The Battle of Agincourt*, a historical poem in ottava rima (not to be confused with his ballad on the same subject), and *The Miseries of Queen Margaret*, written in the same verse and manner, *Nymphidia, the Court of Faery*, a most graceful little epic of fairyland, *The Quest of Cynthea and The Shepherd's Sirena*, two lyrical pastorals, and, finally, *The Moon Calf*, a sort of satire. Of these, *Nymphidia* is perhaps the best thing Drayton ever wrote, except his famous ballad on the battle of Agincourt, it is quite unique of its kind and full of rare fantastic fancy.

The list of Drayton's voluminous publications was *The Muses' Elbow* in 1630. He died in London and was buried in Westminster abbey. Drayton corresponded familiarly with William Drummond, Ben Jonson, William Browne, George Wither and others among his friends. There is a tradition that he was a friend of William Shakespeare, supported by a statement of John Ward, once vicar of Stratford-on-Avon, that "Shakespeare, Drayton and Ben Jonson had a merry meeting, and it seems drank too hard, for Shakespeare died of a feverer there contracted." He had a share, with Anthony Munday, Henry Chettle and Robert Wilson, in writing *Sir John Oldcastle*, which was printed in 1600.

The poet with whom it is most natural to compare Drayton is Daniel, he is more rough and vigorous, more varied and more daring than the latter, but Daniel surpasses him in grace, delicacy and judgment. In their elegies and epistles, however, the two writers frequently resemble each other. Drayton, however, approaches the very first poets of the Elizabethan era in his charming *Nymphidia*, a poem which inspired Robert Herrick with his sweet fairy fancies and stands alone of its kind in English literature, while some of his odes and lyrics are inspired by noble feeling and virile imagination.

In 1748 a folio edition of Drayton's complete works was published under the editorial supervision of William Oldys, and again in 1753 there appeared an issue in four volumes. But these were very unintelligently and inaccurately prepared. A complete edition of Drayton's works with variant readings was projected by Richard Hooper in 1876, but only three volumes were completed, a volume of selection, edited by A. H. Bullen, appeared in 1883. See especially Oliver Elton, *Michael Drayton* (1905) (E G).

DREADNOUGHT. see BATTLESHIP

DREAMS. Traditionally, dreams have been defined as states of consciousness taking place during sleep. In the light of critical reflection, however, this definition is hardly adequate. Not every state of awareness occurring during sleep is classifiable as a dream state, nor is sleep in the conventional meaning of the term invariably necessary for the production of the dream consciousness. People often hear a telephone ringing even though they are asleep or dozing. Upon being fully roused, they find that what they heard in the sleep or quasi sleep state squares with external reality, since the telephone is still ringing. Such correct apprehen-

sion of genuine event is obviously not to be classified as a dream even though sleep and the apprehension were concomitant.

An essential characteristic of the dream is thus a manifest discrepancy between dream images and external reality. In other words, dreams are illusory or hallucinatory experiences and just because such experiences can take place in the absence of ordinary sleep, the adequacy of the traditional definition is to be questioned. The often mentioned case of a mirage may be cited in this connection—that of the thirsty desert traveller who perceives a clump of trees in the distance only to find the trees nonexistent upon arriving at the site of the phantased oasis. A mirage is consequently to be classified as a species of dream even though the traveller is not actually asleep.

Similarly, the experiences of some mentally sick patients, who misconstrue their hallucinations as real events, may also be classified as dreams despite the fact that the patients are by no means asleep. Their hallucinations are often responsible for the abnormality of their speech and conduct. Psychiatrists customarily interpret the abnormal behaviour of such patients by saying that they are living in a dream world. It is important to note that they do not have to be asleep in order to live in such a dream world.

The hallucinated phantasies of the insane person are very different from the ordinary daydreams of the normal person. The latter does not act out his daydreams, while the former does. This difference supplies a clue to understanding of the dream process. The daydreams of a normal person are not subject to confusion because for him the events of the daydream are correctly localized either in the past or the future. Those referring to the past are designated as reveries of the remissive variety while those projected into the future are referred to popularly as building air castles. The ordinary daydream thus differs from the ordinary night dream in its temporal setting, for it is characteristic of the latter to be accepted as real at the time it occurs. In technical language the temporal locus of the dream experience is the present.

In the light of the foregoing considerations it is possible to formulate a more revealing definition of the concept of dreaming. A dream is to be regarded as an illusory or hallucinatory experience whose temporal locus is the present and which is usually accepted as real or as having genuinely existential status at the time it occurs. This last qualification is necessary in order to allow for the relatively rare dreams in which the dreamer is actually or incipiently cognizant of the fact that he might be having a dream. Ordinarily, however, it is not until fully alert consciousness supervenes that the dreamer recognizes the unreal status of that which he has just experienced in his dream.

Incidentally, this unreality of dream events is also suggested by the derivation of the word dream. Etymologists trace it through the Anglo Saxon to the root meaning of the modern German word for dream, *Traum*, and the latter word is in turn related to the German verb, *trügen*, which means to deceive. By stressing the role of illusory and hallucinatory factors in the dream experience the definition just formulated tends to preserve the idea of deception implicit in the root meaning of the word.

Problems of Dream Psychology.—Interest in the nature and significance of dreaming harks back to antiquity. Soothsayers, as is well known, ventured to read prophetic import into dreams. Divination by means of dreams a recognized art in ancient times, was called *oneironomy*. In fact, the general study of dream phenomena was called *oneirology* (From the Greek word *oneiron*, a dream). The general import of this oneirological approach may be suggested by recalling the Old Testament account of Joseph's interpretations of Pharaoh's dreams. For the unsophisticated in all ages dreams have been fraught with mystical or superstitious significance of a sort that enabled the exponent of oneironomy to have his art taken seriously by those who consulted him. Even today so called "dream books" are purchased by the credulous for the purpose of ascertaining the presumed prophetic meaning of given dream symbols.

The modern scientific study of dream phenomena of course has nothing in common with this venerable oneirological tradition.

Scientific study of the subject was initiated in 1861 with the publication of A. Maury's study of sleep and dreams. Later investigators devoted themselves to similar application of scientific method to problems of dream psychology. For the most part these problems have had little in common with the mystical and often superstitious beliefs which the credulous of all ages have tended to associate with dreams. Instead they have had to do with questions so framed as to be amenable to study by the methods of science. The following will serve as convenient examples of such questions:

1. What is the role of internal and external stimuli in the production of dreams?
2. Is dream imagery different in kind from that of imaginative productions in daydreams and creative thinking?
3. What is the relationship between the depth of sleep and the incidence of dreams?
4. Can the duration of dreams be measured?
5. Are dreams revelatory of conscious and unconscious desires and personal conflicts?
6. Can dream symbols be interpreted in dependable fashion?
7. Are dreams produced during hypnotic sleep different from those occurring normally?
8. Do the dreams of the blind and deaf differ from those of normal people?
9. Does the frequency and nature of dreaming vary as a person grows older?
10. Does dreaming serve any useful function?

Methods Employed—In order to find the answers to questions of the foregoing sort, students of dream psychology have had recourse to varying techniques of investigation. Some have endeavored to influence the dream consciousness by pinching the sleeping subject or bringing odoriferous substances close to his nostrils. The experimenter would then either arouse the subject for the purpose of securing an immediate report on his dream life or else wait until he awakened spontaneously to furnish such a report. Some experimenters applied stimuli to themselves prior to falling asleep. For example, one investigator would knot a string around his finger or keep a metronome ticking and prepare himself to observe the possible influence of such tactual and auditory disturbances on his dreams. Parenthetically, it should be noted that self observation of this kind is rendered more reliable if the experimenter keeps a pencil and notebook handy so that he can write down his observations immediately upon awakening, for dreams are fleeting and delay in recording may render it impossible to remember more than a few fragments of what had been a relatively complex dream.

Some investigators have utilized reports of dreams supplied by psychologically untrained observers. For certain purposes a direct method of this kind may furnish useful data. In studying the dreams of children, for instance, it is helpful to collect their reports of their own dreams in their own language. Furthermore, as will be amplified subsequently, the method of dream interpretation employed by psychoanalysts also takes its point of departure from the subject's spontaneous recollection of a dream that he chances to think of during the analytic hour. As developed by Sigmund Freud, this psychoanalytic approach to dream phenomena involves the method of free association. Some detail of the dream, such as a vision of a sobbing ostrich, is made the point of departure for a recital of whatever ideas chance to be associated with this detail. Anything that is either directly or remotely linked up with the notion of a sobbing ostrich is reported, and even embarrassing ideas and impulses that one would normally not talk about are brought to expression by the patient. This, in brief, illustrates the Freudian method of dream study by means of free association.

Some interesting findings have also been reported by a few psychologists using a method of experimental induction of dreams during hypnosis. The technique is rather easy to employ. Hypnosis is induced by any one of the traditional routine procedures and then the hypnotized subject is told that he will soon find himself experiencing a dream. A suggestion of this kind arouses a definite set to dream. Once this set is aroused the experimenter introduces various disturbances calculated to induce a dream. He may sound a buzzer, call out a person's name, hold a bottle of perfume near the subject's nostrils, stroke the skin surface with a tuft of

cotton, change the position of the subject's arm or leg or introduce any other kind of disturbance. Some psychologists have awakened the hypnotized subject in order to get his dream report. This is not necessary in most instances since the hypnotized subject may be made to respond to the suggestion that he supply an account of each dream as soon as he has experienced it. A cooperative subject does this without awakening from the hypnotic state. In this way a whole series of dreams may be collected during a single experimental session. By means of this technique it is also possible to get an approximate measure of the duration of a dream. All that is required is to set a stop watch in motion when the dream stimulus is applied and to stop it as soon as the subject starts his account. Using this method it was found by one investigator that the hypnotic dream averages about 30 sec. The hypnotic technique has also been used to influence the course of ordinary night dreams. This is accomplished by giving the subject a posthypnotic suggestion to dream about some specific theme on a particular night and to be sure to report the resulting dream to the investigator.

There has been some question regarding the legitimacy of comparing dreams produced during hypnotic sleep with those occurring during ordinary sleep. Phenomenologically considered, there seems to be no difference. This is equivalent to saying that there is no assured way of recognizing hypnotic dreams by mere examination of their verbal descriptions. Furthermore, the subjects themselves, when questioned about the possible differences between their hypnotic and their ordinary dreams, seem unable to observe any decisively differentiating characteristics. Nevertheless, cautious psychologists are not yet willing to regard them as caused by precisely equivalent or identical mental processes. This reluctance is justified to the extent that experimental study has demonstrated clear cut physiological differences between natural sleep and the hypnotic trance. From the methodological viewpoint however, the ease and flexibility of the technique of inducing hypnotic dreams renders it an important and valuable adjunct to the scientific study of dream phenomena. It has supplied some revealing insights into the process of dream formation.

Depth of Sleep and Dream Frequency—In terms of the concept of fluctuations in depth of sleep a few studies have been directed at the question of the incidence of dreams as such fluctuations occur. The problem is a difficult one because of much that is unknown regarding the details of the physiology of sleep. Glossing over these difficulties, it may be sufficient to state that in investigators have tended to assume that ease of arousal is inversely related to profundity of sleep. By noting how strong a disturbance must be introduced to awaken a sleeper at different hours on different nights they were able to construct curves purporting to represent the depth of sleep. In general, the curves show the second hour of the sleep period to be most resistant to arousal of full waking consciousness. Following this second hour sleep seems to become more and more shallow as the terminal period of the sleep session is approached. A few psychologists have kept records of the number of dreams experienced at various hours during the night and the drift of their findings is to the effect that the variations in frequency parallel the sleep curve, that is, the shallower the sleep the greater the number of dreams. One study of this kind showed 75% of dreams taking place after 4 A.M.

Memory and Dreams—Despite the general agreement of these studies, there has been little agreement on their interpretation. An obvious inference that dreaming seems to be incompatible with the most profound sleep states has been questioned by some students of the subject. They would interpret the data as revealing more of a relationship between memory and depth of sleep than one referring to dream frequency. According to some of them, it is not inconceivable that a dream process of some sort characterizes the entire sleep period continuously. In the light of such a concept dreaming would be a normal concomitant of sleeping, but being able to remember one's dreams would be abnormal in the sense of being relatively infrequent in comparison with the total number of dreams occurring throughout the sleep period. An interpretation of this sort is partially supported by the fact that memory efficiency is intimately related to alert, un-

imagined wakefulness. Accuracy and control of one's memory functions is seriously disrupted by states of exhaustion. Since sleep is the sovereign remedy for fatigue, memory efficiency ought to improve toward morning, and consequently more dreams ought to be recalled as the time for waking approaches. However, this would not necessarily mean that more dreams had taken place during the terminal hours of sleep.

The crucial issue in this controversy hinges on the question of the existence of dream experiences which, by hypothesis, the dreamer is unable to recall. Because of the extreme privacy or subjectivity of the dream process, it has been difficult to furnish conclusive evidence in support of the possibility of having experienced a dream for which one is totally unaware upon awakening. Of course the timidity of experience of being cognizant of having had a dream even though one cannot remember what it was about has some bearing on the question, but such evidence is suggestive rather than coercive.

More convincing proof has been supplied by hypnotic dream studies. In one such study the experimenter worked with a subject who insisted that he never dreamed. He was most emphatic in his insistence that his ordinary sleep was dreamless. When the experimenter asked how he could understand the meaning of the word dream, he admitted having dreamed as a child. But he was sure of this being altogether a thing of the past. Nevertheless in hypnosis, this young man reported vivid dreams which he described in considerable detail. The report was given during hypnosis and then another dream would be aroused and another report made and so on throughout the experimental period. And yet when the subject was awakened, he insisted that no dreams had occurred. He maintained that all he could remember was being put to sleep and that nothing happened after that until he was aroused. He was seemingly completely amnesic for the intervening period. Even when the experimenter asked leading questions about the dream events that had been described only a few minutes earlier, the subject just stared at him in uncomprehending perplexity. What is more, even reading a verbatim, stenographic account of his dreams to him failed to arouse any feelings of familiarity. Experimental sessions of this sort took place on fairly frequent occasions and the results were invariably the same: he could never remember having had a dream. It is thus possible to demonstrate the existence of hypnotic dreams which are completely refractory to recall upon awakening. This renders the application of a similar hypothesis to the ordinary night dream less of an untenable, purely speculative stab in the dark.

Content of the Dream.—It is a commonplace observation that the sequence of events in a dream episode is more bizarre than that characteristic of waking consciousness. The dreamer's control of attention, judgment, imagery and other mental functions is much reduced or altogether absent. The dream is something that happens to him as opposed to something that he does for himself or to himself. To a large extent he is a passive observer of events sweeping over him. These events are presented in the form of a phantasmagoric play of images. This should not be construed to mean that the images are exclusively visual, for psychological studies have demonstrated the variegated nature of dream imagery. Although visual and auditory imagery seems to predominate as it does in waking life, any other kind of imagery process may be woven into the fabric of the dream. In only one respect does dream imagery seem to differ significantly from the spontaneous utilization of imagery in waking life: coloured images in dreams are much less frequent in dreams. Subjects who claim not to be likely to appear in gray pictures rather than in colour. This point is not unimportant because occasional writers have implied that the perception of coloured images is altogether absent from the dream process. Such a statement is not in accord with fact. Coloured images do occur, but they are not as frequent as the ubiquity of colour in waking experience would lead one to expect. Why there is such a striking reduction in frequency is an unsolved problem in the psychology of the dream.

Dream content is, of course, not a static but a dynamic phenomenon. It is as if one were experiencing some event. Material for the dream story comes from stimuli impinging on the dreamer at

the moment as well as from his store of past experiences and contemporary interests and urges. Often events from the dreamer's remote past may be reactivated in the dream and play a vivid role. Sometimes such reactivated experience parallels the original one without much distortion. This is an instance of what the psychologist calls reproductive imagination to designate the origins of phantasies recognizable as approximate duplicates or reproductions of prior experiences. At other times the dream experience may involve a transposition of earlier and more recent images into a novel and unique pattern of happenings akin to what psychologists classify as a product of productive or creative imagination. Dream content, it should be noted, is a product of the dreamer's past and not a foreboding of events to come as the ancient oracles asserted.

This is brought out by comparison of the dreams of children with those of adults. Very young children, for example, are likely to dream of wizards and fairies, and the older child of school examinations and athletic heroes. To cite other examples, children of the destitute are likely to dream of wonderful toys, hungry people of food, homesick soldiers of their families and prisoners of freedom. The wish is fitter to the dream as well as to the thought. Desires, worries and other tensions may also have a direct bearing on the kind of dream content experienced.

It seems safe to assert that the language of the dream is more pictorial than linguistic. Verbal images do not loom up frequently or prominently in the course of dream content. The dreamer seems to function more like a newspaper cartoonist than like a reporter or editorial writer. The paucity of verbal content in dreams means, of course, that critical analysis or subtle reasoning is not likely to occur in dreams. Language seems to be an almost indispensable tool for such refined mental operations. Because of the restricted role of language in the dream, the thinking of the dreamer is largely limited to that which can be symbolized by nonverbal means.

Structure of the Dream.—An ordinary daydream is often regarded as a matter of idle association or reverie. The sight of a box of candy, for example, induces one to think of eating between meals, and this recalls visions of parental scoldings for raiding the icebox and this, in turn, reminds one that electrical refrigeration is certainly an improvement over the old fashioned bow, etc., etc. In schematic terms this amounts to saying that the structure of waking association of a random sort follows the pattern of item A arousing B, B eliciting C, C provoking D, etc. Is this type of structure also the structure of the dream pattern? Is the dream just a sequence of idle associations aroused in a sleeping individual by a chance stimulus such as a clanging ambulance bell or a clogged nostril? To find the answer the pattern of such free association must be compared with those dream patterns resulting from known forms of experimentally controlled stimulation. Examination of hypnotic dreams aroused by simple stimuli demonstrates that dreaming is not just a matter of free association. Although such stimuli provoke the dream pattern, the relationship between the instigating factors and the resulting pattern of response is not like the simple A B C D sequence just mentioned.

In the dream the instigating stimulus becomes a constituent feature of the pattern. It is buried within the pattern in such fashion that knowledge of the dream alone is not sufficient to enable one to ferret out the antecedent stimulus. It is as if a cat were to be captured by its owner. An example of this may be supplied by the hypnotic dream of one subject who dreamed that he was in a room and was visited by his sweetheart who did not react to his loud and stroked his hand. This particular dream had been touched on when the experimenter stroked the back of the subject's hand with a tube of absorbent cotton. Here the cotton of course was experienced toward the end rather than at the beginning of the dream. In another hypnotic dream another subject dreamed that he was dressed in his track suit and running too exercise when he chanced to see a dead horse by the side of the road. In this instance two stimuli had been applied simultaneously: pressure on the sole of the hypnotized subject's shoe along with a whiff of ammonia. The former stimulus was responsible for the idea of running and the latter for that

of the dead horse, but both ideas were woven into the pattern of the dream and even though their provocative stimuli had been presented concurrently the resulting images were not concurrent until the close of the dream.

Dreams as Trial Percepts—The fact that dreams seem to be characterized by a type of structure in which the consequences of the provocative stimuli come to be constituent features of a larger dream context is of considerable theoretic importance. It suggests that some dreams are to be explained as attempts by the dreamer to account for an ambiguous or dimly apprehended stimulus pattern in terms of whatever backgrounds of experience happen to be touched off by the stimuli in question. This phase of the dream process is analogous to the common waking experience of being startled by a strange sound while we are absorbed in a novel. A what-cin that be attitude, as opposed to the attitude of free association, comes to dominate consciousness. For the time being the novel is relegated to a subordinate position. As the strange sound is repeated, various possibilities suggest themselves: an intruder in the attic, somebody tinkering with a car outside, a rattling venetian blind, etc. These possibilities are rejected almost as soon as they occur because the troublesome noise fails to square with these possibilities. Then the startled reader recalls having set a trap in the attic some days earlier. The curious noise is now recognized as that of a rat dragging a trap across the attic floor. This interpretation squares with the unique characteristics of the startling noise and the problem is regarded as solved. It is solved by means of a series of trial percepts brought to bear on the situation.

This utilization of trial percepts may help to account for many dreams. In sleep many stimuli that would evoke immediate recognition on the part of a waking person are blurred or ambiguous because so much of relevant sensory material is shunted out by the heightened sensory thresholds characteristic of sleep. Only fragments of a given total stimulus pattern are experienced by the sleeper. The what can that be mental set is aroused because of the strangeness of such fractured stimulation. It is like trying to read a book printed with broken type. Imaginative guess work has to replace clear cut, facile perception. The dreamer, in other words, being cut off from the world of reality by heightened sensory thresholds, accepts those few sensory fragments which break through to awareness as being the core of genuine happenings interpreted in the light of whatever trial percepts are brought into play. But such interpretation differs from the same process carried out by a fully alert person, for the dreamer fails to recognize the trial or hypothetical character of the series of interpretations. What the alert person knows to be just a bare suggestion or a possibility is accepted as actual fact by the dissociated consciousness of the dreamer.

Dream consciousness, to employ a grammatical metaphor, tends to be in the present indicative. The past, the future, the perfect and the subjunctive are not utilized. For the dreamer the cognitive equivalents of "it might be," "it's as if" or "maybe this is" are largely nonexistent. The dream world is a world of the present in which what happens takes place here and now and in which all

Freud was primarily interested in the dream as an expression of dynamic trends in the life of the dreamer. It was as though Freud had asked "What can this dream mean in terms of this patient's longings, desires, wishes or urges?" An approach of this kind tends to view dreams as products of the optimistic mood. It is concerned with the assumption that dreams are to be regarded as expressions of balked wishes or frustrated yearnings. Freud regarded the dream as supplying a "royal road" to the realm of unconscious motivation. For him dreams were either actual or attempted wish fulfillments. He conceived of the sleeping individual as largely cut off from external stimulation with the critical functions of waking consciousness almost shunted out for the most part, so that internal tensions, the repressed but regnant strivings of the unconscious, could find vicarious expression in the symbolism of the dream. A vicarious outlet of this kind, he held, makes its appearance in sleep because the mind's forces of inhibition are also dozing. Illicit impulses consequently would be expected to meet with less resistance from such a somnolent conscience.

An analogy may help clarify this Freudian outlook. If the tensions of the unconscious be likened to denizens of the underworld reluctant to come out of hiding into the bright light of day time reality where the police might see and recognize them, then the bright light would be analogous to the consequences of external stimulation, both visual and auditory, and the police would be comparable to the critical goals of conscience which tend to prevent one from yielding to morally repugnant cravings. In terms of later Freudian theory this policing function of conscience was attributed to the superego and the hide out of the dynamic denizens of the psychic underworld of the unconscious was known as the id. In brief, because sleep deactivates superego functions, frustrated id impulses have a better chance of expressing themselves in the drama of the dream.

To understand the drama of the dream, as Freud saw it, it is necessary to become familiar with certain distinctions he introduced. The story of a dream as it is told by an individual upon awakening is not the whole story nor the real story. Such a story supplies what Freud called the manifest content of the dream. He contrasted this with the latent content of the dream. By reverting to the preceding analogy, the difference between these two kinds of content can be made clear. An underworld crook would hesitate to come out of his retreat without disguising himself. He might dress like a priest in order to throw off suspicion. The priestly garb would then exemplify what Freud called manifest content, while the nefarious impulses lurking underneath this garb would illustrate the notion of latent content. Freudian dream interpretation thus almost invariably calls for penetration of the disguise of the manifest content of dream imagery so as to get at the core of latent dream motivation.

In penetrating such disguises the Freudian detective is on the alert for certain characteristic dodges he attributes to the strategy of id impulses. One of these is condensation or the process of giving expression to more than one impulse by means of a single dream image or symbol. For instance, the desire to cut loose from rigid convention plus the desire to dominate over one's adversary in sadistically ruthless fashion may come to symbolic expression in the form of the crooked cross of the swastika. The process is akin to what psychoanalysts sometimes call over determination, meaning that a multiplicity of motives may be responsible for a single act or a given symptom. Another of these dodges or dynamisms is that of displacement or the shift of emphasis from a revealing symbol or figure to a neutral one. For a woman to report experiencing a patriotic thrill as she perceived the British flag in her dream might serve as an example of this provided that in the course of her free associations to the idea of this flag she comes to confess a secret love for some Londoner named John. The flag, the Union Jack, would then be interpreted as a disguised expression of her unconscious longing for closer ties with John. What was experienced as a patriotic thrill in the manifest content had been a more personalized, libidinous thrill in the latent stage of its origin. Instead of expressing this erotic longing directly by means of a dream image of John, the

Freud's Dream Theory

heart of Sigmund Freud's contribution to the psychology of dreaming. His views on the subject were originally expounded in his book on *The Interpretation of Dreams*, first published in German in 1900. Many critics regard this as Freud's outstanding work and Freud himself once expressed the opinion that "the most valuable" of his discoveries are to be found in this work. An enormous literature grew up in connection with Freud's brilliant approach to the dream problem.

impulse was displaced from John to the seemingly harmless image of the British flag. In actual dream interpretation the Freudian analyst thus has to work back from the symbolism of the manifest content to the motivational sources in the latent content. In doing this he must not only guard against being misled by the distortions resulting from condensation and displacement but also against those caused by what Freud called secondary elaboration. This refers to inaccuracies in the report of the dream as made by the dreamer in order to make the account more coherent or more plausible. In other words, even the manifest content is apt to be distorted in the process of telling about the dream. Significant items may be left out and new ones may be added quite unconsciously as the narrator strives to make his story more dramatic or more plausible. Such secondary elaborations must be recognized and stopped *before* the analyst can probe into the unconscious determinants of the dream.

As has already been explained, this sort of probing is accomplished by having the patient react to specific items in the manifest dream content with whatever ideas such items chance to arouse. According to Freudian technique the resulting train of free associations will expose a track leading to the unconscious (tension responsible both for some of the patient's neurotic symptoms as well as some of the vagaries of his dream life). Furthermore, as a result of analyzing a tremendous number of dreams, Freud found what he took to be a fairly stereotyped relationship between certain dream symbols and certain unconscious wishes. He then felt justified in speeding up the process of dream interpretation whenever such fixed symbols occurred by decoding them immediately without having recourse to the often tediously circuitous free association route. The vast majority of these standardized symbols were taken to be expressions of infantile or childish notions of sexuality. Notions of this kind are especially subject to repression because their early manifestation tends to provoke the shocked or horrified disapproval of parents. It does not take the young child long to learn of the strength and sternness of society's code of sex taboos. What he does not dare express simply has to be repressed. It is consequently easy to understand, say the Freudians, why so much of the dynamics of unconscious motivation has to do with impulses harking back to the dawn of sex curiosity. And it is precisely such impulses which Freud regarded as playing such an important role not only in neurotic behaviour, but also in dream symbolism.

Critique of Freud's Theory.—There can be no question about the brilliance, boldness and originality of Freud's contribution to the psychology of dreaming. Even though admirations of parts of his theory can be found in earlier writers, especially Plato, no previous worker dealt with dream phenomena with such profundity of psychological insight and with such speculative daring. No serious student of such phenomena can afford to neglect these insights and speculations. Almost all modern studies are grounded in them. This holds true even of those students of the subject who have seen fit to repudiate or modify the Freudian theory. In fact, many who have taken Freud's teachings as a point of embarkation have wandered far from their original psychoanalytic moorings. This applies to such men as Carl Jung, Alfred Adler, William Stekel, Otto Rank and others. Nor have the rank and file of nonpsychoanalytically trained psychologists given Freud's dream theory their unqualified endorsement. But the thinking of all of them has been stimulated and fertilized by the genius of Freud.

A whole volume would be required to furnish a detailed account of these divergent theories and these rejections and transformations of specific aspects of Freud's ingenious formulations and suggestions. However, only a bare outline of the more salient points of controversy can be introduced here. One of these points has to do with Freud's utilization of stereotyped dream symbols. Almost an army of critics has attacked this teaching so that it seems safe to say that practically all competent students reject this notion of fixed dream symbolism. To be somewhat more concrete the Freudian idea of the inevitable and certain phallic import of a snake symbol is no longer endorsed. Sometimes, of course, such a symbol may have such import in a particular dream of a particular individual, but not every manifestation of this symbol in the case of any individual's dream is to be linked with phallic implications as a routine interpretation. After all, a snake may be symbolic of deception or of undulation or of the phylum of reptilia or of the Garden of Eden or a host of other notions so that to restrict its symbolic significance to representation of the male sex organ exclusively is hardly warranted. Criticism of this sort can

be applied to all other allegedly fixed dream symbols. This means that dreams cannot be interpreted by consulting so-called dream books purporting to supply a code of dream symbols.

Freud's technique of looking at motivational determinants by means of free association has also been exposed to a barrage of criticisms. Some critics have called attention to the difficulty of finding out when to call a halt in the onward flow of the patient's associations. How is one to recognize the terminus of latent content? Others have maintained that even if latent content be reached by such a train of associations it would not follow that dream formation had taken the same associative pathway in the reverse direction. For example, a woman may dream of a game of cards in which she holds four aces. By means of free association the latter item may induce her to think in successive fashion of the four horsemen of the Apocalypse, a eucalyptus tree, a shoe tree, a shoe salesman and finally, the owner of a shoe store whom she met at a dance some months previously. Let it be further assumed that she admits having found him a very attractive person. Does it follow, the critics of this point ask, that her supposititious desire to "win the hand" of this attractive man expressed itself in the dream by the reverse sequence of associations going from the unconscious desire for the man, to a shoe salesman, to a shoe tree, to a eucalyptus tree, to the four horsemen of the Apocalypse and ending with the thrill of holding a hand with four aces? Evidence justifying an affirmative answer to this question has not been supplied to the satisfaction of these critics.

An additional phase of Freud's theory to which many critics objected was his emphasis on unconscious infantile sexuality as a preponderant source of motivation in dreams. These critics regard criticism of this phase as decidedly exaggerated. They would enlarge the scope of potential dream motivation to include the entire gamut of man's repertoire of lusts, aspirations, ambitions, fears, cravings and strivings. The life of conation both conscious and unconscious, is not to be compressed within the narrow confines of a child's frustrated sex curiosity.

It ought to be stated that Freud himself was not unmindful of some of these objections and sought to answer them. It ought also to be stated that his followers no longer accept the early formulation of the theory in its orthodox form. Few, if any, for instance, endorse the doctrine of fixed dream symbolism.

The attack on Freud's theory has been severe, but there are basic features of his formulation which seem to have weathered the storm of adverse criticism. These likely include Freud's emphasis on the need for a distinction between manifest and latent content, the role of such dynamics as displacement and condensation and what may possibly constitute the most penetrating insight, recognition of dreaming, as a dramatic projection and distorted expression of underlying personal conflicts. By thus envisaging the dream as a product of motivational tensions Freud paved the way for the development of numerous other so-called projective techniques for studying the complexities of human motivation. These are methods calculated to induce people to reveal their inner preoccupations and desires by the kinds of responses they invent to account for the meaning of pictures shown to them, by the figures they project into meaningless graphic representations of clouds or ink blots, by what they choose to draw or model when supplied with crayons or clay or by the way in which children "play house" when manipulating dolls symbolic of a family group. All such methods may be regarded as outgrowths of Freud's teaching regarding the psychological significance of the dream phantasy.

A Bipartite Theory.—It would be misleading to think of every dream as a projection of unconscious personality conflicts. A satis factory theory of dreams must account for all dream phenomena. As a consequence, the Freudian view requires supplementation. In terms of a broad perspective, dreams may be regarded as products of two sets of factors: (1) the stream of sensory impulses that chance to spill over the heightened sensory thresholds of the sleeping person, and (2) motivational tensions which, figuratively speaking, are clamouring for expression. By taking account of these two sets of factors it ought to be possible to explain the nature of all dream content at least in terms of a first approximation to probable scientific fact.

Understanding of this bipartite approach to dream phenomena will be facilitated by consideration of one of the just mentioned projective techniques. In confronting a person with an ink blot on a sheet of paper and asking him what the blot might be or what it makes him think of, two kinds of replies might be forthcoming.

By noting the outline of the blot he might find enough resemblance to the coast line of Australia to venture the guess that the blot can be taken to be a map of that continent. Such a response is not so much a projection of the individual's personal thoughts as it is a product of his general intellectual background. It is a product of what was previously described as the what-can-thus-be type of mental set induced by strange or ambiguous stimulus patterns. It is more or less implicit in every act of difficult perception such as trying to recall what friend a stranger seen on the train resembles or, to revert to an earlier illustration, what a strange noise coming from the attic might mean. What people do under such circumstances is to try out various possible suggestions supplied by their background of relevant experience until they stumble on something that fits the perplexing pattern. The motivation back of such effort is often little more than intellectual curiosity of the kind involved in solving crossword puzzles, watching

a steam shovel operate or reading the headlines of a newspaper

No crucial personality conflicts are revealed by perceptual acts of this sort. Many dreams can be regarded as products of this kind of perceptual effort induced by the ambiguous nature of sensory patterns experienced by the sleeper. More ambiguity occurs in sleeping than in waking because so much of the total perceptual field is cut off. This truncated stimulus pattern is not easily recognizable precisely because it is a distortion of the familiar nature of waking perception. Even recognition of a whiff of cigar smoke may constitute a perceptual puzzle for the sleeper with the sensory setting so different from that of waking experience. There is no visual apprehension of a lighted cigar, no awareness of social convention and no familiar feeling of sitting in a chair at the club. Orientation with respect to time and place is also apt to be warped or absent. Instead the smell of smoke may be part of a dim awareness of cramped leg muscles and limp arm muscles plus insipid heartburn. It is this totality of a novel stimulus pattern to which the dreamer responds with the what-can-it-be attitude. The consequent dream formation may be regarded as a series of trial percepts—many of them bizarre—brought to bear on what amounts to a bizarre problem. Trial percepts may therefore be viewed as part of the stuff of which dreams are made.

The rest of the stuff the bipartite theory would utilize in accounting for dreams may also be exemplified by means of the ink blot technique. Seeing the blot's contour as a map of Australia merely served as an illustration of the psychological factors involved in the trial percept type of response. However, if a dark smudge on the blot were to remind a subject of black despair or of sudden death or of the dark forces of evil or of conspirators whispering in the night, then a different set of psychological factors would be involved. In such a case the subject would be projecting his own emotional disturbances onto the blot material. Projection of this kind would constitute a species of tension release for him. What he attributes to the blot would be more of a sign of what is going on within him than a description or an explanation of the blot as a visual object. Under the circumstances it should be clear why trial percepts are closer to perceptual reality than are processes of tension-release. The tenuous nexus between provocative stimulus and tension-release may account for the bizarre character of many dreams. It is akin to the incongruity observable in connection with many everyday emotional outbursts in which worried or irritable people give rise to pent up feelings which are touched off by annoyances disproportionately trivial as compared with the magnitude of the resulting emotional upheaval.

In the light of the bipartite theory dreams are products of tension-release and of trial perception. Sometimes one set of factors may be responsible for a given dream, sometimes another set and often both sets of factors may be operating conjointly. These possibilities can be illustrated by the familiar dream of falling through space. In extremely rare instances such a dream is indicative of a semicircular canal disturbance as has been demonstrated by checking on the dreams of patients so afflicted. In a large number of instances, however, such dreams are consequences of passive shifts in the bodily position of the sleeper. This has been shown by means of experimental study of the dreams of hypnotized subjects. A slight deflection of the pillow, just enough to cause the subject's head to slip a fraction of an inch, will suffice to produce a dream of diving with the body twisting in the direction in which the head was made to slip.

The foregoing examples illustrate falling dreams as trial percepts. But such dreams may also be expressions of tension-release. They may conceivably be unconscious outlets for suicidal tendencies or symbolic expressions of fear of failure or the lure of erotic temptation. To illustrate by means of the last possibility let it be assumed that a passive shift of the head of some woman causes her to dream of falling off a precipice and landing in a muddy pool. Subsequent analysis of the dreamer's background, let it be further assumed, reveals a history of persistent struggle with a banal sex conflict. Under the circumstances, in terms of the bipartite theory, one might hazard the guess that the passive bodily shift touched off the trial percept of falling and that the moral conflict determined the emergence of the muddy pool as the terminus of the dream. In other words, the verbal terms it would be as if the dreamer had said to herself, "If I yield to this desire, I'll be like a fallen woman and end up in the mire of social disgrace." It should thus be clear that many dreams may be products of both sets of factors stressed by the bipartite theory.

In conclusion, it should be noted that in terms of knowledge of the psychology of dreaming there is no way of telling from direct scrutiny of a given dream whether to regard it as the consequence of a trial percept or whether it was a function of tension-release or whether both sets of factors were involved. To settle questions of this sort the investigator must know more about the inner life of the dreamer than bare knowledge of a single dream can supply. The dream may be a "royal road to the unconscious," as Freud taught, but it continues to be a winding and difficult highway on which the dream analyst must proceed cautiously lest he fail to steer clear of numerous psychological pitfalls. In other words, a smooth, flushed highway to and from dreamland still awaits the dream construction.

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(D B K.)

DREDGES AND DREDGING Dredging is the name given to that branch of excavation which deals with the process of removing materials lying under water and disposing of them according to the requirements of the work in hand. The machines employed to that end are termed dredges (dredgers outside the U.S.) and the term dredging plant covers not only the dredging machines themselves but much auxiliary apparatus employed in connection therewith.

Spurred by the demands for increased facilities for shipping, and assisted by the great advances of mechanical science, dredges developed rapidly from primitive tools to powerful and costly appliances.

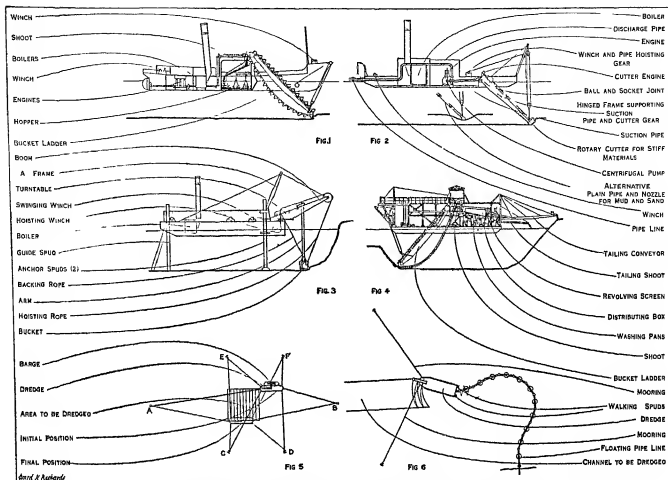
Applications of Dredging—Although dredging machinery is, from the nature of its duties, mounted on floating craft in the great majority of instances, the term does not exclude subaqueous excavation by plant mounted on land. Dredging may be divided broadly into two classes according to the object for which it is employed, viz. (1) as a means of removing material for the purpose of increasing existing depths of water or reclaiming low-lying ground, and (2) as a means of mining for making available earths useful in themselves or because they contain precious constituents.

Its field, however, covers a multitude of purposes within the bounds of these two main divisions, and the following uses to which the plant may be put will illustrate the wide scope of dredging operations.

Material Shifting Dredges—The creation and maintenance of satisfactory depths of water in harbours, docks, rivers and canals for the purposes of navigation, the removal of material for the foundations of marine and river works and for the preparation of sites for floating docks, the deepening, widening and straightening of rivers to increase or conserve their discharging capacity, the cutting of drainage and irrigation canals, the removal of material for the reclamation of low lying land or the formation of dykes, levees or dams.

Mining Dredges—The recovery of gold and culm from rivers or placer deposits, also platinum, tin and other heavy metals, the raising of gravel, sand and clay for building and industrial purposes.

Characteristics of Materials Dealt with—Dredges have been constructed to deal, in varying degrees of efficiency, with anything from mud to rock. The materials when removed from the bottom are termed spoil and naturally occur in endless variety of kinds and mixture of kinds. In general, however, the natural basins of alluvial deposits forming the rivers and bays in which harbours and other marine works are mostly sited are the situations peculiar to dredging operations. Sand and mud are the most common materials met in dredging forming the bulk of obstruction to navigation and of accumulations in and about harbours and river channels. Materials other than sand and mud are more difficult to dredge. Clay and loam are classed as loose materials but can scarcely be regarded as "free getting" since they may be somewhat difficult to dislodge from the apparatus when being discharged. Further along the scale of compactness comes a wide and rather indefinite class of mixtures of loam and boulders in various degrees of cementation. They are resistant to penetration and cause difficulty because of size of the boulders. Gravel is often found in dense layers strongly compacted with sand, and this, together with indurated sand, is difficult to dis-



DIAGRAMS SHOWING DREDGES IN ACTION AND METHODS OF OPERATION

Fig. 1—Action of bucket ladder hopper dredge Fig. 2—Action of suction dredge Fig. 3—Action of dipper dredge Fig. 4—Mining dredge for the recovery of tin Fig. 5—Moorings arranged for dredging a given area at one setting Fig. 6—Method of dredging on the walking spud system

tegrate, but once penetrated, removal is comparatively easy. Conglomerates, consisting of pebbles held together by natural forms of cement, and solid rock require either the application of excessive power in the dredging tool or previous disintegration by percussion or blasting, with subsequent dredging of the debris.

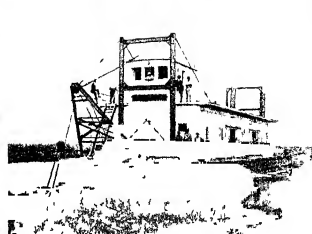
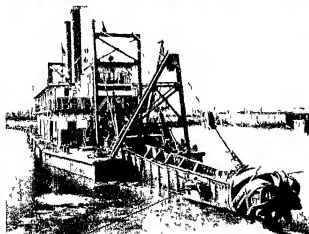
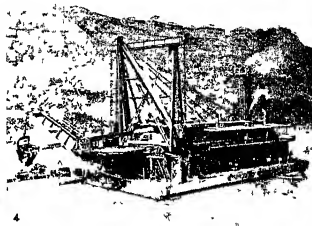
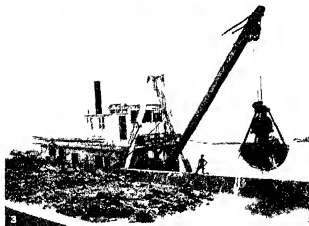
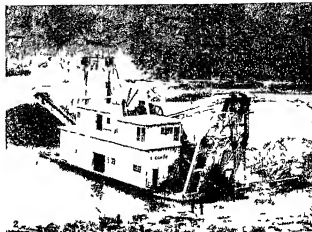
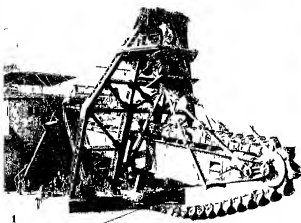
Classification of Dredging Plant.—Dredges fall into two main classifications according to the conditions under which they operate, viz., seagoing vessels and vessels for inland water service. The former are generally shipshape vessels constructed as far as possible in the accepted manner for withstanding sea conditions and ocean voyages, and carrying their own propelling machinery. The latter class is of lighter construction partaking more of the box or pontoon form and generally lacking propelling machinery. Inland dredges are sometimes made portable for over land shipment by bolting together a number of small pontoons and erecting thereon demountable machinery and equipment. There are of course intermediate types and, in general, dredging vessels are constructed more strongly to withstand the working stresses to which they are subject than vessels for commercial purposes. Mining dredges as a class are of the inland type. A further clarification is possible in accordance with the method of disposal. Stationary dredges discharge their spoil into barge, brought along side, or to river banks or shore either directly or through long shoot or pipes. Hopper dredges receive the spoil into a specially formed hold or hopper in the hull of the dredge and when full proceed to sea or other convenient site to dump their load. The inland dredge class as a whole is of the stationary type, but scow dredges are of either type according to the particular requirements of the work and situation, and not infrequently hopper dredges include arrangements which make them capable of working on either

system.

Basic Types of Plant.—The basic types of dredging machine are the bucket-ladder dredge, the suction, or hydraulic, dredge, the dipper dredge, the grab dredge and the scraper dredge. In addition, dredging often necessitates the employment of a variety of auxiliary plants, and there are a number of appliances which, although not falling strictly within the definition of a dredge, in that they do no more than loosen without raising the spoil to the surface, yet serve to carry out in some measure, with the help of moving water, the work of dredging.

The Ladder Dredge.—The main feature of the ladder dredge is a continuous chain of buckets running round a rigid frame called the ladder extending down from the ship to the bottom of the water, as shown in fig. 1. The buckets run empty down the underside of the ladder, dig into the material as they turn round the end and return full along the top side of the ladder. On reaching the top, each bucket, as it turns over, discharges its contents into a shoot which conveys the spoil to the vessel's own hopper, to a barge or, in some cases, to the shore. The revolving members at each end of the ladder are called tumblers and the top tumbler drives the bucket chain. The ladder of the typical ladder dredge is hinged at the top to a high structure on the vessel, the height of which is regulated by the requirements of the discharging operation, and extends downward at an angle not exceeding 45° through an open recess or well in the hull, the lower end being supported by rope tackle which serves to adjust it to the dredging depth required or to raise it entirely when it is desired to steam away.

The Suction Dredge.—The suction, or hydraulic, dredge, shown in fig. 2, depends on quite different agencies for its opera-



BY COURTESY OF (1) THE Yuba Manufacturing Company (2, 4) THE Suctus Erie Company (3) THE Hayward Company, (5, 6) THE Ellicott Machine Corporation

GOLD AND CHANNEL DREDGES AT WORK

- 1 Digging ladder of a large gold dredge. The steel derrick supports the ladder arm around which the bucket chain travels. Small buckets raise the gold bearing sand of river bed for panning within dredge house. The size of the machine is evident by comparison with the figures at left.
- 2 Gold dredge in Bonanza Creek, Yukon, a forerunner of dredge in fig. 1. Right, bucket chain removing gold bearing sand from creek bed; centre power and separating house; left, discharge conveyor dumping gravel.
- 3 Orange peel dredge dipping up slag from side of pier. In this form of dredge the hoist controls a bucket divided into triangular sections pointed at base. When lowered the bucket is open until it strikes into bed of material, then closed upon the material. The filled bucket is shown being carried over wall of the pier.
- 4 Large dipper dredge at work in the Panama canal. This type of dredge operates like a steam shovel scooping up material from bed of waterway and depositing it in barge at side. A trap door in the bucket scoop is operated by a chain or rope under the movable arm in the swinging hoist.
- 5 Hydraulic pipe line dredge showing arm raised above surface. The spiral dredging head revolves digging silt which is drawn by suction into pipe located within dragging arm. At left edge of picture may be seen the discharge pipe leading from dredge to barge or to land.
- 6 Hydraulic dredge driven by Diesel engine used in shallow water. The dredge is shown removing grass grown bank from river channel. A pipe line may be seen (right) in the rear of the dredge, supported by pontoons reaching the shore.

tion. Whereas the ladder dredge removes and raises the material mechanically, the suction or hydraulic dredge, as its name implies, relies on suction to lift the material to the surface. The device consists essentially of an airtight suction pipe, one end of which is lowered to the bed of the sea or river, and the other connected with a centrifugal pump. The latter comprises a casing within which an impeller, or fan, is revolved at high speed and by its action expels the contents, whether air or water outward from the centre through an outlet on the periphery or rim of the casing, thereby causing a partial vacuum at the centre, to which the suction pipe is attached. The atmospheric pressure on the water outside proceeds to repair this vacuum by forcing water in through the only available route (viz., the suction pipe) and the water in its mid rush into the pipe agitates and carries with it a proportion of solids. In some situations, means are provided at the suction pipe end, or nozzle, of disintegrating or actually cutting the compact materials to enable them to come under the influence of the so-called suction.

The Dipper Dredge.—The dipper and grab dredges are also of the bucket type, but more intermittent in operation than the ladder dredge. The dipper dredge is illustrated diagrammatically in fig. 3. The principal features of the dipper dredge are the bucket and the arm to which it is attached the boom which supports and guides the arm and which is mounted on a turntable so that dredging can be undertaken around a wide arc and the load deposited to either side, the hoisting rope which passes over a sheave at the boom head and gives the required excavating movement to the bucket and the backing rope by means of which the vessel may be turned and moved forward using the bucket resting on the bottom as an anchor. The bucket has a hinged bottom, the catch of which is released by a hand rope to dump the load. To counteract the heavy digging reactions the vessel is made to rest on the bottom partly independent of water support on two anchor spuds, and a guide or poling spud is provided at the stern.

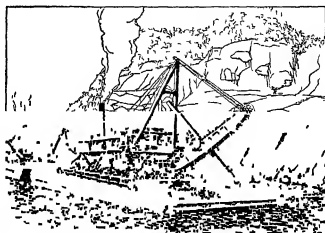
The Grab Dredge.—The grab dredge employs a slewing crane to operate its bucket, which is in two parts hinged together and controlled by levers and chains or ropes. The bucket is dropped to the bottom in an open condition by means of one rope, digs in partially by virtue of its own weight and completes its bite by means of the strong leverage effected by the other rope on the two halves when the crane begins to hoist. By holding on the hoist, or holding rope, and releasing the closing rope the bucket opens and discharges its contents. Some grabs are specially arranged to operate with one rope only, discharge being effected by means of a tripping device suspended from the job head.

The Scraper Dredge.—The scraper, or the dragline bucket dredge, is a form in which material is handled with a scoop suspended from a swinging boom. The scoop is drawn toward the machine by a line attached to the front and a second line at the rear holding it at the proper angle to slice the earth away as it is moved forward. When the scoop is filled, it is lifted to the point of the boom, both lines being kept taut, and is then swung around, on slackening the drag, or hauling line, the scoop dumps automatically.

Auxiliary Plant and Miscellaneous Appliances.—There are two methods of dealing with rock under water. British engineers generally rely on the rock breaker, or cutter, whereas U.S. engineers use the drill boat. The rock breaker consists of

The Mining Dredge.—The mining dredge for the recovery of precious metals is generally an adaptation of the ladder dredge. It is often to be found in considerable distances from a river, having cut its way through the land and deposited the spoil behind it in effect carrying with it the pool in which it floats. A typical tin dredge is shown in fig. 4. The earth brought up by the buckets is discharged into a perforated cylindrical revolving screen which disintegrates it and allows the heavier tin laden soil to drop through the perforations into a distributing box, while the large rough materials pass out of the screen and are discharged over the stern by a belt conveyor. The soil from the distributing box together with an ample supply of water is led by shoots into pans in which it is agitated by mechanically operated jigs. This operation allows the heavier tin to sink to the bottom of the pans while the lighter soil runs in suspension in the water and passes overhead through a tail shoot. The metal is collected from the pans at intervals.

Prime Movers.—Steam as a mode of power is particularly well adapted to the rough and fluctuating character of the work of dredging. Steam plant has been universally used and is comparatively simple and well understood while its inherent flexibility enables it to accommodate itself conveniently to the constantly varying power requirements and to sustain a heavy pressure on the tool when the latter has been brought to a dead stop by the severity of the work. The internal combustion oil engine has found some application in situations where economy of space and fuel are vital considerations. In general its lower range of flexibility and inferior capabilities of sustained power at low speeds together with the high pressures possible, necessitate the introduction of safeguards which operate to reduce the economy and convenience to be expected from its higher thermal efficiency and self contained character. The diesel electric drive in which the oil engine operates under favourable conditions as a prime mover for the electric secondary machinery, which drives the various motions, has found many applications in recent years. This drive possesses characteristics more suited to driving operations than the direct oil engine drive and is found to be economically comparable to steam plant, even with the complication of electrical equipment. The electric drive pure and simple is in use in the tin mining areas,



DIPPER DREDGE AT WORK IN A SLIDE IN CULEBRA CUT DURING THE CONSTRUCTION OF THE PANAMA CANAL.

where many dredges are supplied through cables from a central generating station.

Selection of Dredging Plant.—It will be evident that the selection of dredging plant to satisfy the requirements of different localities and different circumstances needs the exercise of sound judgment. The ladder dredge is eminently adapted for dealing up to great depths with all classes of material from mud to the softer varieties of rock, including small boulders, and of preparing a level bottom. Its mechanism tends to make it heavy and cumbersome, with correspondingly heavy capital cost and upkeep charges. It may, however, be regarded as the universal large

pulvers, grappels, rakes and harrows, mechanical stirrers, water jets and other devices for placing the material into suspension so that it may be carried away by river flow or by the ebb tide.

dredging tool and is preferred in a great number of cases where accuracy of work in a wide variety of materials is required and it can be kept fully employed, provided its bulk and widespread moorings are not of grave consequence. The maximum dredging depth in sea works is 70 ft., and this the ladder dredge can tackle. Some of the mining dredges, however, work down to 100 ft. and more. In more restricted situations and for less extensive projects the grab dredge generally proves more economical in first cost and upkeep, and is well suited to maintenance work and work of an intermittent nature or in awkward situations. The dipper dredge is as capable as the ladder dredge of dealing with all classes of materials, and as a tool for really difficult individual tasks at depths up to about 50 ft. has no equal because of the great force which can be exerted with the cutting edge of its bucket and the large capacity, sometimes up to 15 cu yd., of the latter. The grab dredge is not so powerful but can dredge at great depths exceeding any other type and is eminently suitable for pioneer inland work. The suction dredge succeeds when large quantities of soft materials have to be dealt with, provided there is no objection to the large admixture of water. Quantity, not quality, is its leading characteristic, for it effects its object in free flowing materials by excavating large holes in the bottom. The irregularities are subsequently levelled down by sea or river action, thus effecting an increase in the depth of water. In the more compact sands a series of high-pressure water jets around the nozzle serve to break up the material sufficiently, but in clay and similar substances a rotary cutter is required and serves to increase the accuracy of dredging to as great a degree as any dredge can attain. By reason of the large quantity of water, often 90% of the total volume pumped, the suction dredge is relatively inefficient, but the operation is continuous and has the valuable property of enabling, when required, the spoil to be discharged direct through a pipe system to considerable distances without expensive rehandling. The scraper is in efficient form for shallow cuts over large areas. It has a wide reach by the means of a boom and will excavate soft or fairly hard material. The majority of all types of dredges have their excavating member so located in advance of the hull that the vessel can cut its own flotation.

Methods of Dredging—In the case of the bucket dredge, practically only one general method of dredging is pursued. The vessel is moored by means of six anchors and chain cables set out as shown diagrammatically in fig. 5. The head and stern moorings are much longer than the side moorings, and the vessel swings to or pivots about the head mooring A and is dragged slowly transversely by one pair of side moorings C and D. On reaching the limit of the cut to that side the vessel is advanced about six feet by pulling on the head mooring, the stern line being paid out to correspond, and the vessel is dragged across to the other side of the cut by side moorings E and F, the other side moorings C and D being paid out the while. This operation goes on until the head chain becomes too short and the angles of the side chains tend to become ineffective, when the vessel is pulled back by the stern mooring B to commence a fresh series of cuts at a lower depth or, if the required depth has been reached, dredging is stopped for the time being and the whole of the anchors taken up and relaid in a fresh position. The depth of cut is on the average about 18 in. and the handling of the moorings is effected by steam winches. The excellent control of operations which this method gives permits very accurate dredging. In reality, the dredged area would at first present the appearance of a ploughed field with exaggerated furrows, but sea or current action soon levels out the ridges.

Special Cases—The excavation of bridge piers, piers and work of a similar type, where the area to be excavated is limited and the depth is great, is usually done by some special form or method (See CAISSON, COFFER-DAM, WELL).

Influence of Tide and Weather—In a seaway the whole operation is highly skilled, since the dredging master must adjust the depth of his ladder to the varying tide level so as to keep the work uniform, and it will be appreciated that inclement conditions make it exceedingly difficult to maintain a level bottom. In practice, work is not generally permissible when the swell attains

about two feet in height, because of the structure's being exposed to immense stresses from the ladder's bumping on the bottom. It will be apparent that this system of dredging constitutes a serious obstruction to shipping in a narrow waterway, more especially when barges are employed to remove the spoil, and that the operation of lifting and relaying moorings on a fresh field is a heavy undertaking. A hopper dredge will present less of an obstacle but loses, for dredging, the time occupied in transporting the dredgings to the dumping site and returning to its work. When the hopper is full, the three forward chains are coupled together and let go, and similarly with the three stern moorings, the ends being attached to mark buoys. The operation of picking up these moorings again and connecting them to the winches is also one of considerable moment.

Suction Dredging—The suction dredge operates generally on the same principles as the bucket dredge, but in some cases the six anchor moorings are dispensed with in favour of two "walking" spuds, placed abreast some distance apart at the stern, together with two forward side, or breast, moorings, consisting of wire ropes and anchors. In operation under this system one spud is let down to the bottom to act as an anchor, and the forward end with suction pipe is swung by one breast mooring to the limit of the cut. Their relative positioning brings the other spud in advance of the pivot spud, the former is let down to act as pivot, the latter raised and the dredge swung on a new advanced arc back to the opposite side of the cut by the other breast mooring. The two spuds thus act as legs and the dredge "walks" forward. The breast mooring lines or cables are usually attached to winches on the dredge and are run through sheaves to the shore anchors. Fig. 6 illustrates this method. Through remote controllers in a central control house the dredge operator can manipulate the mooring lines and the two spuds without outside help.

Bar Dredging—A particular case in which a different method is employed is the dredging of a navigable channel through a sand bar blocking a river entrance. Here large quantities must be removed under arduous open sea conditions, precluding in most cases the employment of such a rigid structure as a bucket ladder, or in some cases even the use of moorings. The suction dredge is eminently adapted to this work since its suction pipe can be made flexibly jointed, thus relieving the ship of any bumping stresses. In those cases where the sand will not run freely to the suction pipe, the latter must be made somewhat more rigid and is fitted with a drag head or cutting edge. The dredge steams slowly ahead, and the drag head slices off the material to a depth of 18 in. or 2 ft. to bring it under the influence of the suction pipe. This is of course a rough operation since the result is simply the cutting of a series of longitudinal furrows. In such situations the bar is often of sufficient width to permit a full load's being obtained in one cut. The drag method is also employed successfully where the area is large and the depth to be removed small, and it is capable of more accurate work than ordinary suction dredging.

Stationary Dredging—In the case of the dipper dredge, which relies on spuds, no external moorings are necessary. The dredging machinery being arranged on a turntable, cuts are taken around an arc of about 90° or more while the vessel remains stationary. The anchor spuds are then lifted and the vessel moved up to suit the next series of cuts by means of the backing rope and the stern spud acting after the manner of a punt pole. The anchor spuds are then reset and dredging operations continued. A development of the suction dredge employs a suction pipe mounted on a turntable after the manner of a dipper dredge, and operates on a similar method the hull being kept stationary during the progress of each arc of cut either by moorings or by spuds. The grab dredge is another example of this system of operation, but requires about three or four moorings only to retain and adjust its position at its work, the dredging reactions being purely vertical.

Determination of Work Done—The work done by dredges is measured either "in the solid" or "in the loose" (termed "measurement in-place" or "scow measurement" in the U.S.). Measurement in the solid involves the determination by soundings taken before and after dredging of the levels of the excavation. Measurement in the loose is based on a determination of the amount

of spoil actually issuing from the dredge, either from the known capacity of the barges or hopper used or, in the case of pipe line work, by survey of the deposit. Rough and ready methods based on known data are sometimes employed, such as by counting the rate at which the buckets travel on a ladder dredge, the number of dips or grabs per hour or estimation of the velocity of flow and percentage of solids in a pipe line. Spoil, originally lying closely compacted in its natural state on the bottom, has been dug into, stirred up and mixed with water by the action of the dredging tool, hence a swelling, generally taken as 30% in the absence of definite data, is observable in loose, or barge, measurement, as compared with solid, or place, measurement.

Disposal of Spoil—The disposal of spoil demands close consideration since it has an important effect on the cost of dredging. Where it is desired simply to get rid of the spoil, as in the improvement and upkeep of navigable channels, it is usually requisite to transport it considerable distances out to sea and deposit it in deep water from where there is little likelihood that it will find its way back under the influence of currents or sea action. For this purpose a fleet of barges, either self propelled or towed, may be employed or the dredge itself conveys to sea the spoil which it excavates. In each case the hopper bottom is formed of a number of doors which can be opened to allow the spoil to drop out. The conditions determining the method to be adopted vary almost with every project. Obviously, it is advisable to keep such an expensive item of plant as a dredge fully employed if at all possible, and the use of hopper dredges is resorted to only when attendant barge traffic is either impracticable because of inclement conditions or likely to cause serious additional obstruction to navigation in a busy and restricted waterway. The hopper type is useful also in the smaller sizes for general maintenance work as a self contained unit. In those cases where the distance to the dumping site does not exceed a mile or two or where the material is required for reclamation purposes, towed barges are used, while for long distances, large speedy self-propelling barges are necessary. For the important work of reclaiming land the suction dredge and a long pipe line are generally employed as long as free getting materials are to be dealt with. The portion of the pipe line from the dredge to the shore is made in sections 30-50 ft long, flexibly connected by ball and-socket joints so as to permit the dredge its necessary range of movement. Each section of the pipe is carried on a pontoon and the floating pipe line connects to a shore delivery pipe line laid directly on the ground or mounted on trestles. If harder materials must necessarily be used or the conditions of exposure, or obstruction to navigation preclude the use of a pipe line, it becomes necessary to employ a fleet consisting of a cutter-suction or ladder dredge and a special reclamation vessel with barges as the connecting links. The reclamation vessel is in most respects equipped like a suction dredge except that its suction pipe is arranged over one side so as to dip into a barge, it is moored to a wharf or staging on the other side and its discharge pipe is flexibly connected directly to the shore pipe line. By this means low-lying areas situated up to 6,000 ft from the water front can be reclaimed, and at still further distances by the employment of boosting pumps.

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DREISER, THEODORE (1871-1945), U.S. author, was born at Terre Haute, Ind., on Aug. 27, 1871. He attended the public schools at Warsaw, Ind., and for a brief period Indiana university. He then went into newspaper work in Chicago, St. Louis and Pittsburgh. He began writing for various periodicals, engaged in editorial work, and became in 1907 editor-in-chief of the *Buttencik* publications in New York city. This post he held until 1910. His first novel *Sister Carrie*, published in 1900, was suppressed, but not before it had aroused the admiration, for its unsparring and poignant realism, of Frank Norris, the noted U.S. realist, and later in England of Arnold Bennett, H. C. Wells and Hugh Walpole. Dreiser's second novel, *Jennie Gerhardt*, did

not, however, follow until 1911. It had been written as a relief from editorial work, and its publication found Dreiser now devoting himself entirely to literature. In 1914 he brought out *The Financier*, the first of two books based upon the career of the traction magnate, Charles T. Yerkes. The second, *The Titan*, followed in 1914. In the year between Dreiser published *A Traveller at Forty*, an autobiographical volume, the fruit of a first trip abroad. *The Genius*, in 1915, was a long and detailed study of the ruthless type of artistic temperament. This was followed by Dreiser's first venture into intimate drama, *Plays of the Natural and Supernatural*, and the same year, 1916 brought forth *A Hoosier Holiday*, based upon a revisiting of his native State. Subsequent volumes included *The Hand of the Potter*, a tragedy (1918), *Twelve Men* (1919), *Hey, Rub-a-Dub-Dub* (1920), *A Book about Myself* (1921), *The Color of a Great City* (1923) and *A Gallery of Women* (1929). The publication in 1925 of *An American Tragedy*, based upon an actual American crime, brought Dreiser his first widespread popular recognition. The novel was dramatized by Patrick Kearney, presented by the Theatre Guild and proved the sensational play of the season.

Theodore Dreiser was in 1929 probably the most important realist writing fiction in the United States, and thus, in spite of the fact that he had been called "the most suppressed and unsuppressible writer in America," and the more important fact that he could hardly be said to have achieved a style, his writing being often heavy handed and clumsy. His large attempts, his close attention to detail, the cumulative effect he gained by laborious presentation of the exact truth were qualities that would not in themselves account for the stature he attained as a novelist. A greater quality than these is to be found in the deep human sympathy underlying his treatment even of the most sordid and sombre human affairs. It goes hand in hand with a sincerity that never swerved. The manner of Dreiser's writing has been the subject of much criticism from an artistic point of view, but there is general agreement as to the value of his super-representational presentation of some of the most significant aspects of modern American civilization. He built solidly the story, for the most part, of tragic lives, tracing their inevitable course every step of the way and refraining from any comment save that implicit in the lives themselves. He achieved a remarkable detachment in his writing. Dreiser died in Hollywood, Calif., on Dec. 28, 1945.

A brother of Theodore Dreiser was the late Paul Dreiser, the popular song writer. A collection of his best songs appeared with an introduction written by Dreiser. Further biographical and bibliographical material upon this novelist may be found in Burton Rascoe's *Theodore Dreiser* (1925), in Bessie Graham's *The Bookman's Manual* (1924) and in H. L. Mencken's *A Book of Prefaces* (1927). (W. R. Be.)

DRELINCOURT, CHARLES (1595-1669), French Protestant divine, born at Sedan on July 10, 1595, became minister of the Reformed Church at Charenton. His *Catechism* (*Catéchisme ou instruction familière, 1652*) and *Christian's Defense against the Fruits of Death* (*Consolations de l'âme fidèle contre les frayeurs de la mort, 1651*) became well known in England by means of translations, which were very frequently reprinted. It has been said that DeWoe wrote his play of Mrs. Veal (*A True Relation of the Apparition of Mrs. Veal*), who came from the other world to recommend the perusal of *Drelincourt on Death*, for the express purpose of promoting the sale of the English translation of the *Consolations*, to the fourth edition of which (1706) his contribution is added. Drelincourt died on Nov. 3, 1669.

DRENTE (or **DRENTHE**), a province of Holland, bounded north and northeast by Groningen, southeast by Germany, south and southwest by Overijssel, and northwest by Friesland, area, 1,028 sq. m., pop. (1945) 269,769. Drente is a sandy plateau forming the nucleus of the surrounding provinces. The sandy soil is covered with bleak moorland, patches of wood, and fen. This is only varied by the strip of fertile clay and grass-land which is found along the river banks, and by the areas of high fen in the southeastern corner and on the western borders near Assen. The surface slopes from southwest to northeast,

where it ends in the ridge the Hondsrug (Dog's Back) along the eastern border. The watershed runs from east to west, along the line of the Orange canal. The southern streams are all collected at two points on the southern borders, namely, at Meppel and Koevorden, whence they communicate with the Zwarte Water and the Vecht respectively by means of the Meppeler Diep and the Koevorden canal. The Steenwyker Aa, however, enters the Zuider Zee independently. The northern rivers all flow into Groningen.

History.—The megalithic sepulchral mounds, the *Hunnabeden*, particularly along the western edge of the Hondsrug suggest the early settlement of the region. In the 5th and 6th centuries the country was overrun by Saxon tribes, and later on was governed by counts under the Frankish and German kings. In 1046 the emperor Henry III gave the countship to the bishop and chapter of Utrecht, who governed it through the burgrave, or châtelain, of Koevorden, a dignity which became hereditary after 1143 in the family of Ludolf or Roelof, brother of Heribert of Bierum, bishop of Utrecht (1138–1150). After 1232 the countship passed to Henry I of Borculo (1232–1261). In 1395 Remald IV (d. 1410) of Borculo Koevorden was deposed by Bishop I rederick of Utrecht, and the country was henceforth administered by an episcopal official (*amtsman*). With its popularly elected assembly of twenty-four *Etten* (*jurats*) Drente remained practically independent. In 1522 it was conquered by Duke Charles of Gelderland, from whom it was taken by the emperor Charles V in 1536, and from that time it became part of the Habsburg dominions.

Drente took part in the revolt of the Netherlands, but owing to its poverty and sparse population, it had no separate representation in the assembly of the states general. It was subdued by the Spaniards in 1580, but reconquered by Maurice of Nassau in 1594. Drente retained its local independence and had its own stadtholder. At the general assembly of 1651 Drente unsuccessfully claimed admission as a province. After the deaths of William II (1650) and of William III (1702) Drente remained for a time without a stadtholder, but in 1722 William Charles Henry, who had become prince of Orange, was elected. His descendants held the office, which was declared hereditary, until the French conquest in 1795. In 1796 Drente at length obtained representation in the states general. Between 1806 and 1813 Drente, with the rest of the Netherlands, was incorporated in the French empire, and, with part of Groningen, formed the department of *Ems Occidental*. With the accession of William I it was restored as a province of the new kingdom. The province was speedily conquered by Germans in invasion of May 1940.

Two industries have for centuries been associated with the barren heaths and sodden fens so usually found together on the sand grounds, namely, the cultivation of buckwheat and peat-digging. The latter being directed also towards the draining of the land and its subsequent use for cultivation. The soil thus prepared is, however, soon exhausted. Potatoes, rye, oats, beans and peas are cultivated. In connection with the cultivation of potatoes, the by-products (spirits, potato meal, etc.), are important. Furthermore, agriculture is accompanied on the sand-grounds by the rearing of a poor type of sheep and cattle, which assist in fertilizing the soil. The breeding of pigs is also widely practised. Of the fen-colonies in Drente the best known are those of Frederikssoord and Veenhuizen.

Owing to the general condition of poverty which prevailed after the French evacuation early in the 19th century, attention was turned to the unclaimed heath-lands in the eastern provinces, and the Society of Charity began by establishing the free agricultural colony of Frederikssoord, about 10 m N of Meppel. In addition, various industries, such as mat and rope making, and jute and cotton weaving were introduced. In later times forest culture was added, and the Gerard Adriaan van Sweten schools of forestry, agriculture and horticulture were established. To this colony were added those of Willemsoord and Klonne VII in Overysel, and Wilhelmsoord partly in Friesland. The colony of Veenhuizen lies about 7 m NW of Assen, and was founded by the same society in 1823. In 1859, the Veenhuizen estates

were sold to the government.

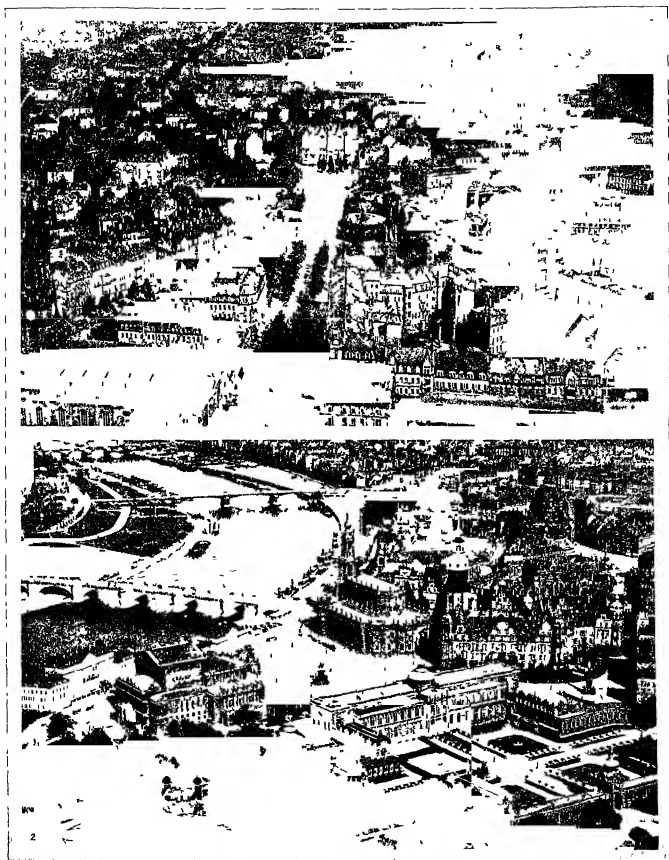
Owing to its geographical isolation, the development of Drente has remained behind that of the other provinces of the Netherlands, and the character and customs of the people likewise conservative. Assen is the chief town. In the south are Meppel and Koevorden. Hoogeveen, situated between these two, owes its origin to the fen reclamation which was begun here in 1625. Extensive fir woods have been laid out in the neighbourhood Zuidlaren, at the northern end of the Hondsrug, has an important market. The railway from Amsterdam to Groningen traverses Drente, branch lines connect Meppel with Leeuwarden and Assen with Delfzijl.

DRESDEN, a city of Germany, capital of the *Land* of Saxony, 71 m ESE from Leipzig and 111 m S from Berlin by railway. Pop. (1939) 625,174, mainly Lutheran. It lies 403 ft above the Baltic, in a broad valley on both banks of the Elbe. The prospect of cupolas, towers, spires and copper green roofs is of striking beauty. On the left bank of the river are the Altstadt (old town) with old and new suburbs, and the Friedrichstadt (separated from the Altstadt by a long railway viaduct), on the right, the Neustadt (new town), Antonstadt, and Albertstadt. Five fine bridges connect the Altstadt and Neustadt. The beautiful central bridge—the Alte or Augustusbrücke—with 16 arches, built in 1717–1731, and 1,450 ft long, has been demolished (1906) and replaced by a wider structure. Up stream are the two modern Albert and Königin Carola bridges, and, down stream, the Marien and the Eisenbahn (railway) bridges.

History.—Dresden (Old Slav *Dregga*, forest, *Dreggjan*, forest-dwellers), which is known to have existed in 1206, is of Slavonic origin, and was originally founded on the right bank of the Elbe, on the site of the present Neustadt, which is thus actually the old town. It became the capital of Henry the Illustrious, margrave of Meissen, in 1270, but belonged for some time after his death, first to Wenceslaus of Bohemia, and next to the margrave of Brandenburg. Early in the 14th century it was restored to the margrave of Meissen. On the division of Saxony in 1485 it fell to the Albertine line, which has since held it. Having been burned almost to the ground in 1491, it was rebuilt, and in the 16th century the fortifications were begun and gradually extended. John George II, in the 17th century, formed the Grosser Garten, and otherwise greatly improved the town, in the first half of the 18th century, Augustus I and Augustus II, kings of Poland as well as electors of Saxony, modernized Dresden. The Neustadt, which had been burned down in the 17th century, was founded anew by Augustus I, he also founded Friedrichstadt. The town was bombarded in 1760 during the Seven Years' War. Napoleon made it a centre of operations in 1813, and one buttress and two arches of the old bridge were blown up. The dismantling of the fortifications, begun by the French in 1810, was completed after 1817, and gardens and promenades made. Many buildings were completed or founded by King Anthony, from whom Antonstadt derives its name. Dresden again suffered severely during the revolution of 1849, but all traces of the disturbances which then took place were soon effaced. In 1866 it was occupied by the Prussians, who did not finally evacuate it until the spring of the following year. There was a good deal of fighting in the streets during the year of 1919.

Situation and Buildings.—Dresden is often called "German Florence," because of its situation, its art treasures and the educational advantages it offers. Within two decades (1880–1900) the capital almost at a single bound advanced into the front rank of German commercial and industrial towns, but while gaining in prosperity it lost much of its mediæval aspect, and old buildings in the heart of the Altstadt were swept away. The Theaterplatz in the Altstadt is especially fine.

The most imposing churches include the Roman Catholic Hofkirche, built (1739–1751) by C. Chavert, in rococo style, with a tower 300 ft high. It contains a fine organ and pictures, the outside being adorned with 59 statues. On the Neumarkt is the Frauenkirche, with stone cupola rising 311 ft., close to the Altmarkt, the Kreuzkirche, rebuilt after destruction by fire in 1897, also with a lofty tower surmounted by a cupola, and near the



BY COURTESY OF (—) THE GERMAN TOURIST INFORMATION PHOTOGRAPH (1) DEUTSCHE LUFT HANSA (FROM ORIENT AND OCCIDENT)

AIR VIEWS OF DRESDEN, SAXONY

- 1 The city of Dresden, Germany showing the Albertplatz
- 2 The centre of Dresden showing the Elbe River and three of its bridges
The Zwinger, one of the most famous art galleries and museums in

the world with its enclosed court is in the right foreground. The opera house is to the left. Across the open Theater Platz is the former court church, and across the narrow street from this the former royal palace.

Postplatz the Sophienkirche, with twin spires. In the Neustadt is the Dreikönigskirche (dating from the 18th century) with a high pinnacled tower.

The former royal palace in the Altstadt built in 1530-1535 by Duke George (and thus called Georgenschloss), was thoroughly restored between 1890 and 1902, in German Renaissance style. The Georgentor has been widened, and through it, and beneath the royal apartments, vehicular traffic from the centre of the town is directed to the Augustusbrücke. The whole is surmounted by a lofty tower—387 ft—the highest in Dresden. The interior is splendidly decorated. In the palace chapel are pictures by Rembrandt, Nicolas Poussin, Guido Reni and Annibale Caracci. The adjoining Prinzen Palais on the Taschenberg, built in 1715, has a fine chapel, in which are various works of S. Torelli, it has also a library of 20,000 volumes. The Zwinger, begun in 1711 in the rococo style was intended to be the vestibule to a palace, but now contains a number of collections of great value. Until 1846 it was open at the north side, but this space has since been occupied by the museum, a building in Renaissance style, the exterior of which is adorned by statues of Michelangelo, Raphael, Giotto, Dante, Goethe and other artists and poets by Rietschel and Hahnel, and it contains the famous picture gallery. The Brühl palace, built in 1737 by Count Brühl, minister of Augustus II, has been in some measure demolished to make room for the new Standehaus (diet house), with its main façade facing the Hofkirche, before the main entrance there is an equestrian statue (1906) of King Albert. Close by is the Brühl Terrace, approached by a fine flight of steps, on which are groups, by Schilling, representing Morning, Evening, Day and Night. The terrace commands a view of the Elbe and the distant heights of Loschwitz and the Weisser Hirsch, but the prospect has become somewhat marred, owing to the extension of the town up the river and to the two new up stream bridges. The Japanese palace in the Neustadt, built in 1775 as a summer residence for Augustus II, receives its name from certain oriental figures with which it is decorated, it is sometimes called the Augusteum and contains the library. Among other buildings of note is the Hoftheater, in the Renaissance style, built after the designs of Semper, to replace the theatre burnt in 1869, and completed in 1878. A new town hall of huge dimensions, also in German Renaissance, with an octagon tower 400 ft in height, stands on the former southern ramparts of the inner town, close to the Kreuzkirche.

In the Altstadt the most striking of the newer edifices is the Kunstakademie. The Albertinum, which was formerly the arsenal, originally built in 1559-1563, was rebuilt 1884-1889, and fitted up as a museum of oriental and classical antiquities, and as the depository of the state archives. On the right bank of the Elbe in Neustadt stand many administrative buildings. In the suburbs which encircle the old town are to be noted the vast central Hauptbahnhof (1893-1898) occupying the site of the old Bohmischer railway station, the municipal hospital and the exhibition buildings.

The chief pleasure-ground of Dresden is the Grosse Garten, in which there are a summer theatre, the Reitschel museum and a château containing a museum of antiquities, chiefly objects removed from the churches in consequence of the Reformation. Near the château is the zoological garden, formed in 1860. A little south of Dresden, on the left bank of the Elbe, is the village Racknitz, in which is Moreau's monument, erected on the spot where he was mortally wounded in 1813. The mountains of Saxon Switzerland are seen from this neighbourhood, and are much visited in summer.

Art—Dresden owes part of its fame to its splendid picture gallery, founded by Augustus I and increased by his successors at great cost. It is in the museum, and contains about 2,500 pictures, being especially rich in specimens of the Italian, Dutch and Flemish schools. The gem of the collection is Raphael's "Madonna di San Sisto," for which a room is set apart. There is also a special room for the "Madonna" of the younger Holbein. Other paintings with which the name of the gallery is generally associated are Correggio's "La Notta" and "Mary Magdalene," Titian's "Tribute Money" and "Venus," "The Adoration" by Paul Veronese, Andrea del Sarto's "Abraham's Sacrifice," Rem-

brandt's "Portrait of Himself with his Wife sitting on his Knee," "The Judgment of Paris" and "The Boar Hunt," by Rubens, Van Dyck's "Charles I, his Queen and their Children."

Of modern painters, this magnificent collection contains masterpieces by Tefregger, Vautier, Mikart, Munkácsy, Fritz von Uhde, Bocklin, Hans Thoma, portraits by Leon Pohle, Delacroix and Sargent, landscapes by Andreas and Oswald Achenbach and allegorical works by Saschi Schneider. In separate compartments there are a number of crayon portraits, most of them by Rosalba Carriera, and views of Dresden by Canaletto and other artists. Besides the picture gallery the museum includes a magnificent collection of engravings and drawings, arranged so as to mark the great epochs in the history of art. A collection of casts, likewise in the museum, is designed to display the progress of plastic art from the time of the Egyptians and Assyrians to modern ages. This collection was begun by Raphael Mengs, who secured casts of the most valuable antiquities in Italy, some of which no longer exist.

The Japanese palace contains a large public library with about 3,000 mss and 20,000 maps. It is especially rich in the ancient classics, and in works bearing on literary history and the history of Germany, Poland and France. There are also a valuable cabinet of coins and a collection of ancient works of art. A collection of porcelain in the "Museum Johanneum" (which once contained the picture gallery) is made up of specimens of Chinese, Japanese, East Indian, Sévres and Meissen manufacture, carefully arranged in chronological order. There is in the same building an excellent historical museum. In the Grünes Gewölbe (Green Vault) of the Royal Palace, so called from the character of its original decorations, there is an unequalled collection of precious stones, pearls and works of art in gold, silver, amber and ivory. The objects, which are about 3,000 in number, are arranged in eight rooms. They include the regalia of Augustus II as king of Poland, the electoral sword of Savoy, a group by Dinglinger, in gold and enamel, representing the court of the grand mogul Aurangzeb, and consisting of 132 figures upon a plate of silver 4 ft 4 in square, the largest onyx known, 6½ in by 2½ in, a pearl representing the dwarf of Charles II of Spain, and a green brilliant weighing 40 carats. The royal palace also has a gallery of arms consisting of more than 2,000 weapons of artistic or historical value. In the Zwinger are the zoological and mineralogical museums and a collection of instruments used in mathematical and physical science. The Körner museum contains numerous reminiscences of the Goethe-Schiller epoch, and of the wars of liberation (1813-15).

Education—Dresden is the seat of a number of well known scientific associations. The educational institutions are numerous, including a technical high school (with about 1,100 students), which enjoys the privilege of conferring the degrees of doctor of engineering, doctor of technical sciences, etc., a veterinary college, a political economic institution (Geheftung), with library, a school of architects, a royal and four municipal gymnasia, numerous lower grade and popular schools, the royal conservatorium for music and drama, and a celebrated academy of painting.

Music—The orchestra attached to the Hoftheater, founded by Augustus II, became famous throughout the world, owing to its masters, Paer, Weber, Reissiger and Wagner. Symphony and popular concerts are held throughout the year in various public halls, and, during the winter, concerts of church music are frequently given in the churches.

Communications and Industries—Dresden lies at the centre of an extensive railway system, which places it in communication with the chief cities of northern and central Germany as well as with the southeast. Here cross the grand trunk lines Berlin-Vienna, Chemnitz-Görlitz-Breslau. It is connected by two lines of railway with Leipzig and by local lines with neighbouring smaller towns. The navigation on the Elbe has largely developed, and, in addition to trade by river with Bohemia and Magdeburg-Hamburg, there is a considerable pleasure boat traffic during the summer months. Among the more notable industries of Dresden may be mentioned the manufacture of china, of gold and silver ornaments, cigarettes, chocolate, coloured postcards, per-

ceased fire, Napoleon, riding by, half carelessly told them to be open, and one of their first shots, directed at 2,000 yards range against the mass of officers on the sky line, mortally wounded Gen Moreau, who was standing by the Emperor Alexander. A council of war followed. The tsar was for continuing the fight, Schwarzenberg, however, knowing the exhaustion of his troops decided to retreat. As at Bautzen, the French cavalry was unable to make any effective pursuit.

DRESDNER BANK The *Dresdner Bank* was established in Dresden, Germany, in 1872 by a syndicate headed by Eugene Gutmann. It became Germany's second largest commercial bank as the result of a long concentration process, which reached its peak during the banking crisis of 1931-32, when the bank was reorganized and absorbed the *Darmstädter und National Bank*. After the 1932 reorganization, the bank had a capital of RM 150,000,000, most of which was held by the German government. Even though the stock was transferred to private investors in 1931, the *Dresdner Bank* continued to be very closely bound to the National Socialist government.

The assets of the bank increased from RM 2,800,000,000 in 1938 to RM 6,700,000,000 in 1943. More than three fourths of this increase consisted of government securities, which accounted for 53% of total assets in 1943.

The head office of the bank was established in Berlin in 1881. In 1941 the bank had 194 branches and 174 agencies, 82 of the latter were located in Berlin. Particularly before and during World War II, the bank developed an extensive foreign system with branches in a great many countries, including Turkey, Egypt, Czechoslovakia, Poland and Rumania; in addition, it obtained controlling interests in many foreign banks.

The bank had close relations with numerous industrial enterprises. Important firms such as Friedrich Krupp A. G., Robert Bosch G. m. b. H., Rheinmetall-Borsig A. G. and Norddeutscher Lloyd were represented on its board of directors.

The head office of the bank in Berlin was closed in 1945, and its branches in eastern Germany liquidated. In western Germany, its branches were temporarily reorganized into ten independent banks in each province, with new and different names for each; in 1952 they were consolidated into three independent banks, each covering a different section of the country, and interlocking directorates were forbidden. The *Dresdner Bank*, as such, no longer exists. (H. A. Ax.)

DRESS (from the Fr. *dresser*, to set out, arrange, formed from Lat. *directus*, arranged, *dirigere*, to direct, arrange), a substantive of which the most usual meaning is that of clothing or costume in general, or, specifically, the principal outer garment worn by a woman. The verb "to dress" has various applications which can be deduced from its original meaning. It is thus used not only of the putting on of clothing, but of the preparing and finishing of leather, the preparation of food for eating, the application of cleansing and healing substances or of bandages, to a wound, the drawing up in a correct line of a body of troops, and, generally, adorning or decking out, as of a ship with flags. In the language of the theatre the "dresser" is the person who looks after the actor's wardrobe and assists him in the changing of his costumes.

INTRODUCTION

The subject of dress in its currently accepted meaning of clothing is of far wider application than appears at first sight. To the average man there is a distinction between clothing and ornament, the first being regarded as that covering which satisfies the claims of modesty, the second as those appendages which satisfy the aesthetic sense. This distinction, however, does not exist for science, and indeed the first definition involves a fallacy of which it will be as well to dispose forthwith.

Modesty is not innate in man, and its conventional nature is easily seen from a consideration of the different ideas held by different races on this subject. With Mohammedan peoples it is sufficient for a woman to cover her face, the Chinese women would think it extremely indecent to show their artificially compressed feet, and it is even improper to mention them to a

woman in Sumatra and Celebes the wild tribes consider the exposure of the knee immodest, in central Asia the finger tips, and in Samoa the navel are similarly regarded. In Tibet and Tonga clothing might be discarded without offence, provided the individual were tattooed, and among the Caribs a woman might leave the hut without her girdle but not unpainted. Similarly, in Alaska women felt great shame when seen without the plugs they carried in their lips. Europeans are considered immodest in many ways by other races, and a remark of Peshlari is to the point: "Were a pious Mussulman of Pershian to be present at our balls and see the bare shoulders of our wives and daughters, and the semi-embraces of our round dances, he would silently wonder at the long suffering of Allah who had not long ago poured fire and brimstone on this sinful and shameless generation." Another point of interest lies in the difference of outlook with which nudity is regarded by the English and Japanese. Among the latter it has been common for the sexes to take baths together without clothing, while in England mixed bathing even in full costume, is even now by no means universal. Yet in England the representation of the nude in art meets with no reproach, though considered improper by the Japanese. Even more striking is the fact that in civilized countries what is permitted at certain times is forbidden at others, a woman will expose far more of her person at night, in the ball room or theatre, than would be considered seemly by day in the street, and a bathing costume which would be thought modest on the beach would meet with reprobation in a town.

Modesty therefore is highly conventional, and to discover its origin the most primitive tribes must be observed. Among these, in Africa, South America, Australia and so forth, where clothing is at a minimum, the men are always more elaborately ornamented than the women. At the same time it is noticeable that no cases of spinsters are found, celibacy, rare as it is, is confined to the male sex. It is reasonable, therefore, to conclude that ornament is a stimulus to sexual selection, and this conclusion is enforced by the fact that among many comparatively nude peoples clothing is assumed at certain dances which have as their confessed object the excitation of the passions of the opposite sex. Many forms of clothing, moreover, seem to call attention to those parts of the body of which, under the conditions of Western civilization at the present day, it suits at the concealment, certain articles of dress worn by the New Hebrideans, the Zulu Xosa tribes, certain tribes of Brazil and others, are cases in point. Clothing, moreover—and this is true also of the present day—almost always tends to accentuate rather than to conceal the difference between the sexes. Looking at the question then from the point of view of sexual selection it would seem that a stage in the progress of human society is marked by the discovery that concealment affords a greater stimulus than revelation, that the fact is true is obvious,—even to modern eyes a figure partially clad appears far more indecent than a nude. That the stimulus is real is seen in the fact that among nude races flagrant immorality is far less common than among the more clothed, the contrast between the Polynesians and Melanesians, living as neighbours under similar conditions, is striking evidence on this point. Later, when the novelty of clothing has spent its force, the stimulus is supplied by nudity complete or partial.

One more point must be considered there is the evidence of competent observers to show that members of a tribe accustomed to nudity, when made to assume clothing for the first time, exhibit as much confusion as would a European compelled to strip in public. This fact, considered together with what has been said above, compels the conclusion that modesty is a feeling merely of acute self-consciousness due to appearing unusual, and is the result of clothing rather than the cause. In the words of Westermarck "The facts appear to prove that the feeling of shame, far from being the cause of man's covering his body, is, on the contrary, a result of this custom, and that the covering, if not used as a protection from the climate, owes its origin, at least in a great many cases, to the desire of men and women to make themselves mutually attractive."

PRIMITIVE DRESS

Primitive adornment in its earliest stages may be divided into

three classes, first the moulding of the body itself to certain local standards of beauty. In this category may be placed head deformation, which reached its extreme development among the Indians of North West America and the ancient Peruvians, foot constriction as practised by the Chinese, tooth chipping among many African tribes, and wrist compression common in Europe at the present day. Many forms of deformation, it may be remarked in passing, emphasise some natural physical characteristic of the people who practise them. Secondly, the application of extraneous matter to the body, as painting and tattooing, and the raising of ornament into scars often by the introduction of foreign matter into flesh wounds (this practice belongs partly to the first category also). Thirdly, the suspension of foreign bodies from, or their attachment to, convenient portions of the body. This category, by far the largest, includes ear, nose and lip ornaments, head dresses, necklets, armlets, wristlets, leglets, anklets, finger- and toe rings and girdles. The last is important, as it is from the waist-ornament chiefly that what is commonly considered clothing at the present day has been developed.

Setting aside for the moment the less important, historically, of these, nearly all of which exist in Western civilization of the present day, it will be as well to consider that form of dress which is marked by the greatest evolution. It is generally supposed that man originated in tropical or subtropical latitudes, and spread gradually towards the poles. Naturally, as the temperature became lower, a new function was gradually acquired by his clothing, that of protecting the body of the wearer. Climate then is one of the forces which play an important part in the evolution of dress, at the same time care must be taken not to attribute too much influence to it. It must be remembered that the Arabs, who inhabit an extremely hot country, are very fully clothed, while the Fuegians at the extremity of Cape Horn, exposed to all the rigours of an antarctic climate, have, as sole protection, a skin attached to the body by cords.

Dr C. H. Strutt divides clothing climatically into two classes: tropical, which is based on the girdle (or, when the attachment is fastened round the neck, the cloak), and the arctic, based on the trouser. This classification is ingenious and convenient as far as it goes, but it seems probable that the trouser, which also has the waist as its point of attachment, may itself be a further development of the girdle. Certainly, however, in historical times the division holds good, and it is worthy of remark that one of the points about the northern barbarians which struck the ancient Greeks and Romans most forcibly was the fact that they wore trousers. Amongst the most northerly races the latter garb is worn by both sexes alike, farther south by the men, the women retaining the tropical form, farther south still the latter reigns supreme. No distinct latitude can be assigned as a boundary between the two forms, from the simple fact that where migration in comparatively recent times has taken place a natural conservatism has prevented the more familiar garb from being discarded, at the same time the two forms can often be seen within the limits of the same country, as, for instance, in China, where the women of Shanghai commonly wear trousers, those of Hong-Kong skirts. The retention by women in Europe of the tropical garb can be explained by the fact that her sphere has been mainly confined to the house, and her life has been less active than that of man, consequently the adoption of the arctic dress has been in her case less necessary. But it is noticeable that where women engage in occupations of a more than usually strenuous nature, they frequently don male costume while at their work, as, for instance, women who work in mines (Belgium) and who tend cattle (Switzerland, Tirol). The retention of the tropical pattern by the Highlanders is due directly to environment, since the kilt is better suited than trousers for walking over wet heather.

Another factor besides climate which has exerted a powerful influence on dress—more perhaps on what is commonly regarded as “jewellery” as distinct from “clothing”—is superstition. Doubtless many of the smaller objects with which primitive man adorned himself, especially trophies from the animal world, were supposed to exert some beneficial or protective influence on the wearer, or to produce in him the distinguishing characteristics

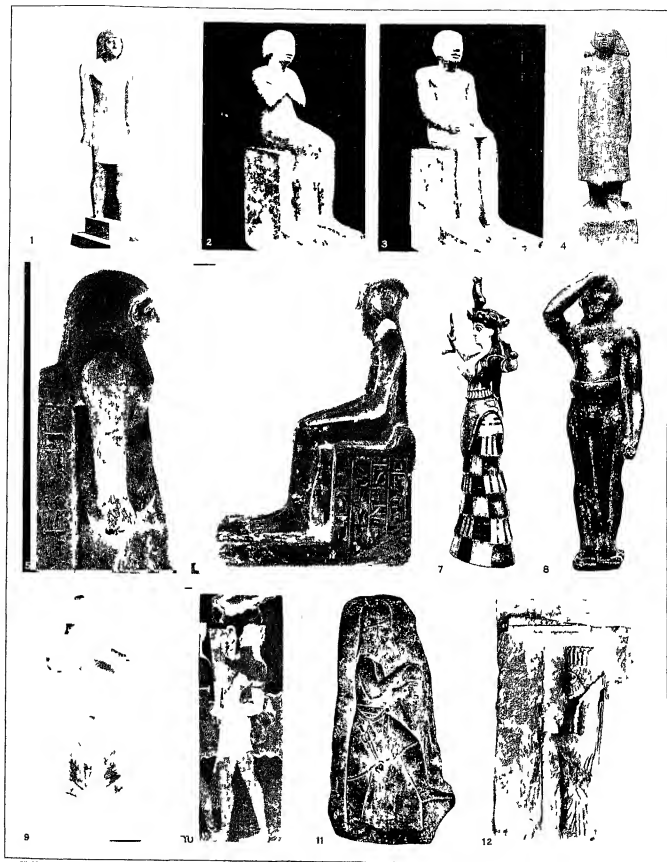
attributed to the object, or to the whole of which the object was a part. Such objects might be imitated in other materials and by successive copying lose their identity, or their first meaning might be otherwise forgotten, and they would ultimately exercise a purely decorative function. Though this factor may be responsible for much, or even the greater part, of primitive “jewellery,” yet it does not seem likely that it is the cause of all forms of ornament. Much must be attributed to the desire to satisfy an innate aesthetic sense, which is seen in children and of which some glimmerings appear among the lower animals also.

See E. Westermarck, *The History of Human Marriage* (London, 1901); R. Coen, *Le Costume historique* (Paris, 1888); C. H. Strutt, *Frauenkleidung* (Stuttgart) (T. A. J.).

BABYLONIAN AND ASSYRIAN COSTUME

c. 3000–2000 B.C.—In Sumerian days (3000–2000 B.C.) Babylonian men wore a fringed garment of wool, known to us generally by the name of the *kamakes* (a graecized form of the classical period); the wool seems to have been unspun, and probably the garment consisted merely of natural locks without the hide. It has been conjectured that *kamakes* of feathers were also worn. One shoulder was generally covered by this garment, the other left bare, but a long and heavy cloak, open in front, was often worn. The feet were bare. Men and women both wore their hair equally long. Men dressed it in a *catogan* or chignon at the back, often with the addition of two plaited tails crossed at the back beneath the chignon and with their ends fastened over the forehead. Women had rather more elaborate chignons, sometimes three, one at the back and two at the sides. Priests had their heads shaven and performed certain rites stark naked, as also did the kings and great men, who on these occasions wore their hair down their backs. Beards were occasionally worn. Large hats with brims indicated a mark of dignity, and were worn by gods and kings. Gods had them adorned with horns. Later on we find the kings and important personages wearing a turban consisting of a round cap with a thick band around it. A tunic, sometimes sleeved, and long robes also came in. Warriors wore conical copper helmets like the mediaeval bassinet, and carried shields and spears, a king could wear a gold helmet made in imitation of his own headress (tomb at Ur) and use golden swords and javelins. Copper breast-plates may also have been used. Feet were generally bare, but in later days in Assyria sandals and elaborate high boots were worn. A cylinder-seal of stone was carried, fastened to a great pin with lapis lazuli and round gold head, and used to fasten the garment. It was also used as a stiletto, if needed. Large-knobbed walking sticks were always carried. Herodotus correctly describes the seal and stick carried by every Babylonian. Daggers had often gold and lapis hilts, sometimes even gold blades in early times. In later days the well-known Assyrian “Tara” with its spike was worn by the kings, the bull horn headress was given to gods. The heavily ornamented robes of the Assyrian period were well known, the enormous earrings and necklaces, the elaborately curled hair and beards of the Assyrian have been familiar to us since the days of Lyrd. The war-gear of the later period shows, of course, the development from copper to bronze and then to iron weapons: the helmet taking the characteristic Assyrian peaked form, and in the 7th century it is crowned with the Graeco Carian crest adopted from the West. Great round shields were carried and hauberks worn of metal plates or scales sewn on leather.

We have so few representations of Babylonian or Assyrian women, other than goddesses (who wear long flounced robes) that it is almost impossible to say much of their costume. In the early period one sees them wearing a modification of the men's *kamakes*, with hair rather more elaborately dressed than the men's (see above) and ornamented with nodding balls or flowers of gold and lapis on a comb-like ornament that was stuck into the *catogan* with a sharp ended shank. Later on they wore a shapeless robe, with the hair usually “down.” Assyrian women wore earrings of great length and weight like the men's, and other ornaments like theirs. The Ur excavations have shown that the Sumerian women of 2,000 years before already used “unity-cases” of gold, with tweezers, earpick and head-scratcher complete.



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

EGYPTIAN, CRETAN, PERSIAN DRESS, 27TH TO 5TH CENTURY B C

1 Male dress Vth dynasty (c 2600 B C) 2 and 3 Male dress XIIIth dynasty (c 2200 B C) 4 Male dress XIIIth dynasty 5 Male dress XIIIth dynasty (c 2000-1800 B C) 6 Female dress, XVIIIth dynasty (c 1650-1600 B C) 7 Cretan (Minotaur) priestess or serpent goddess Knossos (c 1800 B C) 8 Cretan male costume 18th-17th centuries

9 Cretan female costume 18th-17th centuries 10 Cretan male costume 17th-16th centuries "The Cup bearer" fresco Knossos 11 Persian costume, 6th-5th centuries Persepolis 12 Persian warrior one of the "Immortals, 6th century Persepolis



BY COURTESY OF THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM

ENGLISH DRESS, 16TH TO 18TH CENTURY

- 1 Coat and trunk (1681) made for Sir Thomas Isham's wedding but never worn. The drab coloured silk brocade is woven in silver gilt thread and cream coloured silk.
- 2 Lady's dress and petticoat (early 18th century) of coffee-coloured silk embroidered with coloured silks.
- 3 Back of lady's dress: Elizabethan (1558-1603). The silk brocade is woven in colours on a cream coloured ground and slashed.
- 4 Man's coat: early 16th century.
- 5 Glove said to be of Henry VIII's era, but possibly of James I's as suggested by the style of decoration and the alternating thistle of Scotland and rose of England. The satin cuff embroidered with coloured silks, silver gilt thread and seed pearls, is fringed with gold and silver lace.
- 6 Shoe and clog (early 18th century) silk damask and brocaded front.

The Persians wore as court dress a modification of the Assyrian gear including the turban and curled hair and beard. Their native headdress was a "Phrygian" hood, sometimes worn with a veil or scarf across the mouth to keep the dust out, like the *litham* of the Turke. Small felt hats, square topped or round, were worn as their descendants are to this day, a waistied tunic and gaily coloured pyjama trousers confined at the ankle, were characteristic of the Persian male costume, so far as it was not influenced by that of Mesopotamia.

In later times in Persia we find the Sassanian kings wearing a development of the old Persian dress, with high tunics and many chaplets and necklaces of beads, earrings, etc. The hair was worn very bushy, over the shoulders, this was characteristic of the men. We know little of what the Persian women wore.

MINOAN COSTUME

The Bronze Age in Greece—From the contemporary representations of the men and women of the Bronze age in Greece we can gather a very good idea of their costume. The men wore a very scanty dress, considering the fact that in winter and in the mountains everywhere in Greece the climate is sometimes cold. It consisted principally of a waistcloth tightly folded round the loins, sometimes with the addition of a conspicuous sash or sash or cord for the penis, and confined at the waist by a large and very tight belt. Naturally the Cretans have unusually small waists, a characteristic of the race to this day. This seems, judging by the universal testimony of the statues and wall paintings, to have been artificially accentuated from youth by tight belting, so that the men appear with waists like wasps. It



FIG. 1—PRINCE AND THE WARRIOR
WARRIOR VASE HAGIA TRIADA

even seems probable that in the case of the young men the belt was of metal, riveted on the boyhood, and retained till manhood, so that the young men had waists artificially constricted to the size of those of small boys. In mid age it would seem that this ring was removed, and the body eventually assumed a normal form. Statuettes of older men show them as somewhat obese. The women often wore the same constricting belt when young. In form it was generally bevelled. Over the tight waistcloth was worn a kilt, in court dress apparently ornamented by a hanging fringe of network (Knossos frescoes, etc.). This kilt, sometimes with the sheath showing, is carefully represented in the Egyptian wall-paintings of the Kestian ambassadors to Egypt in the time of the XVIIIth Dynasty (see Egypt). It was gaily ornamented with zigzag and other patterns, thus contrasting vividly with the white kilt of the Egyptians. Sometimes this kilt is of considerable length, reaching to the calf of the leg, at other times it, or a development of the waistcloth resembling our bathing-drawers or

at the waist like those worn by the priestesses, and usually white. Normally the men wore the hair unshorn, and falling loose to the waist or below it on the top of the head it was done up into fantastic knots or curls (horns) which were carefully represented by the Egyptian artists in characteristic fashion evidently dictated by various modifications of this hair dressing, more or less elaborate. Sometimes part of the hair was piled up in coils on the top of the head, while the rest hung loose about the body (Typhos figure, Knossos frescoes, etc.).



FIG. 2—DRESS OF A
GREEK WARRIOR IN PRO-
CESSION ON WARRIOR
VASE MYCENAE

Some times, in the case of warriors, it was all knotted up in a "bun" or chignon at the top or back of the head like that of a Sikh. At other times it was twisted (plaited) in a pigtail (Knossos relief vase) or simply tied behind at the neck in 18th century fashion (Vaphio cup) or confined by bands or skirts at the top or sides or back (Chieftain vase). A fresco (unpublished) in the Ashmolean Museum shows it tied up in three separate bunches, one at the back of the neck, one at the top of the head and the third over the forehead. Hairdress was not common, but we have representations of a broad-brimmed hat, the late Greek *petasos* (Leiden Museum, fig. 4), and of small round caps evidently concealing a topknot. A god (?) can wear a turban, or is shown wearing a high headdress of peacock (?) feathers (Knossos fresco). Metal helmets of Roman rather than of Greek form, with a domed crown, ear pieces and with a knob at the top were worn, sometimes with the addition of nodding crests, the forerunners of the *adspers* of later days. The hair is sometimes invisible, being evidently knotted beneath the helmet, or is shown falling down the back, when it is worn (gladiators vase). We have representations of cuirasses on the clay tablets, but usually armour does not appear, or was perhaps of a laminated type like that worn by the Philistines, Shardana and other "Peoples of the Sea" in the Mediterranean area at the end of the Bronze age. The shield was of a peculiar double shape like the figure 8, and reached from ankle to neck, replaced by a smaller round shield at the end of the period, which was of non-Minoan (probably central European—Hellenic) origin. The usual weapons were a rapier like sword with decorated hilt, though rarely (Mellin) a great broadsword appears (typical of the Philistines and Shardana later, like the round shield and laminated body armour), daggers, and spear-heads of a peculiar rounded form somewhat resembling the medieval Japanese, bows and arrows with barbed metal heads, and slings were also used. The Cretan slingers were always renowned. The "Peoples of the Sea" who overran the Minoan lands at the end of the Bronze age, coming perhaps from Europe, perhaps (or partly) from the Caucasus by sea, were characteristic headgear of their own, the Philistines a high feathered cap, the Shardana a round helmet with crescent and ball as insignia. They may have shaved their heads or worn short hair, as it is never shown long in the Minoan and the (shorter) early classical Greek (Iron age) fashion. The kilt was common to them as also to the Hittites of Anatolia.



FIG. 3—MINOANS IN THE TOMB OF
USER ANON WITH MINOAN BULL
RHYTON AND STANDING BULL

During the early classical period, Greek men wore their hair long, but not so long as the Minoans. Generally reaching the small of the back, it was worn either hanging in loose ringlets (sometimes with a band at the neck), or else braided in two plaits that were wound round the head (we have no instance of this fashion in Minoan times), rolled round a headband, or knotted in a *κροσίδας* at the back of the head. Short hair did not come into fashion until the second quarter of the fifth century, after the

puttees, or high boots like those still universally worn in thorn and stony Crete, of soft white leather. The arms and neck were decorated with bracelets and necklaces of gold or silver, or stone and *kyanos* (glass heads). Then, next to the narrow waist, the most characteristic note of Minoan male costume, the hair, was evidently worn at its full natural length. Occasionally it is seen cut short, but this would seem to be so only in the case of mourning men and priests, the latter seem to have worn long robes, confined

Persian wars, and then was retained (except, as now, in the case of priests) for 1,000 years, throughout the classical Greek and Roman periods until the fall of the Roman Empire, when the "barbarian" fashion of long hair came in again. A difference between Minoan and classical Greek costume is seen in the fact that the early Greek men often went more or less naked, they habitually exposed their persons in a way that the Minoans never did. We have only one certain representation of a naked Minoan, and he is swimming, and one doubtful, the "Blue Boy" or saffron gatherer on a fresco from Knossos. There is none of women (see below). Women's hair in the early Iron age was always worn hanging, in tresses, over the shoulders, sometimes confined at the neck by a band. (For classical Greek dress see section "Greek and Roman.")

Minoan women wore a heavy petticoat-like skirted and flounced garment reaching the ankles and a sort of short sleeved "zouave" jacket, sometimes with a tight belt like the men. This dress was gaily ornamented with patterned designs. The flounces of the skirt make it resemble curiously the fashionable European skirts of the '70s and '80s.

Boys were exposed or protected by sheaths. But no representation of a nude woman exists. A cloak with a high "Mediterranean" collar behind is represented. On the head are various forms of headgear, some times a high blunted conical *polos* (Knossos), sometimes a sort of flat turban. Generally the hair flowed loose, but is always represented as clipped considerably shorter than that of the men, which must have been unshorn from childhood, judging by its length, the hair of the women rarely reaches the wrist. It is not often knotted up or entirely concealed beneath the head-dress. Bare heads were perhaps rare in the case of the women until the Late Minoan period (c. 1500 B.C.) when we see a court fashion of bare heads with the hair partly knotted behind, partly falling at the sides in comparatively short curls, the fashion much resembling that of the ladies of the courts of Louis XIV and Charles II, with perhaps a touch of the French Second Empire coiffure associated with the Empress Eugénie (Knossos frescoes). With this golden diadems were often worn, of a type resembling those of classical times (*ibid.*, Mycenae, Tiryns frescoes). Necklaces of gold, lapis and glass of the peculiar Minoan blue (*kyanos*), were of course worn, and possibly ear-rings by the women. We have only one representation of a man wearing ear-rings, and that is doubtful (cupbearer fresco, Knossos). Egyptian and Asiatic men and women both wore ear-rings and ear studs, the Egyptians from about 1500 B.C., and not before. Elaborate gold hairpins were used by the Minoan women, golden hairpins of simpler form also by the men, as we see from their discovery with weapons in tombs of men at Mycenae. They would of course be as necessary for the heavy male coiffure as for the women's hair. The women's shoes are rather a doubtful point, probably their feet were usually unshod. Priestesses were long walked robes which were also worn by priests, apparently, or temple-musicians of the male sex, as in Lydia. When they participated in the games, as in the religious sport of the bull-leaping (*tauromachia*) the girls wore the young men's dress of tight belt and waistcloth (Knossos fresco, etc.).

Generally we know more of the male costume than the female, owing to the greater number of representations of men, and the fact of their double costume, for war as well as peace. At present it is difficult, except in the case of the women, to confine certain costumes to certain periods, as our knowledge increases it will be possible to do this as accurately as we now can do it in the case of the Egyptians, with our much greater Egyptian material.

The female costume is even more unlike that of classical times than the male, though in the Early Iron Greek age women still

wore a full skirt tightly confined at the waist, just as the men often wore a tight belt round the waist in the Minoan fashion, but without any clout or sheath.

We have practically no representations of children, so cannot say whether their costume differed in any notable way from that of their elders. An ivory figure of a boy god is shown with hair long, flowing from beneath his tiara, but much shorter than that of the men. He wears the tight waist belt. A head of a boy on a sealing has short hair.

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EGYPTIAN COSTUME

Until the 18th Dynasty men in the way of costume wore a simple white kilt, which under the 12th Dynasty was often made very high, so that it began almost immediately under the armpits. It was often starched and stiff in the case of persons of some rank. Kings wore more particularized garments, of the same general type, in archaic days unconventional clothes were apparently worn by them, which later fell out of use. In early days the natural hair was worn long, and the kings kept it in a linen bag of characteristic shape, to exclude the dust, with a pigtail behind, which in later times was retained as a specifically royal head-dress, pigtail and all, although the head was usually shaved and a short wig worn. Wigs were probably introduced very early, and it may well be imagined that the discomfort of thick and long hair in the Egyptian climate conducted to their invention. We certainly find them in use as early as the Old Kingdom, and a fringe of false hair was found in a 1st Dynasty tomb at Abydos. Under the 4th and 5th Dynasties a short wig of curls cut step wise was popular, wigless heads are rare. Under the 18th, we have at the British Museum two companion figures of a noble wearing each a different type of kilt, and one a short wig, the other a skullcap. Under the 12th Dynasty the hair was kept short close to the skull rather than shaved, and the wig was of a longer and very conventional type, men are often represented without it. Under the 13th Dynasty the wig grows longer still, and either it (or possibly the natural hair?) is dressed in three masses, one over each shoulder, the third down the back, something like contemporary female fashion (see below), but not plaited.

Under the 18th Dynasty the long natural hair was commonly worn again, sometimes simply parted in the middle and combed down over the shoulders, but far more usually surmounted by a short wig, so that we see the natural hair falling in front of the ears to the level of the chin or shoulder, while the short artificial wig above it is cut off diagonally across the ears, and forms a square fringe of curls in front. Many men however undoubtedly shaved the head, as of old, and wore nothing but a wig, usually imitating the combed wig and long hair fashion, the shoulder locks being stiff curls as artificial as the rest. In the Ramesseid period all men of position appear to have shaved the head and

to have worn wigs of this type, priests now usually wear no wig.

This fashion now became universal. Under the Bubastites the "step" form, which had continued sporadically since the time of the Old Kingdom, came in again generally. Under the Saites at first a modification of the Ramesseid wig, later a full rounded form was used besides the archaic "step" form. Under the Ptolemies and Romans Egyptian men seem to have generally dispensed with wigs, appearing always with carefully shaven crowns. Boys at all times preserved the ancient juvenile fashion of shaving only part of the head, generally the left side, and wearing a single thick plait of their own hair over the right ear, hanging below the shoulder, wigs were an attribute of manhood. Royal princes of mature age wore an intimation of this lock to indicate their filial relationship to the king and a particular rank of priest wore it combined with a short wig over the rest of the scalp,



FIG 4—BRONZE FIGURE OF A YOUTH WEARING A PETASOS (HAT)



FIG 5—SHABANA GUARDS WITH BROADSWORDS



AMERICAN DRESS, 18TH CENTURY

The Washington Family Engraved by Edward Savage after his own painting. The powdered wig, high stock, jabot and powdered hair of the men, the high collar, elbow sleeves and the high-waisted and frequently powdered hair of the women are characteristic features.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART



BY COURTESY OF (1) 4) 5) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM (2) 3) THE METROPOLITAN MUSEUM OF ART, NEW YORK

WOMEN'S DRESS, 18TH AND 19TH CENTURIES

- 1 Lady's dress of Chinese painted silk, England. The period is the second half of the 18th century
- 2 An American 19th century dress (1810) of checked blue silk
- 3 An American 18th century dress, Robe à la Française, of flowered yellow silk
- 4 Late Victorian dress (1880) made of silk with flounces of tassled trimming
- 5 Gold gauze dress of the era of George IV (1820-30)
- 6 Victorian dress (England c. 1865-70). This evening gown of silk gauze shows the pelonage and the fringe trimming of the period



TRENDS IN WOMEN'S DRESS—EARLY 20TH CENTURY

and 3 1900 The S curve was built in and skirts swept the floor; day and evening trimmings were profuse. The tailored daytime dress with short position back jacket, tight fitting sleeves and shirtwaist was trimmed with velvet, beading embroidery buttons and braid.

4 1900 For evening, the same S curve, the skirt a bit more sweeping than for day. An extreme décolleté, lace edged chiffon flou, lace strips in the brocade skirt and a jewelled buckle on the velvet belt.

5 1910 Hats overturned into massive inverted buckets, as this black tulle

over white lace designed for late summer.

5 and 6 1910 Skirts slowly straightened and became a bit shorter. By 1910 they began to clear the ground (fig 6) and at one point shrank into the hobble skirt. The waistline loosened, shoulders sloped.

7 1910 Heavy beading and metallic embroidery on net became the evening fashion, often topped with a beaded or feathered headress. The décolleté less extreme, sleeves almost always present, even for evening







TRENDS IN WOMEN'S DRESS AT MID-20TH CENTURY

- 1 1947 The first important post World War II change: Dior's New Look with rounded shoulders and hips billowing skirt and hemline averaging 14 in. from the floor. Here a black wool suit with tight bodice, puffed in waist and padded hips
- 2 1948 The great bouffant ball dress an inevitable release after wartime fashion restrictions. A Dior model using layers of white tulle and
- 3 1951 The "moodle" saffron and stiletto eye make up
- 4 1951 Fitted coat in shaggy wool by Hattie Carnegie
- 5 1950 Dior model with oblique side swiping scarf out in one with the jacket and a skin tight skirt

through a hole in which the plait emerged, as a religious vestment Caps, or hats, except occasionally a light skull cap, were not worn till Roman days. Peasants habitually wore their natural hair more or less long, and usually worked naked or with but a close fitting waist cloth, as they do to-day. Under the 18th Dynasty men's dress became more elaborate, over the waist clout or kilt a long linen robe was worn, carefully fluted or gauffed, depending from just below the navel, while a cape or semi sleeved jacket of similar material covered the shoulders.

Necklaces were worn more commonly than before, and such things as bangles, while ear-rings or ear-studs were now introduced from Asia and were worn after the middle of the dynasty as ordinarily by men as by women. The studs (of rosette shape) were large and made a great hole in the lobe, which is always indicated in the statuary of this time, and found on the mummies. Later on, after the 20th Dynasty, these great ear-studs were no longer worn by men, and after the 22nd women also seem to have given them up. But small ear-rings were certainly worn by men as well as by women under the Sates, though the piercing of the lobe necessary for them was not noticeable enough to be represented in the statues. Shoes, or sandals of reed or palm-fibre were now usual for the better classes, earlier the feet had always been bare.

The elaborate dress of the 18th Dynasty persisted with little alteration till Ptolemaic times, although under the Sates men are often represented archaically as wearing only the kilt, as under the Old Kingdom. In Roman times a new fashioned garment with *dagged* borders leaving one shoulder bare, was introduced. The royal crown proper , which remained the same from the 1st Dynasty till Roman times, was composed of two parts, , the upper, white, for Upper Egypt, and , red, for Lower Egypt. A peculiar blue royal helm, , was introduced under the 18th Dynasty.

Women—The early dress of women was a close-fitting garment, often blue, with a yoke over the shoulders and a "hobble" skirt. Wigs were early worn over the natural hair which is shown parted in the middle beneath it in a 4th Dynasty statue in the British Museum. Except under the 13th Dynasty, when the men's coiffure was as long as that of the women, the women's wigs were always longer than the men's. Under the 12th the hair, real or false, was worn in a peculiar style, in two masses, bound with gold, and turned up and outwards at the ends on the breasts. These masses were mostly of small plaits. This coiffure continued till the 18th Dynasty, when it was succeeded by a more flowing coiffure of plaits and curls. Certainly women sometimes had shaven heads beneath their wigs like the men, but the natural hair was no doubt commonly worn long by them, whereas it never was by the men.

After the pre-dynastic period except possibly under the 13th and certainly under the 18th Dynasty. Towards the end of the 18th Dynasty fashionable women took to exposing their shaven polls, which they never had done before, dropping the use of the wig altogether. Queen Nefertiti wore a high cap or *polos* on her shaven crown, with *mfu* or ribbons hanging from it behind, but her daughters are represented with shaven, and what is more, deformed skulls, it is evident that the practice of elongating the female skull in childhood rather on the style of the Botocudos Indian of Brazil, the Incas or the Solomon Islanders, was fashionable at the 'Amarra period. This fashion seems not to have persisted for any length of time, but the royal women



BY COURTESY OF SIR F. PETRI AND OF THE TRUSTEES OF THE BRITISH MUSEUM
FIG. 6.—THE HEADRESS OF A PHILISTINE

certainly continued to shave their heads, and go without wigs, in order to wear certain headresses with convenience, for a long time afterwards. The female mummies of this and later time usually exhibit a mixture of real and false hair when the "hair" is not wholly a wig. But one woman, an unknown person buried in the tomb of Amenhotep II., has very long natural hair. Small girls often wore part of their natural hair plaited at the side to signify youth like the boy's sidelock, or even often had their heads partially shaved in complete imitation of the boys. The older tight dress which we see represented till the end in the case of goddesses, gave way under the 18th Dynasty to a more gracious costume of gauffed linen, on much the same lines as that of the men, but of a more flowing and robe like character. Particoloured robes are worn by queens. Necklaces, ear studs, sandals, etc., are the same as the men's, though the women do not wear sandals so often as the men. This general costume continued till the end, when colours came in, in the late Roman period elaborately patterned caped or shawled garments were worn. Women often seem to have worn a lily on their heads, and both sexes at festivals were fond of placing a lump of highly scented unguent on the head, which is carefully represented in the tomb paintings and stelae. In Roman times women (and men at feasts) wore large wreaths, Greek costume was then no doubt largely worn by both sexes. Otherwise only the queens wore anything in the way of a headress (see above). (H R H)

GREEK AND ROMAN

Sources of information about the dress of the ancient Greeks and Romans are to be found in their literature, their sculpture and their painted vases. Existing examples, though mostly provincial and late in origin, are also of some historical interest. In primitive times, among both the Greeks and Romans one voluminous cloak was thought sufficient dress for a man, and even in later times it was the only garment regarded as indispensable. A tunic or shift was nevertheless worn by men, women and children. At first it appears to have been sleeveless, but individual fancy and variations due to colonization or conquest caused much diversity in apparel. Among the Romans the tunic was often ornamented. The *tunica palmata* was worn at triumphs. Men of senatorial rank wore a tunic with a double stripe in purple down the front (*tunica laticlavata*). Knights had a narrow stripe from each shoulder downwards (*tunica angusticlavata*). In this latter form the tunic went into common use. A man's linen tunic of Graeco Roman times from Egypt has the two purple stripes as well as double sleeve bands. Other tunics found in Egypt were more richly adorned. One for a child has in addition a roundel on each shoulder, and two others both on front and back. In course of time the simple slit for thrusting the head through was shaped or cut away in front. Two tunics were sometimes worn, as time passed (and probably always among the peasantry) no other garment was considered necessary.

The cloak, worn over the tunic, varied much at different times and places. Among the Greeks it usually took the form of a large oblong cloth wrapped about the body so as to envelop it from the neck to the ankles. The Romans used a similar garment, known as the *pallium*. But the distinctive Roman cloak was the toga, a large cloth in the form of the segment of a circle (rather less than a semi-circle) worn with the straight side uppermost. One end came forward over the left shoulder reaching nearly to the ground. The garment was then passed round the back, over (or under) the right arm, and across the front, the other end being thrown over the left shoulder to fall behind. There were variations in manner of wearing and in shape according to time and place. The toga was laid aside when there was work to be done. In later times it became a ceremonial garment, gradually losing its amplitude until it was no more than an ornamental band worn over the shoulder by certain officials. A few shreds of men's and women's garments, too incomplete to betray their form, have been excavated at various times from Greek graves of the 3rd to the 5th century B.C. in the Crimea. They are chiefly of wool, though linen has been found (see TEXTILES AND EMBROIDERIES). Though apparently Greeks and Romans both favoured undyed wool for garments, these specimens from the Crimea



FROM MONUMENTI ANTICHI BY PERMISSION OF THE DIRECTOR OF THE REGIA ACCADEMIA DEI LINGUE
FIG. 7.—SIDE OF THE PAINTED POTTERY LARNAX FROM CRETE

are mostly coloured (generally purple or green). Some are plain or striped, others have woven, embroidered or painted designs. The ornamentation includes deities, figures on horseback, chariots, birds, vines, honeysuckle and scrolls.

In Græco Roman Egypt the cloak is oblong, and often of ample dimensions. It is variously ornamented, with figures, animals, birds, fishes, trees, plants, foliage and conventional patterns. The Roman cloak was put to a variety of uses. It might be spread over a bed or couch or laid on the floor. It served also as a shroud for burial.

Those found in Egypt have all been used at last for enveloping the dead. The tunic and the cloak were the chief garments of Greek and Roman times, but various others were also worn in different places and on particular occasions. One among them, the *chlamys*, may be mentioned. It was a kind of short mantle or scarf, apparently more ornamented (as a rule) than the large cloak.

In shape it seems to have been either a narrow oblong or the segment of a circle. The garments of the Greek and Roman women were more voluminous than the men's, but otherwise they did not differ greatly in classical times. Instead of the toga, women wore the *stola*, with the *pallium* over it. Men often went barefooted, but leather or wood sandals and buskins were worn. Women wore shoes, and carried fans and parasols. Knitted socks, and knitted or netted caps, hair nets and bags have been found in abundance in Egypt. Caps of fur and leather, and broad brimmed hats, were worn on occasion. Brooches, clasps and girdles were used, especially by the women, but the skill of the wearer in adjusting the cloak seems to have been chiefly relied on for keeping it in position.

MEDIAEVAL AND MODERN

The tunic and cloak, which were the principal garments worn in Greek and Roman times, continued to hold their place, with modifications, for many centuries. As the tunic became the chief garment, it was sometimes elaborately decorated. One early Christian writer speaks of people wearing garments on which animals, forests, mountains or huntsmen were figured, while on others were biblical scenes. Late pagan and early Christian garments, found in Egypt, have ornamentation of this nature.

Mediaeval.—At the time of the Norman conquest of England the dress of men and women consisted of a couple of tunics and a loose cloak. The chief innovation was the tight "chausses" or hose enveloping the legs, in classical antiquity trousers were a barbarian garb. From the two tunics were evolved the jackets, pourpoints, jupons, jerkins and doublets of later times, and from the short cloaks the various over garments, often taking fanciful shapes in the middle ages. Patterned materials were often used, though apparently not quite so much as they were afterwards. It is probable that the initials and devices personal to the wearer, seen in the 14th and 15th centuries, were for the most part of embroidery. They might occur once on the sleeve or shoulder, or they would be powdered over the whole garment. The large painted portrait of Richard II of England in the sanctuary at Westminster Abbey shows his robe powdered with crowned Rs and presumably the letters sometimes to be seen on the dresses of unidentified individuals in paintings and tapestries had a personal significance. Another portrait of this king, on the celebrated diphych in the possession of the earls of Pembroke at Wilton, shows his mantle covered with crouching hirs. The white hart was his personal badge and again it explains other instances of such devices, though it should be remembered that fanciful representations of this kind formed part of the general repertory of the pattern designer in mediæval times. By the middle of the 15th century, rich velvets, with variations of the lobed "Gothic" pattern, often interwoven with gold thread, were much used for costume among the well-to-do.

Only a summary statement of the changes which dress went through during the middle ages and later times can be given here. The following outline has more particular reference to England, but generally speaking it holds good for western Europe, and (where applicable) to America. Some developments might occur

earlier in France or Italy, where many fashions originated, and they would tend to survive later in the north.

What may be described as "tailoring," as distinct from drapery, comes into notice about the end of the 13th century. Garments then began to be shaped more to the body, leaving less liberty of adjustment to the wearer. In the latter part of the 14th century "dagging" (the cutting of the edges of the garments into fanciful shapes) takes an exaggerated form, which it keeps for half a century or more.

For head-coverings the plain white wimple began to give way, towards the end of the 14th century, to elaborate head dresses—the horned, the mitre, the turban—culminating in the fantastic steeply peaked head dress or "henmin" of the later 15th century, from France. In the 14th century men wore a kind of hood turned sideways on the head. This was followed by a closefitting cap which, towards the third quarter of the 15th century, was heightened so as to resemble the Turkish "fez" after which it became lower and flatter.

Shoes, which in early times were for the most part of fur or leather, tied by thongs round the instep or ankles, gradually took form with sole and uppers approximately more or less to the shape of the foot, until in the 14th century a tendency to bring the toes to a sharp point is noticeable. In the later years of this century the uppers were sometimes pierced in fanciful shapes. Chaucer refers to this practice when he speaks of the priest abbot having "Paul's windows carven on the soles." Shoes with Gothic tracery over the instep were shown in the wall paintings representing King Edward III and members of his family, formerly in St Stephen's chapel at Westminster. At the end of the century the shoes of Richard II are covered with quatrefoils and discs. The "Cracove" or "poulaine," from Poland, with pointed toes of greatly exaggerated length, then followed, until at the end of the 15th century the fashion ran to the opposite extreme.

16th and 17th Centuries.—In the first half of the 16th century took place the meeting of the French and English kings at the "Field of the Cloth of Gold." This phrase only reflects general tendencies of the time, when fashionable men's clothes were loaded with jewels, and they are said to have spent their fortunes upon their clothes. Early in the 16th century the hose were divided into stockings (*bons de-chausses*) and trunk-hose (*haut-de-chausses*). The trunk-hose went through various phases, looser or tighter, shorter or longer, following caprice rather than any progressive evolution.

The slitting of men's sleeves at the elbow or shoulder, to display the garment underneath, was not unusual in the 15th century, but "slashing" in small parallel cuts is a feature of the next century. By the time of Charles I the slashes became long slits, sometimes extending for practically the whole length of the sleeves, before disappearing altogether. In the latter half of the 16th century men's garments began to be "bombasted" with cotton-wool, hair or sawdust. They form a contrast to the dress of Van Dyck's sitters a few years later. The air of elegant refinement, which must have been due in some degree to the dress itself, is so noticeable in this artist's portraits, that far on in the following century painters would endeavour to recapture some of this glamour by representing their sitters in similar garb. Women's farthingales, in the latter half of the 16th century, extended their skirts to very ample size. The euphuism of the time is reflected in dress, and exaggerated conceits form the subject of embroidery. In a portrait of Queen Elizabeth in the possession of the marquis of Salisbury at Hatfield house, her cloak is embroidered all over with human eyes and ears which, with a serpent on the sleeve, betokened the vigilance and wisdom of the wearer. A more restrained type of ornamentation, chiefly used for linen garments, such as tunics and men's and women's caps, was done entirely in black silk thread. Hence it gained the name of blackwork. It is said to have been brought to England by Catherine of Aragon. Naturalistic flowers were a favourite motive, but badges, rebuses, book illustrations of enigmatic import, and all kinds of fanciful conceits were also included. As time went on, richness was added by the use of heavy gold thread for stems and other details, and later in the century bright colours replaced the black.

In this form, chiefly for floral patterns, it survived well into the 17th century.

The development of the frill at the neck into the great starched and pleated ruff, with its supporting standard, is a noticeable feature of the time. Completely encircling the neck at first, towards the end of the 16th century it was sometimes worn open in front. Soon afterwards it was replaced by the falling collar, but the encircling ruff and the open ruff were still worn well into the 17th century, as so many Dutch portraits bear witness.

Brims are added to men's caps early in the 16th century, and modifications rapidly succeed one another. In the second half of the century men and women wore higher and stiffer head dresses. The 17th century brings in the "steeple" hat, and then the leather hat with broad brim and feathers. The broad-toed shoe with parallel slits or slashes is followed by a shoe in which the luting at the heel begins. A solid corked sole comes first, then a space is cut through under the instep, to be followed by a separate heel piece.

Children's portraits show that it was customary to dress boys and girls, even those of a tender age, very much in imitation of their elders.

About 1660 an important change took place in men's garments, when coat and vest were first evolved as distinct garments in France. This fashion was carried to England by Charles II. At first the vest was long, reaching to the knees and sleeved. The coat was slightly longer.

The coat and waistcoat of the present day are directly descended from these garments.

The trunk hose are full, though very soon after they might have been worn narrower, anticipating the buckled knee breeches of the 18th century. About this time, instead of the natural hair falling to the shoulders, men took to wearing the large periwigs so characteristic of the portraits of Louis XIV and his contemporaries, at the end of the century they tower over the brow, giving added height to the wearer. Cravats, often of rich lace, now replace the falling collar. A notable fashion originating in France took its name from the battle of Steinkerke, fought in 1692. The French officers dressing in haste, it is said, tied their fine lace cravats loosely about their necks. This fashion spread to other countries, both for men and women, and lasted some years.

Women's skirts were full at this time, and bodices were laced in front, sometimes with an embroidered stomacher. Hat-brims were now cocked, developing at the end of the century into the three-cornered hat.

Muffs were carried both by men and women in the 17th century, and in various forms they continued in use by women well into the present century. Gloves first became conspicuous in the 16th century, when they were often elaborately embroidered and sometimes embellished with pearls and jewels as well. In the 17th century, when the frill at the wrist gave place to the turned-back linen cuff, large gauntlets were added to the gloves, giving scope for embroidery in the style of the time. A pair of gloves was a customary gift at the New Year, and pains were taken to render them worthy of acceptance. Such gloves were usually of leather, but subsequently various lighter materials were used, and gloves might reach beyond the elbow when sleeves were short.

18th Century—At the beginning of the 18th century the skirts of men's coats had become fuller and the sleeves had wide cuffs. The sleeved waistcoat was shortened, and at times it was richly embroidered. In course of time the sleeves disappear. As the century advances a distant approximation to the frock-coat of later times is discernible, but the materials continue to be rich. Velvet, often woven in tiny diaper patterns, was much used. When the material was plainer, elaborate embroidery in silk, often embellished with glass pastes and spangles, was usual for fashionable dress. During the course of the century, the skirts of the coat and the corners of the waistcoat were cut away in front, reducing the form more nearly to that of morning-dress of the present day.

Embroidery was used for ladies' dresses, especially for the

underskirts rendered visible by the open front of the dress. The silk brocades of Lyons or Spitalfields, with floral patterns in bright colours, came into use. Indian dyed or embroidered cottons, and Chinese painted silks, witnesses to the growing commerce between the maritime nations of Europe and the far east, were made into dresses, causing much searching of heart among weavers at home, who succeeded in getting restrictive enactments put into force. Towards the middle of the century skirts became very ample, being supported by very wide hoops.

The sack or sacque, a loose dress falling straight from the shoulders, continued in use during the greater part of the century. It had originated about 30 years earlier, when Pepys's wife "first put on her French gown called a sack." Later dresses, too, came from France. A letter of the year 1715 from Sarah, duchess of Marlborough to Lord Stur, ambassador at Paris, is still extant—"asking him to obtain 'two pair more of bodys and a night gown' for her, and a mantleau and petticoat for her grandchild." In the latter half of the 18th century women wore their hair, or wigs, dressed high above the head and powdered, and again men's wigs became larger, but they were already doomed, and Pitt's powder tail of 1795 practically put an end to them.

19th Century—By the opening of the 19th century, the change in men's outlook had swept away much of the overloaded finery of the past and garments more supple and better suited for active life came into use. Men's coats are cut away in front in a manner resembling the modern dress coat, the lapels are large and the collar is high and deep. Waistcoats are short and cut square. Knee breeches are lengthened into the modern trousers. The cocked hat of the 18th century is replaced by the top-hat. The old full dress, moreover, gradually gives way to what we now call the lounge suit, used more and more for all occasions.

Women's dress at the opening of the century is marked by a graceful simplicity, with high waist and low neck. A lower waist and puffed sleeves follow. Meanwhile skirts were widening, until the "crinolines" took their most exaggerated form shortly after the middle of the century. Then followed various adaptations of 18th century styles. About 1880 the projecting "bustle" at the back was in full popularity. Fringes, trimmings, flounces and long trains were in use during the latter part of the century.

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FAR EASTERN

The appearance, customs and personal characteristics of Chinese, Japanese and Koreans are distinctly different, and this has consequently brought about dissimilarities in the dress. Only within the last few decades when European costumes have to some extent been adopted, has there been any tendency to uniformity in style.

China—All classes in China wear a *san* (jacket) and *hoo* (trousers), the combination being similar to the Western pyjamas. There are three kinds of each—the single, the lined and the wadded with cotton, to suit the season of the year. To the *san* is attached a narrow collar-band. The *ma kua* is the ordinary jacket with loose sleeves for the common people, and the *bashun*, a sort of vest, is worn over it. The *po* is a long gown and the *qua* a larger and longer *ma kua*. The *po kua* is the official full dress of men, while the *lung po*, or dragon gown, was worn by the emperor at State ceremonies. There are several other gowns in use—the *Chang san* in summer, *chiao* in spring and autumn and *tamou* in winter. When it is very cold the *pipao*, or fur coat, takes the place of the *tamou*. The *lo pang*, another kind of overcoat of silk or fur, is worn by the wealthy.

There are all kinds of coats embroidered with dragons, moons, stars, hills, mountains, waters and flowers. Each design has its peculiar symbolism, frequently it is a Buddhist emblem or the representation of some philosophical concept, such as the "waves of eternity." The mandarins were specially privileged to wear

gold-embroidered clothes, and sometimes the emperor granted the nine orders of mandarin the distinction of wearing a peacock feather on the hat.

Red is a symbol for happiness, and thus we find the bride wearing an elaborate gown of red, the tassel on the top of men's hats and the cord on their *queues* are red.

Japan—In A.D. 283 two women weavers were sent from Korea to Japan to teach the making of figured silks and brocades. The *ho* or ceremonial garment of the Japanese emperor and nobles, has an ancient origin, the Chinese seamstresses came to Japan, about A.D. 300 and made this with silk imported from China. Emperor Yuryaku (A.D. 457-479) reformed the national dress and, in the reign of Emperor Suiko (A.D. 593), rank was signified by distinctive headgear a custom imitated from that of the Chinese Tang dynasty (A.D. 618-906). Costumes were evolved for civilians, ecclesiastics and the militia, differing in colour, patterns, the length of sleeves and the style of hairdressing.

The *kasane*, or loose tunic, was worn with a short lower garment called the *akome*. The *hakama* was a loose skirt reaching only a few inches below the knees over the *shita-gutsu*, or socks. The whole style of headgear was called *suberakashi*. *Kommuri*, a ceremonial headdress, was secured by *konyashi*, or pins and the *yeban*, or cap, was worn over it.

The ladies always wear the *kimono*, a loose gown with a neck piece called an *eri*, and long sleeves, the garment being fastened by a belt. Since the Heian period (794-1199) women have in general dispensed with the *hakama*, and to day the female dress for social occasions consists of an underskirt, two or three outer garments and a *haori*, or interlined silk coat, over the upper part. The *obi*, a belt about 3 yd. long and 10 in. wide, winds about the figure.

Men in rural districts are barefooted, seldom wear *zori* or the wooden clogs called *geta*, and in the hot season they wear almost no clothing. The common jacket and trousers of cotton crepe, blue or white in colour, a large grass hat called *kasa* and straw *zori* are the ordinary dress.

Korea—Among the six departments of the Korean government was the board of rites, whose duty was to regulate, describe and govern the ceremonial code of polite society, including dress. Koreans dressed according to their class, and in each class distinct costumes were used by those of different ages.

A *chugori* (jacket) and *baps* (trousers) are worn by all classes. The *pooroomaki*, a long flowing tunic, goes over these to anywhere between the knees and ankles, the higher the man's position, the more garments he wears. All these are of varying thickness to suit the weather. Women's *chugori* do not descend to the waist, leaving space for a waistband, or *hurida*, which is embroidered and woven by hand. (Y. K.)

TWENTIETH CENTURY

The evolution of modern feminine dress, corresponding closely to the emancipation of women at the beginning of the 20th century, provides one of the most captivating pages in the history of modern civilization. One often considers ridiculous the fashions of other days, but one has only to live the past over impartially to understand that all changes in fashion are rungs in a ladder leading to an inconstant ideal.

Fashions of 1900-25—In 1900 women were filled underclothes. The body was imprisoned in a corset that pushed the bust forward and the lower part of the body out behind. The hair was dressed so as to follow the movement of the body. The neck was stiffened by a collar with whalebone stays. The sleeves, bodice and hat were trimmed with puffs and frills, details that at first view appeared useless but that helped to conceal the twisted line of the body. This silhouette remained without appreciable change up to 1905 when a step back to *fin de siècle* fashions occurred. Sleeves were again puffed at the top, bodices were shaped to a point in front and the complicated dresses were covered with a profusion of puffs and frills. The hat was perched on the side of the head above a display of hair extravagantly curled, it was frequently trimmed with a cluster of feathers, a mode of delicate hat trimming that, changing place very often, lasted until 1914. The high collar made almost its last appearance. In 1909 a col-

lar that freed the neck was popular. During the same year the short skirt appeared for the first time in the 20th century, a short skirt, however, that would have seemed very long later. Enormous hats were loaded with huge, falling feathers. Already the silhouette was being slightly straightened, the bust was less bent and the body a little less deformed by the corset.

So far the few progressive changes in costume were the straightening of the silhouette and the freeing of the neck. They prepared the way for the *directoire* fashions which, already having made a few timid appearances, began to reign definitively in 1910. A bloom of delicate and varied colours was obtained during this period by concealing the dress beneath a transparent tunic of a different shade.

Two years later, in 1912, under the influence of a few Russian ballets, the *directoire* began to orientalize itself. Trouser skirts appeared, heads were turbaned and dresses of bright colours were trimmed with gold embroidery, pearls and diamonds. After 1912 dresses no longer hid the elegant woman's feet and she began to match the colour of her shoes and dress. The oriental influence transmitted by the theatre became, in 1913, dazzling. The trouser skirt persisted next to the skirt tightly draped round the legs, it was surmounted by a short and puffed tunic which very often took the shape of a small crinoline.

The period from 1914 to 1920 was not notable in the history of fashion. Only the year 1917 created a specific line, the barrel dress, which was not seen the following year but which, for some time afterwards, left its traces in a draped movement. From 1914 to 1920 there was nothing worthy of entry in the history of fashion.

In 1921 a new line, the low waist of the "flapper," was found. At the same time the skirt was lengthened slightly. In 1923 the low waist dress was transformed into a straight dress called the *tube dress*, and from this was born the costume—the straight and short dress—which was generally unchanged to 1929.

At its birth in 1924 it was quite simple, so much so, indeed, that it demanded equal simplicity in dressing the hair, which women began to cut like men. Dresses being simple in shape and trimming, the feminine costume tended to fall into dullness. Feminine elegance was saved by research in accessories and by the use of new materials. The seeking of harmony in the smallest details proceeded further, appearing in the make up which in former days had been used simply to correct faults of nature.

(R. DE T. E., X.)

Fashions from 1925 to World War II—The uniformity which had nearly reached a banal monotony during the preceding years changed during 1928 to a silhouette with a great deal of movement. The hemline began to dip in back until it almost reached the floor, particularly in evening gowns. During the day, the "sports" feeling, which had continually increased during each successive year, became even more marked. Physical exercise and intelligent diet had given the athletic figure of woman a slender, active look, and rhythm had taken the place of heartiness. The hipline remained moulded, with a flat front and back, while the waistline, above, was felt rather than defined. Hats, which had completely covered the forehead and eyebrows, were beginning to show them again.

By 1929 the hard silhouette of 1925 and 1926 was completely overthrown. The higher waistline and longer skirtline was, bit by bit, coming into being. Sports clothes became longer—four inches below the knee being the popular length. Trains on evening gowns appeared, giving even greater grace to costumes, but the skirt remained short in front. Clothes again became complicated—almost fussy.

Then there followed the long skirts which at first women trailed through the streets in the daytime. In the course of time the novelty of the long skirt was gradually adjusted and assumed its proper place, for evening. The daytime skirt was worn seven or eight inches below the knee. A softer treatment for bobbed hair ruled. By 1930 the long skirt had at last a sure foothold. The young so-called "flapper" had become submerged. She had greeted as a new and exciting experience the feel of a long skirt swishing about her ankles. Her coats were fitted at the waist,

her slouch became dignified rhythm, and legs and knees were hidden.

The year 1931 ushered in a very graceful and flattering era of spiral treatments in evening dresses that clung to the figure. The motion picture had begun its powerful influence, and women were dramatizing their clothes far more than they ever had before. Inhibitions about colour were abolished. Gaiety, a reaction from the drabness of former years became the exciting gesture of the day. The financial crisis had caused a rather clever pseudo bravado. It was considered chic to be poor. Fewer clothes were in once overflowing wardrobes, which seemed to give an added impulse to inventive designers.

In the 1930s the pill-box hat, the beret, and the sporty felt were also introduced. All of these had great popularity. Hats tilted over the left eye. Women remained slim and straight. The evening gown with a high neck in front, the low back and long sleeves became ever present, even on those occasions when, several years before, only the lowest décolleté would have been correct. Gradually, too, a masculine note crept in. Mannish suits were worn for daytime, sport coats were adapted from various masculine sources, and evening clothes displayed a definite masculine trend.

For daytime wear, shoulders began to play an important part in the trend of fashion. Evening gowns displayed huge ruffled puff sleeves—a mode introduced by a popular motion picture. In 1934 the silhouette also encouraged the revival and adaptation of fashions of 1910. This rather florid, but amusing era, was reconstructed with a simplified modern treatment. The clinging body flaring into a series of frothy flounces below the knee dominated the scene. (G. Ad., X.)

World War II Fashions—During the abnormal period of World War II, fashion trends, like most other phases of life, were sharply influenced by or directly traceable to the cataclysm of war. Silhouettes showed no remarkable variations. The natural kind of line which prevailed just before the war continued to prevail until well after 1945. Regulations limiting yardage in U.S. women's clothes had a great deal of influence in this respect. Then, in 1945, out of Paris, there emerged a complete new trend toward roundness. Shoulders and sleeves were padded to curve outward in big arcs, waists tightened to curve in, hips belled out by much padding and pleating.

Hemlines were a bit more active. They crept up on daytime dresses in 1940, the U.S. had taken over most of the world's designing, and U.S. women liked to show off their legs. Then in 1941 came the ballet-length evening dress, six or even ten inches above the floor.

Suits came close to establishing themselves as the paramount fashion of the war period. What was formerly a costume for tailored days in town became a uniform for 24 hours a day, seven days a week, everywhere. Women in defense jobs or camp-following their husbands found one suit worth a half-dozen dresses, and infinitely variable by means of blouses and jerseys. The suit itself took to many forms and fabrics. Only at the war's end did women tire of suits.

Dresses, after succumbing to the influence of the Austrian dirndl for a while, began to become slim, tubular, ready. With the introduction of the rounded line in 1945, however, all this changed to swelling curves and dolman sleeves.

"Separates," something new and characteristically U.S. in fashion, often substituted for dresses. These were outfits of several pieces—skirt, jacket, shirt, halter, long skirt—which could be combined and varied in numberless ways. Evening clothes became slim and straight of line. Wool was often used in dinner dresses, a new necessity in heatless houses and with the restricted use of automobiles the floor-length dress disappeared almost completely.

Shoes staged their own revolution with the introduction of "flats," ballet shoes and wedge shoes. Women, while appreciating and envying the comfort of low-heeled shoes, had always resented their heavy "sensible" look and were now inspired by the success of espadrilles and peasant sandals.

In 1947 fashion made headlines with the change in hemline

and silhouette originating in Paris. Day skirts were longer, about 12 in. from the floor, and evening skirts shorter. Every natural curve in the woman's figure was accented. The "new look" as it was named by the press, called for natural, sloping shoulders, tiny waists, rounded hips, often padded to increase the natural curve.

But the "new look" suddenly collapsed in 1948. In its place came another complete reaction. Clothes were pared, clipped, cropped and chopped to the point of sparseness. Jackets were shorter and fitted till they were merely little buttoned bodices, no tight. Skirts were straight in front and at the sides, and any fullness was at the back.

The end of 1949 found fashion apparently headed for a revival of the 1920s, but this rather extreme trend modified itself greatly by mid century. Some silhouettes of the flapper age remained but were so modernized as to be hardly detectable. The chemise dress was popular, but it was worn with a belt which allowed for a wastline, high or low, tight or loose.

Other reminiscent features in the early 1950s were the helmet hats, sleevelessness, dangle earrings, long ropes of pearls and the boyish wind swept coiffures that strongly recalled the flapper era.

DRESSER, in furniture, a form of sideboard. The name is derived from the Fr. *dressoir*, a piece of furniture used to range or dresser the more costly appointments of the table. The appliance is the direct descendant of the credence and the buffet, and is, indeed, a much more legitimate inheritor of their functions than the modern sideboard, which, as we know it, is practically an 18th-century invention. It developed into its present shape about the second quarter of the 17th century, and has since then changed but little.

As a piece of movable furniture it was made rarely, if at all, after the beginning of the 19th century until the revival of interest in what is called "farmhouse furniture" at the very beginning of the 20th century led in the first place to the construction of many imitation antique dressers from derelict pieces of old oak, and especially from panels of chests, and in the second to the making of avowed imitations.

The dresser conformed to a model which varied only in detail and in ornament. Its simple and agreeable form consisted of a long and rather narrow table or slab, with drawers or cupboards beneath and a tall upright closed in back arranged with a varying number of shallow shelves for the reception of plates, hooks for mugs were often fixed upon the face of these shelves. Toward the end of the 17th century small cupboards were often added to the superstructure. The majority of these dressers were made of oak, but when, early in the Georgian period mahogany came into general use, they were frequently inlaid with that wood, holly and box were also used for inlaying, most frequently in the shape of plain bands or lines. A peculiarly effective combination of oak and mahogany is found in the dressers, as in other "farmhouse furniture," made on the borders of Staffordshire and Shropshire. The excellence of the work of this kind in that district and in the country lying west of it may perhaps explain the expression "Welsh dresser," which is now no more than a trade term, not necessarily suggestive of the place of origin, but applied to all dressers of this type.

In Europe, they are most frequently found in the houses of small yeomen and substantial farmers, into which fashion penetrated slowly.

In the United States, the term *dresser* is more commonly applied to a piece of bedroom furniture consisting of a chest of drawers, or bureau, with a mirror attached—a sort of dressing table. This application was no doubt brought about by its use as a convenience in dressing or attiring one's self.

DREUX, a town of northwestern France, capital of an arrondissement in the department of Eure-et-Loir, 27 mi. N.N.W. of Chartres by rail. Pop. (1946) 14,184. Dreux was the capital of the Gallic tribe of the *Durocasses*. In 1188 it was taken and burned by the English, and in 1562 Gaspard de Coligny, and Louis I, prince of Condé, were defeated there by Anne de Montmorency and Francis, duke of Guise. In 1593 Henry IV captured the town. It was occupied by the Germans in Oct. 1870,

was later evacuated, and again taken, on Nov. 17, by General von Tresckow. In the 10th century Dreux was the chief town of a county, which Odo, count of Chartres, ceded to King Robert. Later, Louis VI gave it to his son Robert, whose grandson Peter of Dreux, younger brother of Count Robert III, became duke of Brittany by his marriage with Alix, daughter of Constance of Brittany by her second husband Guy of Thouars. By the marriage of the countess Jeanne II with Louis, viscount of Thouars (d. 1390), the Capetian county of Dreux passed into the Thouars family. In 1377 and 1378, however, Perronne and Marguerite, two of the three co-heresses of Jeanne, sold their shares of the county to King Charles V. Charles VI gave it to Arnaud Amanieu d'Albret, but took it back in order to give it to his brother Louis of Orléans (1407), later he gave it back to the lords of Albret. Francis of Cleves laid claim to it in the 16th century as heir of the d'Albrets of Orval, but the parlement of Paris declared the county to be crown property. It was given to Catherine de' Medici (1539), then to Francis, duke of Alençon (1569), it was pledged to Charles de Bourbon, count of Soissons, and through him passed to the houses of Orleans. Vendôme and Condé. Dreux stands on the Blaise, which there divides into several arms. It is overlooked from the north by a hill with a ruined mediaeval castle, within the enclosure of which is a gorgeous chapel, begun in 1816 by the dowager duchess of Orleans and completed and adorned by Louis Philippe. It contains the tombs of the Orleans family, chief among them that of Louis Philippe, whose remains were removed from England to Dreux in 1876. The sculptures on the tombs and the stained glass of the chapel windows are masterpieces of modern art. The elder of the two hotels de ville of Dreux was built in the early 16th century, chiefly by Clément Metzau, the founder of a famous family of architects, natives of the town. It is notable for the carvings of the façade and for the staircase. The church of St. Pierre is Gothic and contains good stained glass and other works of art. Dreux is the seat of a subprefecture. Among the public institutions are tribunals of first instance and of commerce. The manufacture of boots and electric fittings and metal-founding are carried on, and there is also a trade in wheat and poultry.

(X)

Battle of Dreux (1562).—The battle of Dreux was the first regular engagement of the Huguenot Wars in France, and it was fought on Dec. 19, 1562. Henry II, king of France, was accidentally killed at a tourney in 1559, and was succeeded by his ten year old son, Charles IX., whose mother, Catherine de' Medici, claimed the right to conduct the government. On March 1, 1562, the duke of Guise massacred 60 Huguenots at Vassy and the leaders of the reformed faith, Condé and Admiral de Coligny, appealed to the Queen but received no satisfaction. War now began, the Huguenots being declared rebels. As they were vastly in the minority they sought assistance from England and Germany, obtaining promises of money from the first, and 9,000 rapiers and landsknechts from the second. Leaving d'Andelot and his 9,000 Germans at Orléans, in November, Condé made a dash for Paris, but found Guise and Saint-André already there. To gain time to collect her forces, the Queen-mother made overtures for peace, but as no result was reached, on Dec. 10 Condé moved on Chartres, the royal army following and threatening Orléans. Condé now wished to counter-march on Paris, but Coligny persuaded him to move into Normandy and join hands with an English force which had landed there. Thus it came about that the army marched on Dreux. There the Huguenots found their road blocked, and though inferior in numbers were compelled to accept battle, for as Coligny said "We must now look to our hands to save us, not to our feet." On each side the left wing was victorious. In all some 6,000 were killed or wounded, and though no true decision was gained the royalists held the field. Marshal Saint-André and the duke of Nevers were killed on the royalist side, and Condé was taken prisoner. After the battle Coligny withdrew his men in good order to Beaugency. The forces engaged were approximately 4,000 horse and 8,000 infantry on the side of the Huguenots, and 3,000 horse and 13,000 infantry on that of the royalists.

See Kervyn de Lettenhove, *Les Huguenots et les Guises* (1885),

Annuaire Hist. des Princes de Condé pendant les XVI^e et XVII^e siècles (1864), *The Cambridge Modern History*, vol. 11 (1904) (J F C F)

DREW, the name of a family of American actors. JOHN DREW (1827-1862) was born in Dublin and made his first New York appearance in 1846. He played Irish and light comedy parts with success in all the American cities, and was manager of the Arch street theatre in Philadelphia. He visited England in 1855, and Australia in 1859, he died in Philadelphia. His wife, LOUISE LANE DREW (1820-1897), was the daughter of a London actor, and in 1827 went to America, appearing as the Duke of York to the elder Booth's Richard III, and as Albert to Edwin Forrest's William Tell. After this she starred as a child actress, and then as leading lady. She had been twice married before she became Mrs. Drew in 1850. From 1861 to 1892 she had the management of the Arch street theatre in Philadelphia. In 1880 she toured with Joseph Jefferson in his elaborate revival of *The Rivals*, playing Mrs. Malaprop to perfection. She had three children, John, Sidney and Georgiana, wife of Maurice Barrymore (1847-1905), and mother of Lionel, Ethel and John Barrymore, all actors.

The eldest son, JOHN DREW (1853-1927), began his stage career under his mother's management in Philadelphia as Plummer in *Cool as a Cucumber*, March 22, 1873, and after playing with Edwin Booth and others, became leading man in Augustin Daly's company in 1879. His association with this company, and with Ada Rehan as the leading lady, constituted a brilliant period in recent stage history, his Petruchio being only one, though perhaps the most striking, of a series of famous impersonations. In 1892 he left Daly's company, and began a career as a "star," appearing among other plays in *A Marriage of Convenience*, *One Summer Day*, *Richard Carvel*, *Much Ado About Nothing*, *The Will*, *The Circle* (1921-23), *School for Scandal* (1923), *Trelawney of the Wells* (1925-26-27). He died in San Francisco (Calif.), July 9, 1927, while on tour.

See Moses, *Famous Actor Families in America* (1906), Winter, *Wallet of Time* (1913).

DREWENZ, a river of Germany, a right-bank tributary of the Vistula. It rises on the plateau of Hohenstein in East Prussia, 5 m. S.W. of the town of Hohenstein. After passing through the lake of Drewenz (7 m. long), it flows south west through flat marshy country, and forms, from just below the town of Stassburg to that of Leibsch, a distance of 30 m., the frontier between East Prussia and Poland. After a course of 148 m. it enters the Vistula from the right, a little above the fortress of Thorn.

DREWS, ARTHUR (1865-1935), German philosopher, was born on Nov. 1 at Uetersen, Holstein, and was educated at Munich, Berlin, Heidelberg and Halle. From 1898 he was professor at the polytechnic academy in Karlsruhe. His contributions to the critical appreciation and history of philosophy are *Die deutsche Spekulation seit Kant* (1893), *Kants Naturphilosophie* (1894), *Das Ich als Grundproblem der Metaphysik* (1899), *Das Lebenswerk E. V. Hartmanns* (1907), *Nietzsches Philosophie* (1904), *Plotin* (1908), *Die Philosophie im 19. Jhr* (1912), *Gesch. des Monismus im Altertum* (1923). His support of concrete monism and an ultimate Being devoid of consciousness and personality is best seen in his *Die Religion als Selbstbewusstsein Gottes* (1906), *Der Monismus* (1908) and *Freie Religion* (3rd ed., 1921).

DREXEL, ANTHONY JOSEPH (1826-1893), American banker, was born in Philadelphia (Pa.) Sept. 13, 1826. He was the son of Francis M. Drexel (1792-1863), founder of the banking-house of Drexel and Co. Anthony, with his brothers Francis and Joseph, succeeded to the control of the business, and organized the banking houses of Drexel, Morgan and Co., New York, and of Drexel, Hedges and Co., Paris. In 1864 with George W. Childs he purchased the Philadelphia *Public Ledger*, and with him in 1892 founded the Printers' Home for union men at Colorado Springs. In 1891 he founded and endowed the Drexel Institute of Art, Science and Industry in Philadelphia. He died at Carlsbad, Bohemia, June 30, 1893.

DREYER, JOHN LOUIS EMIL (1852-1926), Danish astronomer, was born at Copenhagen on Feb. 13, 1852, and was educated in his native town. In 1874 he became astronomer at

the earl of Rosse's observatory at Birr Castle, Ireland. He remained in Ireland, holding the post of assistant astronomer at the Royal Observatory, Dunsink, from 1878 to 1882, and of director of the observatory at Armagh from 1882 until he retired in 1916. Dreyer's work in astronomy falls into two groups—his observations on nebulae and on the motion of stars, and his work on the history of astronomy. His astronomical observations were started at the Rosse observatory, where the telescope was particularly suitable for his purposes, and continued at Dunsink and Armagh. Dreyer is the author of a number of papers on nebulae and stars, and of *Second Armagh Catalogue of 3,200 Stars* (1886). His "New General Catalogue of Nebulae and Clusters of Stars," published in the *Memoirs of the Royal Astronomical Society* (1888), with supplements in 1895 and 1908, is a standard work. He was particularly interested in the work of Tycho Brahe and wrote *Tycho Brahe, a Picture of Scientific Life and Work in the 16th century* (1890), and prepared a complete edition of Tycho Brahe's work, *Tycho Brahe Opera Omnia*. The first volume was published in 1913, ten volumes appeared before Dreyer's death, and the remaining four were complete in manuscript. Dreyer held many academic honours. He died on Sept. 14, 1926.

DREYFUS, ALFRED (1859-1935), French soldier, was born on Oct. 9, 1859, the son of a Mulhouse manufacturer. After studying at the *école polytechnique*, he entered the army as a lieutenant of artillery. He became a captain in 1889, passed through the *école supérieure de la guerre* (staff college), and received an appointment in the Ministry of War. His name is famous because of the judicial error of which he was the victim, which was repaired only after an agitation which disturbed France for many years and aroused deep feeling all over the world. During the summer of 1894, an anonymous letter abstracted from the German embassy was communicated to the Ministry of War. It had been addressed to the military attaché, Col. von Schwarzkoppen. This letter known as the *bordereau*, or schedule, because it had originally been written as a covering letter to certain military memoranda, enumerated the documents which its writer hoped to send to Schwarzkoppen. A French officer was evidently betraying his country. It happened unfortunately that the writing of the *bordereau* was like that of Dreyfus. Suspicion fell upon him, and he was arrested on Oct. 15. He always maintained his innocence, but by reason of the similarity of the hand writing, appearances were against him. Actual evidence was, however, extremely scanty. For this reason, Gen. Mercier, the minister of war, placed before the members of the court-martial secret documents, utterly valueless as evidence, but which could not fail to impress them. This was done unknown to the prisoner and his counsel, the famous M. Demange, and the fact did not leak out until several years later. On Dec. 22, 1894, Alfred Dreyfus was unanimously found guilty and condemned to detention for life in a fortified area. On March 15, 1895, he was interned on Devil's island, one of the archipelago of the Safety islands off the coast of Guiana. His family never ceased to believe in his innocence. His brother, Mathieu Dreyfus, convinced a terrible judicial error had been committed, strove incessantly to have the case reviewed. This could not be done, however, unless some new facts were brought to light.

An official at the Ministry of War, entirely unconnected with the Dreyfus family, made the necessary discovery. Col. Picquart was the head of the information branch which had to do with the affairs of the secret service. In March 1896 he became possessed of the fragments of an express letter which Col. von Schwarzkoppen, the German military attaché, had torn up unseen, and thrown into the waste-paper basket. It had been found by a French agent. This express letter, known as the "*petit bleu*," was addressed to a French officer, Maj. Esterhazy, and proved that he was in the pay of Schwarzkoppen. On making enquiry Picquart found that Esterhazy led a dissipated life and was heavily in debt. He then discovered that the *bordereau*, wrongly attributed to Dreyfus, was in Esterhazy's hand writing. Convinced that Dreyfus was innocent and Esterhazy guilty, he laid his information before his superior officers, Gen. de Boisdeffre and Gen. Gonse, the chief and deputy chief of the general staff. They, however

still convinced of Dreyfus' guilt, and unwilling to have the matter reopened forbade him to pursue his enquiries, and when he said he could not do with such information undisclosed had him transferred to a distant part of Tunisia. About that time, Col. Henry, the deputy director of the information branch, brought forward a letter apparently from Col. Panizzardi, the Italian military attaché. Dreyfus was referred to it in terms which, had it been genuine, would have left no doubt of his guilt. The letter was, however, a forgery, and the discovery of this fact led to the first revision of the case. Col. Picquart, before starting for Africa, had told the whole story to his friend the lawyer, M. Leblois. Leblois discussed it with Scheurer-Kestner, a well known politician who was vice president of the senate. He became convinced of Dreyfus' innocence, and began to agitate in his favour. At the same time (Nov. 1897) M. Thieu Dreyfus had by the merest chance come to realize that the writing of the *bordereau* was that of Esterhazy. On Nov. 15, 1897, he wrote to the minister of war accusing Esterhazy of the crime for which his brother had been condemned. The general staff was unwilling to own that a mistake had been made. Esterhazy was formally court-martialed, but his acquittal was secured. At the same time a press campaign of extraordinary violence broke out against those who were working for the revision of the 1894 sentence. They were represented as traitors to their country. Col. Picquart was thrown into prison on the pretext that he had communicated confidential papers to a civilian (M. Leblois). The cause of Dreyfus had, nevertheless, gained many supporters, especially in intellectual circles. Georges Clemenceau and Francis H. Pressence in the newly founded *l'Aurore*, and Yves Guyot, Joseph Reinach and others in the *Sicile* set on foot an agitation which did not cease till justice had been done. On Jan. 13, 1898, two days after Esterhazy's acquittal, Zola published in *l'Aurore* under the title "*J'accuse*" the famous open letter to the president of the republic, in which he denounced the efforts which were being made to stifle the truth. At the instance of the Ministry of War, proceedings were taken against him. The case was heard in February. His lawyers, Labori and Albert Clemenceau, brother of the statesman, called many witnesses to the innocence of Dreyfus and convinced a large section of the public. But opinion on the whole was still unfavourable. Zola was condemned to a year's imprisonment. He later took refuge in England for a time.

As the call for revision grew more and more insistent, Cavaignac, minister for war in Brisson's cabinet, tried to arrest it by reading aloud in the chamber on July 7, 1898, the alleged letter from Panizzardi which had been brought forward by Col. Henry some months before. Soon after, however, on Aug. 30, it was made clear that it had been forged by its seeming discoverer, who was arrested and committed suicide in his cell at St. Valérien. This decided the Government to lay the demand made by Mme. Dreyfus for revision of the original sentence before the court of appeal. After months of enquiry, the court annulled the sentence of 1894 and ordered a new trial before a court-martial at Rennes. Little by little the cause of Dreyfus was gaining ground. Loubet, who became president of the republic on the death of Félix Faure in Feb. 1896, was favourably inclined to it, as was also the cabinet of Waldeck Rousseau, which came into power in June. But feeling still run high, especially in military circles, Dreyfus was brought back from Guiana. The new trial lasted a month. On Sept. 9, 1899, the court martial at Rennes by five votes to two delivered an incoherent judgment by which Dreyfus was found guilty with extenuating circumstances, and condemned to ten years' imprisonment. This aroused the general public. On Sept. 19 the Government decided to pardon Dreyfus. He was immediately set at liberty, and after a short stay at Geneva, settled in Paris. At the end of 1903 further facts which came to light led to a demand for a second hearing by the court of appeal, and a further long and detailed enquiry. On July 12, 1906, the court of appeal finally quashed the sentence of 1894. Dreyfus was completely rehabilitated. A Government measure reinstating him in the army with the rank of major of artillery was immediately passed. He was employed for a year in a military office at St. Denis near Paris and resigned in July 1907. In June 1908, on the

occasion of the transfer of the ashes of Zola in the Pantheon, an anti Semite journalist Gregori, fired two shots at him, one of which wounded him slightly

He re entered the army during World War I, was promoted lieutenant colonel in 1918 and shortly afterward an officer of the Legion of Honour After that he lived in retirement until his death in Paris, July 12, 1935

BIBLIOGRAPHY—Dreyfus' letters written in captivity have been published under the title *Lettres d'un Innocent* (1898) His memoirs entitled *Cinq années de ma vie* appeared in 1901 The shorthand reports of the various trials have been published (some by the Librairie Stock of Paris and others by the Ligue des Droits de l'Homme) See also Joseph Renach, *Histoire de l'affaire Dreyfus*, 7 vol (1901-11), Theodore Renach, *Histoire sommaire de l'affaire Dreyfus* (1924), and an anti-Dreyfusite work by Dutrait-Crozon, *Priéts de l'affaire Dreyfus* (1909) (P B)

DREYSCHOCK, ALEXANDER (1818-1869), Czech pianist and composer, was born at Zak, Caslau, Bohemia, on Oct 15, 1818

He studied at Prague and in 1838 began to tour Europe as a virtuoso He became popular with the audiences of Europe, his repertoire including his own compositions as well as classical pieces His compositions, however, were soon forgotten Most of his original music was in the so called salon music category

In 1862 he became professor of the pianoforte at the Conservatory at St Petersburg (later Leningrad) Also appointed court pianist and director of the imperial school for theatrical music, he later went to Italy

He died at Venice on April 1, 1869

RAINUND DREYSCHOCK (1824-1869), born at Zak on Aug 30, 1824, the brother of Alexander, was professor of violin at the Leipzig conservatory and concertmaster of the well-known Gewandhaus orchestra there

He died in Leipzig on Feb 6, 1869

DRIESCH, HANS ADOLF EDUARD (1867-1941), German biologist and philosopher, was born on Oct 28, 1867, at Kreuznach After studying at Hamburg, Freiburg, Munich and Jena, he travelled in the far east, and from 1891 to 1900 worked in the zoological station of Naples

He then settled in Heidelberg where in 1909 he became Privatdozent and in 1911 professor of philosophy In 1920 he was made professor at Cologne and in 1921 at Leipzig Driesch began as a disciple of Haeckel but through the influence of G Wolff and W Roux came to support a dynamic vitalism

His doctrine that the functions of protoplasm cannot be explained mechanically was the outcome of experiments on the blastula of the sea urchin, which showed that any fragment cut at random always gave a complete embryo, and on the restitution of animal parts

From these experiments he concluded that the organism must be a harmonious equipotential system possessing a vital individualizing entelechy which works through the matter with a view to the whole He also maintained that instinct and action are inextricable mechanically

His antimechanism in the psychological sphere is seen in his *Leib und Seele* (Leipzig, 1920, Eng trans with a full bibliography of his works, 1927)

His other important works were *Analytische Theorie der organischen Entwicklung* (Leipzig, 1894), *Science and Philosophy of the Organism* (Gifford lectures, 1907-08), *History and Theory of Vitalism* (1914), *The Problem of Individuality* (1914), *Wissen und Denken* (Leipzig, 1919), *The Crisis in Psychology* (Princeton lectures, 1925)

He became known internationally and lectured in China, Japan and the United States Awarded honorary degrees by many universities, he was a member of many scientific societies of Europe

During a visit to Harvard university in 1926 he advocated "an eventual United States of the world" But in 1934, a year after Adolf Hitler's rise to power, he was won over to the ideas championed by national socialism and incorporated them into his philosophic teachings

He died in Leipzig in April 1941

DRIFFIELD, a market town and urban district, 28 mi E by

N from York, in the Bridlington parliamentary division of the East Riding of Yorkshire, Eng Pop (1951) 6888 Area 3.8 sq mi It is a railway junction and the centre of an agricultural district, and its industries include agricultural implements and milk products, flour milling and sugar refining A canal connects it with Hull Driffield's history goes back at least to Saxon times and there was once a palace there All Saints' church (restored) is Norman and Early English

DRIFT see GLACIAL EPOCH

DRILL In military science, the word *drillen* was used in Dutch, German and Danish from the 17th century for training in military exercises and was adopted into English in the same sense The origin of the application seems to be in the primary sense of "to turn round," from the turning of the troops in their evolutions and from the turning of the weapons in the soldiers' hands

Drill is, formally, the preparation of soldiers for their duties in war by the practice or rehearsal of movements in military order and the handing of arms, and, psychologically, the method of producing in the individual soldier habits of self control and of mechanically precise actions under disturbing conditions and of rendering the common instinctive will of a body of men, large or small, amenable to the control of and susceptible to a stimulus imparted by its commander's will (See ARMY, INFANTRY, ROMAN ARMY)

In textiles, drill is the name of a fabric made in both linen and cotton and commonly bleached and finished stiff The word is a shortened form of "drilling," from the German *drilhch*, or "three threaded," and is so named because the weave originally used in its construction is what is termed the three leaf twill, nine repeats of which appear in the accompanying figure, while immediately below the design is an intersection of all the nine threads with the first pick It is essentially a warp faced fabric, that is,



TWO DRILL DESIGNS
Three leaf twill, a warp faced fabric

Large quantities of drill are shipped to the eastern markets and to other subtropical centres It is also used for military tropical uniforms and for jackets, overalls etc

In agriculture, a furrow in which seed may be sown is known as a drill The word is somewhat doubtful in origin It may be the same as an obsolete word "drill," to trickle, flow in drops also a small stream or flow of water, a rill, and is possibly an altered form of "trill" Drill is also the name of an agricultural machine used for sowing seed or distributing manure (see FILLAGE MACHINERY)

(See also AGRICULTURE, A GENERAL SURVEY, AGRICULTURAL POWER AND MACHINERY, SOWING)

DRILL, a large, short tailed baboon from the Cameroons, resembling the mandrill but with a black face The lower lip is bright crimson and the hairs around the face are yellowish white as is a tuft behind the ears The rest of the animal is yellow brown (See BABOON, MANDRILL, PRIMATES) (J E HL)

DRILLING, PETROLEUM Two basic methods are used for drilling wells to produce oil and gas Cable tool drilling, the older of the two, employs the impact action of a bit suspended on a steel drilling cable This assembly is reciprocated in vertical motion to cut a hole in the earth The bore, so cut, is almost empty of fluid and the cuttings produced by bit action are removed from the hole at intervals by withdrawing the bit and bailing out Until the early 1900s, cable tool drilling was the principal system in use, but it was generally replaced by the rotary tool method for the majority of wells drilled

With rotary tools a bit designed to cut in rotary motion is carried on an assembled string of drill pipe so arranged that it may be rotated and raised or lowered in the well bore as desired. The hole being cut is filled with fluid called drilling mud. This fluid is continuously circulated down through the drill pipe, out the bit nozzles and thence returned to the earth's surface in the annular space between the drill pipe and the wall of the borehole. Circulation of the fluid serves continuously to remove the bit cuttings while also cooling and lubricating the bit and by hydrostatic head prevents the inflow of gas, oil or water from formations penetrated into the hole being cut.

Drilling rigs are built in wide variety to meet the requirements of depths to be drilled, loads to be handled and terrain where wells are located. Many rigs for comparatively shallow depths are truck and trailer mounted to provide mobility and economy in moving from one location to another and for rapid rigging up. Where well locations are in swamps, canals and open water, rigs are frequently built on barges which are towed to locations and set in place by sinking in the desired position. Other rigs, of the heavier types for deep well drilling, must be taken to location in several units and assembled in place. Through use of complex machinery, alloy steels and powerful engines, many drilling rigs are capable of depths in excess of 20,000 ft.

The main sources of power for drilling are internal combustion engines of the spark plug type, using natural gas or LPG (liquefied petroleum gas) products, especially butane and propane. Diesel engines rank second and are followed to a much lesser extent by steam engines and electric power. The modern drilling rig utilizes a variety of power transmission methods, including hydraulic couplings, torque converters, automatic transmissions, V belts, chain and ordinary gear drives. Controls for operating the hoisting equipment called the "draw works," rotary table and drilling fluid pumps (slush pumps or mud hogs) involve ordinary mechanical means plus pneumatic, hydraulic and electrical remote controls. All the control devices are actuated from the driller's position on the rig floor adjacent to the draw works. Also placed there are instruments necessary to the operation of the drilling equipment, including the weight indicator, to show total load on the derrick and weight on the bit at the bottom of the hole, pressure gauges for the slush pumps, both indicating and recording, torque indicator to show rotative loads on the drill pipe and tachometers, temperature, air pressure, oil pressure and ammeter for the engines powering the rig.

The hole being bored should usually be as nearly vertical as possible. Subsurface devices are used either to make a continuous survey of the drift of the borehole or to check its deviation intermittently from the vertical. Sometimes it is desirable to slant a bore intentionally at a specified angle in some desired direction. This practice involves special drilling methods which must be carefully checked with subsurface surveying instruments. Drilling fluids are carefully controlled. It is vital that the mud fluid be of sufficient weight to hold back fluid pressure encountered in formations penetrated, that viscosity be proper for the removal of cuttings from the hole and that free fluid or "water loss" be controlled so that abnormally thick caking will not occur on the wall of the hole.

Drilling fluids are usually made with water as the base, to which are added clay compounds, weighting materials and chemicals for obtaining the desired characteristics. Other drilling fluids are prepared with oils and are known as oil base muds.

Steel pipe, called casing is run into the hole as required to prevent hole caving and blowout of high-pressure oil and gas and, finally, to provide for producing from the selected formation. Casings are sealed in place and protected by "oil well cementing." This involves pumping a liquid slurry of portland cement in water down through the casing and up into the space between it and the bore and allowing it to harden in place. These cements are adapted to specific conditions by addition agents to control setting time, pumpability and final hardness.

With the formation behind the casing sealed after cementing, the hole may be carried deeper at reduced size by drilling down through the casing thus set or, if a producing formation has

been penetrated, the casing may be perforated by shooting with projectiles or explosive jets lowered through the casing on cable containing an electric conductor. Cementing serves to seal off water, oil or gas from escaping to the surface or from one earth formation to another. It is important in well completions to exclude undesired water or excessive gas, or both, from the oil production, otherwise, gas pressure is wasted or oil and gas production flooded out.

It is a common practice when completing wells where the casing is either set through the producing zone and perforated, or landed above the producing zone and completion made in open hole, to apply chemical and hydraulic methods to secure production. Hydrochloric acid mixtures containing corrosion inhibitors and other chemicals are used in limestone formations. Other chemical solutions are used to rid limestone or sandstone of the mud used in drilling, which may have penetrated and partially blocked the pores of the formation.

Another important well completion practice is hydraulic fracturing. This procedure cracks the producing formation rocks by pressure applied by fluids pumped into the well. The fractures so produced provide channels in the rock for flow of oil and gas into the bore of the well.

During drilling operations and prior to completion, it is possible to determine the nature and content of the drilled formations in many ways. By use of core bits a sample of the formation being cut is recovered. The bore may be electrically logged with instruments lowered on an electric conductor cable to determine factors indicative of the kind of rock and the fluids contained in it. A formation offering possible production can be tested for fluid content by drill stem or formation testing. In this instance, the drill pipe is connected to valves and packers which are lowered into the well, then sealed off in the bore to exclude the mud in the well from the formation. The valves are then opened and fluid within the packed off formation flows into the empty drill pipe, thus determining productivity without the necessity of running and setting a string of casing.

At the start of 1954 the world's deepest producing well was 17,306 ft at Weeks Island, La. At the same time, the drilling depth record was 21,482 ft in Kern county, Calif. Three wells had penetrated the 20,000 ft mark, one each in Mississippi, California and Wyoming.

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DRINKING VESSELS Nature provided the primitive man with various forms of drinking vessels such as the coconut, the gourd, eggs of the larger birds, shells and even the human skull many of which have been of such practical use that they have lasted to the present day. The first artificial drinking vessels were so similar to those used for food that it is difficult to make a definite line of distinction. The races of the Neolithic and Bronze Ages furnished vessels of pottery of a beakerlike form, and later prehistoric times produced vessels of gold, bronze and other materials which seem to have been used as drinking vessels.

A specimen, resembling an early Victorian tescup on a high foot, was found by Schliemann in his exploration of the superimposed cities of Troy. It is of clay, but similar forms found at Tyrins and Mycenae are of gold. Schliemann was especially interested in a tall, trumpet shaped cup with two earlike loop handles, a saucerboat-shaped vessel of gold, made with a lip for pouring or drinking at each end and with two loop handles, and others of gold, silver and electrum, three of which were shaped like 18th century coffee cups without handles.

Gothic and Scandinavian Types—The practice of burying with the dead warrior any property that he might need has persisted to our day the actual vessels in use by the pagan Northmen who pervaded northern Europe from the 4th century onward. Among the belongings surrounding one Saxon chieftain were five cows' horns and four glass cups. The horns were 2 ft long and richly mounted at the mouth and at the point with silver bands embossed and gilt. The glasses were of a trumpet shape, with a

small foot, while the sides were ornamented with tubes bent down ward and open on the inner side, so that the liquid would fill them. Another type was a simple cone of glass, sometimes ornamented with an applied spiral glass thread, or festoons of white glass imbedded in the body of the vessel. Still a third form was that of the "tumbler," a plain cup or bowl widely expanded at the mouth and with a rounded base, so that it could only be set down when empty. There are in the museums many other contemporary varieties, plain cylindrical goblets generally with ornamental glass threads on the outside, and a more usual type has an orange-shaped body with a wide, plain mouth. In Belgium, France and Germany the same types occur, also additional forms that do not occur in England—one of which is a drinking glass in the shape of a hunting horn with glass threads forming an ornamental design on the outside. These glass drinking vessels were popular, but a large number of small pottery vessels were found, and in one grave at Broomfield, in Essex, two small wooden cups were found. Horns as drinking vessels retained their popularity at all times, actual horns being supplanted later by horn-shaped vessels.

Church Vessels.—The drinking vessel possessing the most established history is doubtless the chalice of the Christian Church. Upon early Christian tombstones are found such vessels apparently with a symbolic intention. But it is not until about the 6th century that the sacred vessels assumed a definite form. From that time date the lost golden chalices of Monza, representations of which still exist in that city, and the famous chalice of Gourdon in the Bibliothèque Nationale in Paris is probably of about the same time. All of these are two handled with a vase shaped body supported on a high base. Two glass vases of exactly this two handled form are in the Slade collection at the British Museum, and may well have been chalices. This form seems to have been succeeded by a goblet with straight lines and without handles. Then came the rounded cup-shaped bowl as seen in the well known Kremsmünster chalice. An interesting silver vessel, probably a chalice, found at Trewiddle, in Cornwall, is in the British Museum. It is a plain semi-oval, and dates from the 9th century. The 13th century chalice was usually a broad, shallow cup, on a conical base. These gradually became taller, with a bowl smaller in proportion, so that in the 17th century both the civil and religious vessels had lost all sense of true artistic proportions. In Britain chalices ceased to be used in the English church in the reign of Edward VI and were replaced by communion cups. The chalices of the early centuries were made of various materials, glass being more practicable, with gold and silver as preferences when they could be obtained.

Mediaeval Vessels for Common Uses.—Wooden vessels, of which mazer bowls seem to have predominated, were commonly used in the 14th, 15th and 16th centuries. In the latter century they began to take on elaborate mountings, and then, as other materials came into use among the wealthy, they began to lose their popularity. Crystal, agate and other hard stones, ivory and Chinese porcelain, were all in use, as well as the precious metals. Of the cups that are preserved in the British Museum, the royal gold cup of the kings of England and France is of interest. It is of nearly pure gold with a broad bowl and a high foot, the cover pyramidal. The subjects represented on its ornamentation are scenes from the life of St. Agnes, in two rows on the cover and on each side the bowl, on the foot are the symbols of the four Evangelists, and around the base a coronal of leaves alternating with pearls, the cover originally had a similar adjunct, but it has unfortunately been cut away. Its history has been traced from the time when it was made, about 1380, to the present time.

16th-18th Century Types.—Drinking vessels of the 15th and 16th centuries were of so many shapes, materials and decorations that most every type can be placed in that period. There were all sorts of adaptations, such as the ostrich leg mounted on elaborate silver, the coco-nut used in the same way and Chinese and other Oriental wares turned into cups, and a vast number of other forms. Horns, provided with feet so as to serve as standing cups, were quite common. The elegant natural curve of the horn, often mounted with great richness, added still to the charm of the vessel. German silver-smiths made many vessels in the forms of

animals, the head generally removable so as to form a small cup. Stags, lions, bears and various birds are often found. A common type of Switzerland and South Germany was that of a figure of a peasant, generally in wood, carrying on his back a large basket, which edged with silver formed the drinking cup. A curious fancy was to make cups in the form of a globe. These are of historic value, because they show the state of geographical or astronomical knowledge at the time.

Glass cups were not common in England until the 16th century, Venice having practically a monopoly of the supply. The relations of Venice with the East were of so intimate a character that the earlier forms of Venetian glasses were nearly identical with those of the Mohammedan East. This period saw various kinds of wine glasses and goblets with enamelled and lace designs, tankards, practical but seldom graceful, beakers, resembling our modern tumblers and a common type among the Arabians.

In the 17th and 18th centuries a great impetus was given to the production of curious drinking vessels, not in the sense of supplanting the many varieties of the past, but as an interesting innovation. Cups of leather, generally in the form of a lady's shoe, were common. Flagon, or "black jacks" were also of leather. The material that lent itself to a greater possibility in the field of art was that of pottery. In England at various potting centres a great number of cups called "jugs" were made. These were large mugs with three or four handles, so that the cup could be passed from one to another. Some of these have quaint devices and inscriptions. "Puzzle jugs" afforded a good deal of amusement at this time. They were jugs with open-work around the neck, and a variety of spouts, only one of which led to the liquid. The Chinese still cling to the rhinoceros horn as an object of somewhat archaic form, believing it to be an antidote for poison. The beautiful amber hue and the thickness of the horn, together with the various carved decorations, make it a vessel of unusual interest. Tea-cups with no handles, and much thinner than coffee cups, were made in China in the 18th century.

The 19th and 20th centuries have seen the manufacture and use of most every form of drinking vessel that the ancient and mediaeval times produced, after changing the shapes and materials only as a matter of commercial interest. Glass is the most widely used material, being cheaper and more practicable, while clay is a better material when it comes to retaining heat or cold. (See also GLASS, POTTERY AND PORCELAIN, SILVERSMITHS' AND GOLDSMITHS' WORK.)

DRINKS, SOFT see AERATED WATERS

DRINK TRAFFIC see LIQUOR LAWS

DRINKWATER, JOHN (1882-1937), British poet, playwright and critic, born at Leytonstone, Essex, June 1, 1882, and educated at the Oxford high school. After 12 years' work as an insurance clerk, he devoted himself to theatrical enterprise, and became manager and producer to the Pilgrim Players, who developed into the Birmingham Repertory Theatre Co. His first volume of poems appeared in 1906 and his first play, *Cophetua* (in verse), in 1911. He subsequently published several volumes of verse, critical studies on *William Morris* (1912), *Swinburne* (1913) and others, and several plays, of which *Abraham Lincoln* (1918) was produced with great success both in London and in the United States. Among his later plays were the "chronicle dramas" *Oliver Cromwell* (1921), *Mary Stuart* (1922) and *Robert E. Lee* (1923), each of which was performed in London. In 1923 his *Collected Poems* (2 vol.) were published, and in 1925 *The Muse in Council*, a collection of essays, and his *Collected Plays* (2 vol.). In 1925 *The Pilgrim of Eternity* *Byron—a Confession*, a prose work, made its appearance. His autobiography appeared in two volumes, *Inheritance* (1931) and *Discovery* (1932). He wrote prolifically in the last years of his life, but none of his later work was of particular importance. He died March 25, 1937.

DRIP, DRIP-MOULD or **DRIPSTONE** see HOOD MOULD

DRIVER, SAMUEL ROLLES (1846-1914), English divine and Hebrew scholar, was born in Southampton on Oct. 2, 1846. He was educated at Winchester and New College, Oxford.

He was a fellow (1870) and tutor (1875) of New College, and in 1883 succeeded Pusey as regius professor of Hebrew and canon of Christ Church. He was a member of the Old Testament revision committee (1876-84) and examining chaplain to the bishop of Southwell (1884-1904). He died on Feb. 26, 1914. Dr. Driver devoted his life to the study, both textual and critical, of the Old Testament. Among his numerous works are commentaries on the books of the Old Testament. His *Intro to the Literature of the Old Test.* (1897, 9th ed., 1913) became a standard work, and exercised great influence on younger scholars. His other most important work in Hebrew scholarship is to be found in his contributions to the *Oxford Heb. and Eng. Lexicon of the OT* (1906). A bibliography of his works is given in appendix B to Cooke's edition of *Ideals of the Prophets* (1915).

DRIVER'S INSURANCE *see* MOTOR VEHICLE INSURANCE

DRIVING, a word used in a restricted sense for the art of controlling and directing draught animals from a coach or other conveyance or movable machine to which they are harnessed for the purpose of traction (from "to drive", *ie* generally to propel, force along or in, a word common in various forms to the Teutonic languages). This has been an occupation practised since domesticated animals were first put to this use. In various parts of the world a number of different animals have been, and still are, so employed, of these the horse, ox, mule and ass are the most common, though their place is taken by the reindeer in northern latitudes, and by the Eskimo dog in Arctic and Antarctic regions. The driving of each of these requires special skill, only to be acquired by practice combined with knowledge of the characteristics peculiar to the several animals employed.

Under all these different conditions driving is a work of utility, of economic value to civilized society. But from very early times driving, especially of horses, has also been regarded as a sport or pastime. This probably arose in the first instance from its association with battle. In the earliest historical records, such as the Old Testament and the Homeric poems, the driver of the chariot fills a place of importance in the economy of war, and on his skill and efficiency the fate of kings, and even of kingdoms, must often have depended. The statement in the Book of Kings that Jehu the son of Nimshi was recognized from a distance by his style of driving appears to indicate that the warrior himself on occasion took the place of the professional charioteer, and although it would be unsafe to infer from the story that the pleasure derived from the occupation was his motive for doing so, the name of this king of Israel has become the synonym of drivers. Among the Greeks at an equally early period driving was a recognized form of sport, to the popularity of which Horace afterwards made allusion. Racing between teams of horses harnessed to war chariots took the place occupied by saddle-horse racing and American trotting races (*see* HORSE RACING AND BREEDING) in the sport of modern times. The element of danger gave excitement to chariot racing and kept alive its association with incidents familiar in war, just as at a later period, when the institution of chivalry had given the armed knight on horseback a conspicuous place in mediæval warfare, the tournament became the most popular sport of the aristocracy throughout Europe.

Driving as it is practised to-day for pleasure without profit, and without the excitement of racing, is of quite modern development. Oliver Cromwell, indeed, met with a mishap in Hyde Park while driving a team of four horses presented to him by the count of Oldenburg, which was the subject of more than one satirical

a means of communication between different parts of Great Britain, but those who made use of them did so as a matter of necessity and not for enjoyment. But by the beginning of the 19th century the improvement in carriage building and road construction alike had greatly diminished the discomfort of travel, and interest in driving for its own sake grew so rapidly that in 1807 the first association of amateur coachmen was formed. The two principal driving clubs in recent times have been the Four in Hand and Coaching Clubs. The former was founded in 1854 by the then duke of Beaufort, and such was its popularity that the club could not entertain a quarter of the applications for membership. In 1890 therefore the Coaching Club was formed with the duke of Beaufort as president. The meetings of these two clubs in Hyde Park were in pre-war days a great feature of the London season, and on two or three occasions the Coaching Club mustered more than 30 coaches. The Four-in-Hand Club after an existence of over 70 years was dissolved in 1926, but the Junior Club in 1927 continued to be well supported, and in this year some 10 to 12 members drove their drags to the three meetings which were held. The club at this time numbered 41 members.

Road coaching has for long been a popular pastime amongst horsemen in the British Isles. Following the suppression of the stage coaches by railways an important revival of coaching was initiated in 1866, and up to the time of the World War there were numerous well-appointed stage coaches running daily in and out of London, notably on the Brighton and Portsmouth roads. On July 13, 1888, J. Selby, the well-known professional coachman, performed his celebrated feat of driving the "Old Times" coach from London to Brighton and back in 7 hrs. and 50 mins. This drive worked out at an average pace of 13.75 m. per hour, horses being changed so smartly that with 8 teams and 14 changes the latter took altogether only 6 mins. 12 secs. Since the war, owing to economic conditions and the great increase in motor traffic most of these coaches have been compelled to come off the road, but in 1927 the "Old Berkeley" and "Venture" coaches, running respectively to Boxhill and Hampton Court had successful seasons (*see* COACHING).

In modern driving, one, two or four horses are usually employed. When a greater number than four is put in harness, as in the case of the state equipages of royal personages on occasions of ceremony, the horses are not driven but are controlled by "postillions" mounted on the rear side horse of each pair. When two horses are used they may either be placed side by side, in "double harness," which is the commoner mode of driving a pair of horses, or one following the other, in a "tandem." Four horses, or "four-in-hand," are harnessed in two pairs, one following the other, and called respectively the "leaders" and the "wheelers."

Though it is a less difficult accomplishment to drive a single horse than a tandem or four-in-hand, or even a pair, it nevertheless requires both knowledge and the skill that practice alone confers. The driver should have some knowledge of equine character, and complete familiarity with every part of the harness he uses, and with the purpose which each buckle or strap is intended to serve. The indefinable quality known in horsemanship as "good hands" is, partly at least, the result of learning the correct position for the arm and hand that holds the reins. The reins are held in the left hand, which should be kept at about the level of the lowest button of the driver's waistcoat, and near the body though not pressed against it. The driving hand should never be reached forward more than a few inches, nor raised as high as the breast. The upper arm should be loosely against the side, the forearm horizontal across the front of the body, forming a right angle or thereabouts at the elbow-joint, the wrist bent inwards, and the back of the hand and knuckles facing outwards towards the horses. In this position the three joints of the arm form a kind of automatic spring that secures the "give" to the movement of the horse's mouth which, in conjunction with firmness, is a large part of what is meant by "good hands." But this result is only obtained if the reins be also held with the proper degree of bearing on the bit. What the proper degree may be depends greatly on the character of the horses and the seyer

ity of the bit. Pulling horses must be restrained by a strong draw on their bits, such as would bring other animals to a standstill. But under no circumstances, no matter how sluggish the horses are, should the reins be allowed to be slack. The driver should therefore always just "feel his horse's mouth" as lightly as possible, he then has the animal well under control in readiness for every emergency, while avoiding such a pull on the mouth as would cause a high spirited horse to chafe and fret.

These principles are common to all branches of the art of driving, whether of one, two or four horses. When they are observed no great difficulty confronts the coachman who is content with single or double harness, provided he has acquired the eye for pace and distance and the instinctive realization of the length of the carriage behind him, without which he may suffer collision with other vehicles, or allow insufficient room in turning a corner or entering a gateway. For before he can have had the practice by which alone this knowledge is to be gained, the beginner will have learned such elementary facts as that his horses must be held well in hand going down hill and given their heads on an ascent, and to be sparing in the use of the hand-brake, with which many modern carriages are provided. This apparatus is most useful in case of emergency or for taking weight off the carriage on a really steep descent, but the habit which too many coachmen fall into of using the brake on every trifling decline should be avoided. Its effect is that the horses are continually doing collar-work, and are thus deprived of the relief which ought to be given them by occasional light pole or shaft work.

Tandem and Four in hand.—When the ambition of the amateur coachman leads him to attempt a tandem or four in hand he enters on a much more complex department of the art of driving. In the first place he has now four reins instead of two to manipulate, and the increase of weight on his hand, especially when four horses are being driven, requires considerable strength of wrist to support it without tiring. It is of the first importance, moreover, that he should know instinctively the position in his hand of each of the reins, and be able automatically and instantaneously to lay a finger on any one of them. The driver who has to look at his reins to find the off side leader's rein, or who touches the near side wheeler's in mistake for it, is in peril of a catastrophe. It is therefore essential that the reins should be correctly disposed between the fingers of the left hand, and that the driver should as quickly as possible accustom himself to handle them automatically. The coachman should take the reins in his hand before mounting the box-seat, as otherwise his team may make a start without his having the means to control them. It is customary to hitch the reins, ready for him to take them on, behind the tug strap which supports the trace buckle and the pad of the off side wheeler in four in-hand or the off side shaft bearer in tandem. Standing on the ground beside the off-side wheel of his carriage, ready to mount to the box seat, the coachman, after drawing up his reins till he almost feels the horses' mouths, must then let out about a foot of slack in his off side reins, in order that when on his seat he may find all the reins as nearly as possible equal in length in his hand. The reins should then be transferred to the right hand disposed as they will be in the left when ready to start, but one finger lower down, the first finger will then be free to hold on to the footboard in mounting the box. When replaced in the left hand and after mounting, the leader's reins would be operated by the forefinger and the wheeler's by the middle finger. The near leader's rein will then be uppermost of the four, between the forefinger and thumb, then between the forefinger and middle finger and then two reins to the left—the off leader's and the near wheeler's in the order named while at the bottom between the middle and third fingers is the off wheeler's rein. It will be found that held thus the reins are immediately in front of the hand in such a way that each wheel rein and each pair of reins—two near side two off side two wheelers', or two leaders'—can be conveniently manipulated, and the proficient driver can instinctively and instantaneously grasp any of them he chooses with his right hand without having to turn his eyes from the road before him to the reins in his hand.

Having seated himself on the box and transferred the reins thus disposed, from the right to the left hand, the coachman should shorten them till he just feels his wheelers' mouths and hold back his leaders sufficiently to prevent them quite tightening their traces. Then, when he has taken the whip from its socket in his right hand, he is ready to start. This is an operation requiring careful management, to secure that leaders and wheelers start simultaneously, for if the leaders start first they will be drawn up sharp by their bits. The moment it is desired to start, the team should be given their heads and the "office" to start by the coachman at once easing his left hand. When once started a further adjustment of the reins is usually necessary. The driver should see that his team is going straight. If the leaders and wheelers are not exactly on the same line, this or that rein must be shortened or lengthened as the case may require, and it is to be noticed that as the near-wheeler's and off leader's reins lie together between the same fingers, a simultaneous shortening or lengthening of these two reins will usually produce the desired result.

With rare exceptions, reins should be shortened or lengthened by pushing them back or drawing them forward with the right hand in front of the driving hand, and not from behind it. As soon as the team is in motion the leaders may be let out till they draw their traces taut, but draught should be taken off them on falling ground or while rounding a corner.

In rounding a corner a loop of the leaders' rein, on the side to which the turn is to be made, is taken up by the right hand and placed under the left thumb. This "points the leaders," who accordingly make the required turn, while at the same time the right hand bears lightly on the reins of the opposite side, to prevent them making the turn too sharply for safety to the coach behind them.

When the turn is made the driver's left thumb releases the loop and the team returns to the straight formation.

The Use of the Whip.—A necessary part of driving four horses or tandem is the proper use of the whip. The novice, before beginning to drive, should acquire the knack—which can only be learned by practical instruction and persistent practice—of catching up the thong of the whip on to the stick by a flick of the wrist, keeping the elbow close to one's side. Practice and considerable dexterity are required in using the whip on the leaders without at the same time touching, or at all events, alarming or fretting, the wheelers. The thong of the whip should reach the leaders from beneath the swingle or lead bar. This demands skill and accuracy, especially when striking the near leader, but no coachman is competent to drive four horses until he is able to touch with the whip any particular horse that may require it, and no other.

Essential as is proficiency in the use of the whip when driving four horses, it is even more imperative for the driver of tandem. For in four in-hand the leaders act in some measure as a restraint upon each other's freedom of action, whereas the leader in tandem is entirely independent and therefore more difficult to control.

In the usual method of harnessing a tandem the lead traces draw direct from the wheeler's trace buckles. They should never be attached to the shafts, as this is a dangerous practice. The above method entails a considerable length of trace, and a trace bearing-strap passing over the leader's lions is a necessity. Another method consists in having two swingle or lead bars similar to those used in four-in-hand, by means of which the leader's traces can be reduced to the same length as those of the wheeler. But this method is very seldom adopted.

A tandem, owing to the greater freedom of the leader from control, requires in a sense more delicate handling than a four in hand, but the latter supplies the coachman with problems of greater difficulty, and so of greater interest, if only for the reason that he has to deal with the various temperaments of four horses instead of two, while the weight on the hand is obviously more severe, and a heavy coach load entails extra precautions for safety, especially in driving down hill. In Great Britain the coach and-four is the more popular.

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Donald Walker, *British Manly Exercises in Which Riding, Driving, Racing are Now First Described* (1834), William Bridges Adams, *English Pleasure Carriages: Their Origin, History, Materials, Construction* (1837), *The Equestrian: A Handbook of Horsemanship, Containing Plain Rules for Riding, Driving and the Management of the Horse* (1854), J. H. Walsh ("Stonehenge"), *Riding and Driving* (1861), A Cavalry Officer, *The Handy Horse Book, or Practical Instruction in Driving and the Management of the Horse* (1865-67, 1871-81), H. J. Hcin, *American Roadsters and Trotting Horses* (1878), E. M. Statton, *The World on Wheels* (1891), F. H. Ruth, *Works on Horses and Equitation: A Bibliographical Record of Hippology* (1887), the Duke of Beaufort, *Driving* (Badminton Library, 1889), containing a bibliography, Capt. C. Morley Knight, *Hints on Driving* (1894), James A. Garland, *The Private Stable*, 2nd ed. (1902) (X, G W)

DRIZZLE, a steady light rain in which the drops are very minute (diameter less than $\frac{1}{16}$ in, approximately) and numerous. Such small drops seem almost to float in, and thereby to follow, even the slightest motions of the air. Drizzle is distinguished from sprinkles or ordinary light rain in that it falls from thick low lying stratus or strato cumulus clouds, rather than from cumulus or alto stratus, and always causes poor visibility. In theory the precipitation of drizzle is a consequence of turbulence produced by friction of the air with the ground, whereas other rain requires larger-scale vertical motions reaching higher levels in the atmosphere. Freezing drizzle causes glaze (or glazed frost), a thin, transparent ice crust on the ground and exposed objects, but frozen drizzle (or granular snow) consists of very fine snow or ice grains falling under identical circumstances as rain drizzle, except at cloud level temperatures at or below the freezing point. In the U.S., drizzle is sometimes confused with mist (q v)

(R G Se.)

DROBISCH, MORITZ WILHELM (1802-1896), German philosopher and mathematician, was born on Aug. 16, 1802, in Leipzig, where he became professor of mathematics in 1826, professor of philosophy in 1842, and where he died on Sept. 30, 1896. He regarded logic, whose business is the establishment of the general laws of thought, as a formal science independent of psychology. Religion was, for him, the expression of man's desire to escape from the impulses of nature to a divine being whose existence is better demonstrated by the ethical than the teleological proof. Drobisch's support of Johann Herbart appears in his *Beiträge zur Orientierung über Herbart's System der Philosophie* (1834) and in *Neue Darstellung der Logik* (1836). He also wrote *Grundrissen der Religionsphilosophie* (1840), *Empirische Psychologie* (1842), *Quaestiones mathematico-psychologicae spec. I-V* (1836-39) and *Über die mathematische Bestimmung der musikalischen Intervalle* (1846).

See Neubert, M. W. Drobisch (Leipzig, 1902)

DROESHOUT, MARTIN (1602-c. 1650), engraver, baptized in London, was the son of Michael Droeshout and probably the pupil of his father and of his elder brother John, both engravers. Martin's title to fame is his engraved portrait of William Shakespeare (signed *Martin Droeshout sculpit*), which appeared in the first folio edition of Shakespeare's plays (1623). Since the engraver was only 15 years old at the time of Shakespeare's death, the portrait was not done from life. Martin Droeshout's later work is better. The British Museum *Catalogue of Engraved British Portraits Preserved in the Department*, vol. vi (1925) lists eight portraits engraved by Martin Droeshout.

See Sidney Colvin, *Early Engraving and Engravers in England, 1545-1695* (1906), Arthur M. Hind, *List of the Works of Line-Engravers in England* (1906) (C H C B)

DROGHEDA, municipal borough and seaport, on the southern border of Co. Louth, Ireland, on the River Boyne, about 4 mi. from its mouth in Drogheda bay, and 3½ mi. N by W from Dublin by rail. Pop. (1951), 16,773.

The earliest notices call the town Inver Colpa or the Port of Colpa, the present name signifies "The Bridge over the Ford." A synod was convened there in 1153 by the papal legate Cardinal Paparo, in 1224 there was founded a Dominican friary, of which there are still remains, and in 1228 the two divisions of the town received separate incorporation from Henry III. In 1412 Henry IV granted a charter authorizing the combination of the two towns. In the reign of Edward III Drogheda was classed with Dublin, Waterford and Kilkenny as one of the four staple towns of Ireland. Richard II received in its Dominican friary the submissions of O'Neal,

O'Donnell and other chieftains of Ulster and Leinster. The right of coming money was bestowed on the town and several parliaments were held there, including one in 1495, when Poyning's law was enacted. In the civil wars of 1641 the place was besieged by Phelim O'Neill, but was relieved in 1649 it was captured by Oliver Cromwell and the inhabitants brutally massacred. In 1690 it was garrisoned by King James's army, but after the battle of the Boyne it surrendered without a struggle. Drogheda ceased to be a parliamentary borough in 1885, and a county of itself in 1898.

From the close of the 12th century, and for some time after the Reformation, the primates of Ireland lived in Drogheda. Its proximity to Dublin, the seat of government and of the Irish parliament, induced them to prefer it to *Ardmacha inter Hibernicos*. Near Drogheda, in later times was the primate's castle and summer palace at Termonfeckin, some ruins of which remain.

The ancient fortifications of Drogheda have disappeared save that St. Lawrence gateway remains almost perfect, and there are ruins of the West, or Butler, gate. St. Peter's chapel formerly served as the cathedral of the modern Roman Catholic archbishopric of Armagh. In the town there was formerly an archiepiscopal palace, built about 1620, and the Dominicans, the Franciscans, the Augustinians, the Carmelites and the Knights of St. John had monastic establishments. Of the Dominican monastery (1524) there still exists the Magdalen tower, while of the Augustinian abbey of St. Mary d'Urso (1505) there are the tower and a pointed arch. There is a bluecoat school, founded about 1727, present buildings, 1870. The industrial establishments comprise cotton, flax and four mills, sawmills, tanneries, salt and soapworks, breweries, cement-works, engineering works, and the big cement works, one of the largest of its kind in the world. The town is the headquarters of the valuable Boyne salmon fishery. A brisk sea trade is carried on in agricultural produce.

DROHOBYCZ, formerly a Polish town in the province of Lwow, capital of a district which contains the largest oilfield in Poland. Pop. (1937) 32,622. Oil was first found at Boryslaw and Tustanowice in 1904, and reached its highest production in 1909. Drohobycz has a factory of mineral oil, the largest oil refinery in Poland, and is connected by pipe lines with the chief wells. It also produces mineral gas, gasoline and ozokerite. Russian troops conquered Drohobycz in Sept. 1939 and it fell to Germany in 1941. It was incorporated into the USSR in 1945.

DROIT, a legal title, claim or due, a term used in English law in the phrase droits of admiralty, certain rights or perquisites assigned by the crown to the lord high admiral. (See also *WAZACK*.) The most important of these in modern times consisted of ships and goods captured in port in time of war, others were flotsam, jetsam, ligan, treasure, deodand, derelict within the admiral's jurisdiction, all fines, forfeitures, ransoms, recognizances and pecuniary punishments, all sturgeons, whales, porpoises, dolphins, grampuses and such large fishes, with the share of some prizes—such shares being afterward called tenths, in imitation of the French, who gave their admiral a *droit de dixième*. The droits of admiralty were definitely surrendered to the crown by Prince George of Denmark, when lord high admiral of England in 1702. In prize law droits of admiralty are distinguished from droits of the crown, which, before 1914, were granted to the captors of ships and cargoes captured at sea by duly commissioned ships of war. (See H. C. Rothery, *Prize Droits*, being *A Report of H.M. Treasury on Droits of the Crown and of Admiralty in Time of War* [1915], also the *Law Quarterly Review*, vol. xxxii, p. 38, and the Naval Prize Act, 1918, also Holdsworth, *History of English Law*, vol. i, pp. 559-561.)

The term droit is also used in various local conceptions (for French law, see *FRAZAR LAW*), such as the droit of agnacy (q v), the *droit d'achat* (right of preemption) in the case of contraband (q v), the feudal *droit de bris* (see *WRECK*), the *droit de régie*, or ancient royal privilege of claiming the revenues and patronage of a vacant bishopric, and the feudal droits of seigniorial personality.

DROIT ADMINISTRATIF. French administrative law may be described as that section of law which establishes the different administrative organs of the state and defines their powers as regards individuals. It will thus be noticed at once that there is a very close connection between French constitutional and administrative law since in the former the general plan of the operation of the powers inherent in the state is set out whereas in the latter the various organizations by which these powers are enforced are detailed, or—in another phrase—in constitutional law are to be found the principles whose application is enacted through the channels of administrative law.

France is for administrative purposes divided into "départements" which are subdivided into "arrondissements." The latter are again subdivided into "cantons" with a further subdivision into "communes." These different administrative divisions are

not, however, of equal importance. The "départements" and the "communes" are at the same time electoral constituencies, administrative units and so called "personnes morales." The "arrondissements" are neither "personnes morales" nor administrative units. The "cantons" are neither legal nor administrative units although they elect a councillor to the *conseil général* and to the *conseil d'arrondissement*. The "communes" form an administrative centre of great activity.

"Droit administratif" is, therefore, concerned with the general interests of the State, the regional interests of the "départements" and the local interests of the "communes," although for reasons of economy it is often enforced by the same agents as in the case of the "préfet" of a "département" who is at the same time an agent of the State and of the "département."

There are several classes of administrative organs, the authorities entrusted with the execution of administrative decisions ("préfets" and "sous-préfets"), mayors, deliberative councils, which must be subdivided into deliberative councils proper, namely, those who have power to take executive decisions (*conseil général*, *conseil d'arrondissement* and *conseil municipal*) and consulting councils (*conseil de préfecture*, *conseil d'état*), and finally administrative tribunals entrusted with jurisdiction.

The acts of administrative authority are fundamentally divided into two classes, acts of authority proper or, as they are sometimes called, unilateral administrative acts, by means of which the administration orders or prohibits some action by the subject of its administration, as for instance the order of a mayor prohibiting processions in the territory of his commune, and acts of administration proper by means of which the administrative authorities ensure the safeguard of the property of "personnes morales administratives" and enforce contracts, the nature of these acts being from a legal point of view the same as those of a private citizen. Appeals against acts of so-called authority proper are, however, within the jurisdiction of the administrative tribunals, whereas disputes arising out of acts of so called administration proper are tried before the ordinary judicial tribunals.

Acts of authority proper are subdivided into "actes individuels" and "actes réglementaires." "Actes individuels" are those concerning a particular individual in connection with a defined object. "Actes réglementaires" are those by which the administrative authority imposes certain restrictions on a body of individuals. The right to do "actes réglementaires" is entrusted as regards the whole State to the president of the republic, as regards the "départements" to the "préfets" and as regards the "communes" to the mayors. This subdivision of acts of authority proper is important as regards jurisdiction, for only "actes individuels" can be appealed against before the ordinary administrative tribunals. The sole means of attacking an "acte réglementaire" is before the *conseil d'état* which may order it to be cancelled as *ultra vires*.

Private individuals are protected against officials by their power of prosecution before the Criminal Courts in certain cases (Art. 166-195, Crim. Code) and their right of bringing an action before the ordinary judicial tribunals where an official is personally liable, as the responsible for acts done by an official only assured by the administration in cases where the fault is inherent in the service, and finally by appeal to the administrative tribunals.

It is true that in case of tort French citizens can only sue officials of the State in their official capacity in the ordinary courts when the act complained of is alleged to have been committed "with malice," and that in the absence of "malice" the private citizen must seek his remedy before an administrative tribunal. It is, however, interesting to compare generally the rights of French citizens with those of a British subject who, in dealing with State officials or civil servants, finds that he is, in many cases, powerless owing to the immunity these persons enjoy in regard to the consequences of acts done in their official capacity. French Administrative Law may be said to be based on the recognition of the fact that the State, regarded as a "personne morale," has two distinct entities, and that in its public capacity it is a "person" who is responsible for the torts of its servants as well as for contracts made by them or its officials and that consequently it may be sued, if not in the ordinary courts, before the administrative

tribunal whose existence consequently constitutes a protection for the subject against arbitrary decisions of individuals acting officially, whereas English jurisprudence, as already stated, regards acts done by officials or servants of the Crown still on the mediaeval assumption that as "the king can do no wrong" and "the State is the king," it is not responsible for the torts of its servants. This comparison between the English and French system of jurisprudence may be further emphasized by a consideration of the fact that the French administrative tribunals are real tribunals, acting independently of the executive, whose functions and powers are defined in the *Code Administratif*, whereas under the English rule of law Government departments often exercise *in camera*, and without an oral hearing of the applicant, semi-judicial functions under Statutory Powers which, in practice, confer on them the power of judging their own cause without appeal.

Only cases in which a definite right has been violated can be heard before the administrative tribunals, where private interests only are concerned appeal can be made only to representatives of the administration, following the hierarchical order upwards. As regards the cases which come before the administrative tribunals these are divided into four classes—first, those in which the tribunal examines the matter as regards both law and fact, and decides if a decision is to be upheld or replaced by another, secondly, those in which the tribunal has to decide if any administrative act was *ultra vires*, in which case it quashes the decision, thirdly, those in which the tribunal is called upon to interpret the scope and intention of an administrative act, and, fourthly, those in which the tribunal has power to impose a penalty in cases where public property has been encroached upon, or a legal usufruct of public utility unobserved. It must be noticed that this last class of case constitutes an infraction of the rule that every illegal act of any kind, the commission of which entails a penalty, falls within the provisions of the Penal Code and must be tried before the ordinary judicial tribunals.

The fundamental principle of the separation of the judicial and administrative authorities was enacted by the law of Aug. 24, 1790, sec. 2 Art. 13 which enacts that the judges may not in any way interfere with the operations of the administrative corps, or summon before them administrators to answer for acts done in carrying out their proper duties. This principle has been so far developed that if during the course of an action before the ordinary judicial tribunals a question arises which might prejudice a decision of the administrative tribunals, the hearing must be suspended pending a decision by the latter. In cases, however, of "expropriation" on grounds of public utility, in which a decision must be given by the judicial tribunal, the latter may refuse to make an order if all the legal formalities required have not been duly carried out by the administrative authorities.

Finally certain matters which should, according to their nature, be brought before the judicial tribunals have by law been allotted to administrative tribunals, e.g., questions arising out of the contracting for public works, the sale of any part of the national domain and the declaration of the State as a debtor.

Administrative tribunals are divided into tribunals of first instance and those of appeal. The mayor and the council of the prefecture always constitute tribunals of first instance. The "préfets" and the competent minister constitute sometimes tribunals of first instance and sometimes tribunals of appeal. The *conseil d'état* is in principle an appeal tribunal, although in certain cases it is a court of first and last instance, and even a court of cassation. The *cour des comptes* except in one instance is a court of first and last instance. These tribunals are also subdivided into tribunals competent to hear and determine all matters which have not been specially reserved, and special tribunals for the trial of the latter class of cases.

Ordinary tribunals are in the first instance that of the competent minister and in the second instance the *conseil d'état*. Special tribunals for the hearing of general cases are the council of the prefecture, the "préfet," the "sub préfet" and the mayor.

Special tribunals with special functions are those of the *cour des comptes*, the maritime prefects, the council of public instruction, the tribunals with jurisdiction concerning the issue of coinage,

that of the sanitary police, that for excess values and that for the colonies

Administrative judges are removable, with the exception of those of the *cour des comptes* (F No)

DROITWICH, market town and municipal borough, Evesham parliamentary division, Worcestershire, England, 5½ mi NNE of Worcester, and 12½ mi NW from London by the GWR, but served also by the LMSR. Pop (1938) 4,662. Area 2.7 sq mi. It stands on the river Salwarpe, a tributary of the Severn, being connected with the latter by canal. There are three parish churches, St Andrew, St Peter and St Michael, of which the first two are fine old buildings in mixed styles. The principal occupation is the manufacture of the salt obtained from the brine springs or *wyches*, to which the town probably owes its name and origin. The springs also give Droitwich a considerable reputation as a health resort. There are Royal Brine baths (with a clinic), St Andrew's baths and a private bath hospital. Because of the pumping of the brine there is a continual subsidence of the ground, detrimental to the buildings, and new houses are mostly built in the suburbs. In the pleasant well wooded district surrounding Droitwich the most noteworthy points are Hindlip hall, 3 mi S, where (in a former mansion) conspirators in the Gun powder plot defied search for eight days (1605), and Westwood, a fine hall of Elizabethan and Carolean date on the site of a Benedictine nunnery, 1 mi W of Droitwich, which offered a retreat to many royalists during the commonwealth.

A Roman villa, with various relics, has been discovered there, but it is doubtful how far the Romans made use of the brine springs, which are also mentioned in several charters before the conquest. At the time of the Domesday survey all the salt springs belonged to the king, who received a yearly farm of £65, but the manor was divided between several churches and tenants in chief. The burgesses of Droitwich (*Wic, Salwric, Wich, Drightwich*) are mentioned in the Domesday survey. The town is first called a "burgus" in the pipe roll of 1155-56, but the burgesses did not receive their first charter until 1215, when King John demanded a fee farm of £100. The payment of the fee farm gradually lapsed in the 18th century. In mediaeval times Droitwich was governed by 2 bailiffs and 12 jurats. Queen Mary granted the incorporation charter in 1553-54 under the name of the bailiffs and burgesses. James I in 1625 granted fuller charter, which remained the governing charter until the Municipal Reform Act. King John's charter granted the burgesses a fair on May 9, to last for eight days, but Edward III in 1330 granted instead two fairs, on Dec 29 and Oct 28 and three days after. Queen Mary granted three new fairs. In recent times fairs were held in June and December, but these have lapsed and now none is held. James I changed the market day from Monday to Friday.

DRÔME, a department of southeast France, formed of parts of Dauphiné and Provence, and bounded on the west by the Rhône, which separates it from Ardèche, north and northeast by Isère, east by Hautes-Alpes, southeast by Basses-Alpes and south by Vaucluse, area 2,533 sq mi, pop (1936) 267,281. Drôme is watered by tributaries of the Rhône, including the Isère in the north, the Drôme in the centre and the Ayzgues in the south, flowing from spurs of the Alps westward to the alluvial plains on the left bank of the Rhône. North of the Drôme lie the Vercors and the Royans, a region of forest clad north-to-south ridges. South of that river the mountain system is intersected everywhere by torrents. In the east of the department the mountains of the Dévoluy reach 7,890 ft. North of the Isère a district of low hills stretches to the limits of the department on the Vallouise, its most productive portion. The climate, except in the valleys bordering the Rhône, is cold, and winds blow incessantly. Snow lies on the mountains during the greater part of the year.

The agriculture of the department is moderately prosperous. The main crops are wheat, grown chiefly on the banks of the Isère and Rhône, oats and potatoes. Large flocks of sheep feed on the pastures in the south; cattle raising is carried on principally in the northeast. Good wines, among which the famous Hermitage growth ranks first, are grown on the hills and plains near the

Rhône and Drôme. Fruit culture is much practised. Olives and figs are grown in the south, the cultivation of mulberries and walnuts is more widely spread. The rearing of silkworms in Drôme is very important. The Montélimar district is noted for its truffles. Mineral products include lignite, blende, galena, calamine, freestone, lime, cement, potter's clay and kaolin. Brick and tile works, potteries and porcelain manufactories exist in several localities. Industries comprise flour milling, distilling, wood sawing, turnery and dyeing. The chief textile industry is the preparation and weaving of silk, which is carried on in a number of towns. Woollen and cotton goods are also manufactured. Leather working and bootmaking, carried on on a large scale at Romans, are important, also the manufacture of machinery, hats, confectionery and paper. Drôme exports fruit, nuts, oil, cheese, wine, wool, livestock and its manufactured articles, the chief import is coal. It is served by the Paris Lyon railway, and the Rhône and Isère furnish more than 100 mi of navigable waterway. The canal de la Bourne, the only one in the department, is used for purposes of irrigation only. Drôme is divided into the arrondissements of Valence, Die, Montélimar and Nyons, comprising 29 cantons and 378 communes. The capital of the department of Drôme is Valence, the seat of a bishopric of the province of Avignon. The department forms part of the *académie* (educational division) of Grenoble, where its court of appeal is also located, and of the region of the 14th army corps (Lyons). Besides Valence, the chief towns of the department are Die, Montélimar, Crest and Nyons. Nyons is a small industrial town with a mediaeval bridge and remains of ramparts. Suse la-Rousse is dominated by a fine château with fortifications of the 13th and 14th centuries, in the interior the buildings are in the Renaissance style. At St Donat there are remains of the palace of the kings of cisjurian Burgundy, though little of the building is earlier than the 13th century, it is the oldest example of civil architecture in France. The churches of Léoncel, St Restitut and La Garde-Adhémar, all of Romanesque architecture, are also of antiquarian interest. St Paul Trois Châteaux, an old Roman town, once the seat of a bishopric, has a Romanesque cathedral. At Grignan there are remains of the Renaissance château where Madame de Sévigné died. At Tain there is a sacrificial altar of AD 184.

DROMEDARY, a name properly used for the swift, riding breed of camel, belonging to the Arabian (one-humped) species. A dromedary has been known to carry a man 115 mi in less than 11 hr. (See CAMEL)

DROMICEIDAE see EMU

DROMORE, a market town and urban district of Co. Down, N Ire, on the Upper Lagan, 17½ mi SW of Belfast by rail. Pop (1937) 2,176. Area 262 ac. The bishopric there grew out of an abbey of Canons Regular attributed to St Colman in the 6th century, and was united in 1842 to Down and Connor. The town and cathedral were wholly destroyed during the insurrection of 1641, and the present church was built by Bishop Jeremy Taylor in 1661. Remains of a castle and earthworks are to be seen, together with a large rath, or encampment, known as the Great Fort. The town gives its name to a Roman Catholic diocese. Manufacture of linen is the chief industry.

DROMOS, the open air passage, enclosed between stone walls, leading down to the entrance of Greek "beehive" tombs.

DRONE, in music, the bass pipe or pipes of instruments of the bagpipe type, having no lateral holes and therefore giving out the same note without intermission as long as there is wind in the bag, thus forming a continuous pedal, or drone bass. The drone pipe has, instead of a mouthpiece, a socket fitted with a beating reed, and inserted into a stock or short pipe immovably fixed into an aperture of the bag. The Greek classics allude to the existence of a pipe with a drone, either of the argheol or the bagpipe type.

DRONFIELD, a town and urban district of Derbyshire, England, 6 mi S of Sheffield, on the LMS railway. Pop (est. 1938) 6,609. Area 5.4 sq mi. It is on the river Drone, a tributary of the Rother. There are extensive foundries. Spades, shovels, reaping hooks, sickles and scythes are made. Coal is mined in the neighbourhood. The church of St John the Baptist, with a lofty spire, is a good example of Decorated work, with

Perpendicular additions

DRONGO, any of about 20 species of old world passerine birds, also known as king crows or drongo shrikes, forming the family Dicruridae, related to the old world orioles. They are handsome, fork tailed, usually black and 10 to 12 in long, but the prolonged outer tail feathers sometimes double that length. They are commonest in southeastern Asia, but also occur in Africa, Malaysia and Australia. The drongo cuckoo of India (*Surniculus lugubris*) resembles or mimics the common drongo (*Buchanania atra*) and lays its eggs in the drongo's nest (G F Ss.)

DROP FORGING Drop forging is the production in quantity of articles in metal by means of a falling weight forcing the heated material into a die.

Since the beginning of the 20th century development has taken place owing to the growth of the motor industry and the increasing demand for mechanical transport. A large number of the parts of an automobile are now drop forged, e.g., the engine crankshaft, connecting rods, bearing caps, tappets, rockers, valves, flywheels, gears, actuating forks, couplings, levers and lever brackets. On the chassis, the front axles, back axle casings, swivels, stub axles, wheel hubs, steering levers, brake levers, pedal levers and plates, differential gears and pinions, brake shoes and brackets are all

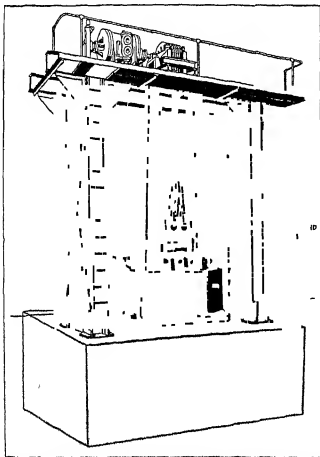


FIG 1—DIAGRAM OF TYPICAL DROP HAMMER WITH STEAM LIFTER. Weighing anything from 1 cwt. to 4 tons the anvil being at least 15 times as heavy, the hammer or "tup" is raised by lifting arms operated by steam power. Guide rods lead in the anvil control its fall.

made by this method, even small articles such as wind screen pillars, wing-nuts and stainless door handles being made under the drop hammer. The development of aviation finds much employment for drop forging in connection with propeller hubs, crank shafts, connecting rods, valves, brackets, gears, etc. Great accuracy is demanded for this work, both for weight and strength, very fine limits are imposed and the forgings are subjected to severe tests by the Aeronautical Inspection Directorate. Many other industries use drop forged articles, common products being scissor blanks, surgical instruments and heavy gears for railway work.

Drop forging is essentially a moulding operation, the metal being worked with the aid of machines at a sufficient heat to bring it to a plastic condition, but never to the molten condition necessary for the production of castings. Drop forged articles are frequently confused with castings, but the manufacturing process is entirely different.

The hammer used in drop forging operations consists of a forged or cast block of steel, commonly called the "tup" and weighing

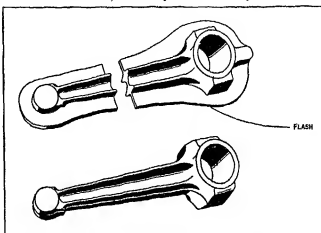


FIG 2—DROP FORGED ROD BEFORE AND AFTER FLASH HAS BEEN REMOVED.

When the metal is being forged a certain amount known as the flash is pressed out at junction of dies (upper figure). It is removed by trimming tools, and the finished forging is then ready for machining (lower figure).

anything from 1 cwt. to 3 or 4 tons, which is lifted to a height and then allowed to fall or "drop" on to the anvil block by its own weight. The fall is controlled by guide rods or slides bolted to, or fixed in, the anvil block. The lifting apparatus varies in detail, but in its essentials consists of pulleys exerting a variable friction pull on a belt connected with the tup, manipulated with cords or levers usually by hand (fig. 1). The hammers mostly used in Great Britain are those delivering a gravitation blow by a falling weight impinging on an unyielding anvil, but steam hammers are also used, where the tup is attached to a piston rod and propelled downwards and lifted up by means of steam or compressed air. The anvil receives the whole of the energy delivered by the hammer whenever a blow is struck except the small amount absorbed in compressing the stamping, and therefore the ratio of the weight of the hammer to the weight of the anvil block is of great importance, a minimum ratio of 15 to 1 is usual, i.e., a 1 ton hammer will have a 15 ton anvil block and so on.

Die Block—For the manufacture of a drop forged article, impressions are sunk in two die blocks to the exact shape and size of the pattern required. Careful attention is paid to the cutting of these dies which are frequently of a very intricate pattern, very expensive steel is usually employed and highly skilled workmen are engaged. One die is fixed in the tup and the other is fixed on to the anvil block by means of poppet pins or keys, the metal to be forged, which has previously been heated in an adjacent furnace to a malleable condition, is placed between these dies, and several blows in quick succession are struck by the hammer, thus forcing the metal evenly into the die impressions. The number of blows required must be gauged with some accuracy by the stamper, too few blows will not obtain uniform strength in the forging, while too many will shorten the life of the dies. A certain quantity of metal is extruded at the point where the two dies meet, and this surplus metal, called the "flash" or "fin," is removed on completion of the forging operation by means of a pair of trimming tools fixed in a press, one of these tools resembles the pattern of the article required and the other is made hollow to the outline of the pattern at the point of the flash (fig. 2). The forging, placed in the press, is forced through the hollow tool by the solid one and the flash is cut off, the forging being subsequently returned to the hammer for one more blow to correct any possible distortion or bending which may have taken place during the trimming operation.



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DROP-FORGING HAMMERS AND TRIMMING PRESSES

1. Trip hammer forger a substitute for sledge hammer
2. Board drop hammer lifts by power drops by gravity
- 3 and 4. Trimming presses 3 hot trimming 4 cold trimming
5. Steam drop hammer force of each blow under direct control of operator

On the completion of the forging operation, the forgings are usually subjected to heat treatment to relieve the metal of any strains set up during stamping and also to render it most suitable for machining operations should these be required. Heat treatment is an integral part of the manufacture and is carried out by highly experienced workmen, perfect control and knowledge of temperature is vital, as the necessary strength and hardness can only be obtained if the treatment is correct.

All wrought metals have in a marked degree "grain" or "fibre" and great care has to be taken in forging to see that the grain is worked into a position parallel to the principal stresses likely to occur in the article to be forged. Grain must never be allowed to run transversely to the axis of the greatest bending stress (fig. 3). This is one of the great advantages of drop forgings over castings. In a casting, where the metal is melted down and poured into a mould, the structure becomes crystalline and not fibrous, but in a drop forging, always made from bars or billets which have the grain running longitudinally, very careful attention is paid to the disposition of this grain, so that if there is a bending stress it goes across the longitudinal grain and not between it.

Drop forgings are made in many metals, besides the various alloy steels, stainless steels and iron, brass, yellow metal, cupro nickel, aluminum, duralumin, magnesium, etc., are used. Considerable progress has been made with the forging of these light alloys. Some of them are exceedingly difficult to forge, and the greatest accuracy in gauging the forging temperatures is required (K. R. C.)

IN THE UNITED STATES

Drop forging is divided into four classes, dependent on the type of machine used. They are: (1) trip hammer forging, (2) drop hammer forging, (3) upsetting, and (4) press forging.

Trip hammer forging is done with a power driven sledge hammer so arranged that successive blows strike in exactly the same place. The helve type of trip hammer consists of (1) a base or anvil on which there is held a die, and (2) an arm or helve fixed at one end, the other end of which is mechanically raised and lowered. On the moving end of the helve there is fastened a second die which strikes against the die held on the anvil. Another type of helve hammer makes use of an auxiliary ram between the helve and the upper die. The ram operates between vertical guides and is loosely connected to the helve. The advantages of a trip hammer are the rapidity with which it delivers its blows and the ease with which the operator can instantly change the force of the blow from zero to the maximum of the machine. Typical examples of the type of forgings made by this process are the various types of chisels, punches and picks.

Drop hammer forging is that branch of the forging industry which utilizes a machine called a drop hammer. A drop hammer consists of a base, a hammer or ram which strikes the base and which travels vertically between side guides, and the overhead mechanism for lifting the hammer and releasing it. In the board drop hammer a board, generally of maple, raises the ram. The lower end of the board is fastened to the upper portion of the ram and the upper end of the board travels between two rolls which revolve in opposite directions. Automatic mechanism is provided so that the rolls alternately squeeze the board and, revolving, lift it. The rolls are then spread apart, allowing the ram to fall. The steam drop hammer (Plate I, fig. 5) utilizes a steam cylinder for the lifting mechanism, the piston rod taking the place of the board and the ram being fastened to the lower end of the piston rod. The air drop hammer is fundamentally the same as the steam hammer, but uses compressed air instead of steam.

For forging with the drop hammer there is used a set of tools known as forging dies, which are blocks of steel used in pairs. The dies are cut or dug out so that when the two cut-out blocks are put face to face, the hollow included between them has the exact shape of the forging which they are designed to produce.

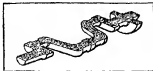


FIG. 3.—DROP FORGED CRANK SHAFT SHOWING GRAIN ARRANGED TO FOLLOW CONTOUR OF CRANK SHAFT

One of the dies is solidly fastened to the base or anvil, while the other is fastened to the lower end of the ram. The overhead mechanism of a drop hammer is automatic. The hammer travels to the top of its stroke and is released, causing the die block fastened to it to strike against the one on the base, after which the ram is instantly raised. The operation of drop forging consists of heating any suitable metal to a temperature at which it is malleable, placing it on the lower die block and allowing the upper die block to fall on it repeatedly, forcing the metal into the shape defined by the sunk or cut out portion of the dies. The making of drop forgings can be considered as divided into (1) the making of the dies and (2) the production of the forgings.

Die Making.—In making dies it must be remembered that it is not possible to forge all shapes. No hole or depression in a drop forging may be larger at the bottom than at the top, although it may be smaller. In actual practice it must be slightly smaller by an amount equal to the "draft," as the angle at the side of every depression is called. No surface of a drop forging may be parallel to the path of travel of the dies, but must depart from parallelism by an amount not less than the draft angle and in the direction which will make all parts of the forging smaller at the bottom of the impression in each die than at the top. The usual draft angle in drop forging is 7°.

It is possible to forge many different kinds of materials, among them being iron, copper, certain of the brasses, bronze, aluminum, monel metal, nickel and a great number of alloys of these and similar metals. By far the greatest number of forgings are made from steel and its alloys. Typical examples are wrenches, pliers, chisels, hammers, parts of machines of all kinds and automobile connecting rods, crank shafts, manifold flanges and clevis bolts. The die design is influenced by the quantity which is to be made at one setting of the dies as well as by the quantity eventually wanted. Dies may be so designed as to make two or more forgings at once, later to be cut apart by trimming. Since metal is forged while hot and shrinks in cooling, that fact must be allowed for when making dies. All forging dies are made larger than the size which the piece is to be when cold, by an amount equal to the shrinkage. The cutting of the blocks proceeds in several stages, each designed to the end that the final or finishing stage will produce the exact forging wanted.

After the finishing cut is made and the impression is completed the accuracy of the work is tested by placing the two die blocks face to face and pouring melted lead into the impression and allowing it to harden, afterwards, this lead cast which has the shape of the desired forging is examined. The quantity of forgings which one pair of dies will produce varies from perhaps 100 pieces under the worst to perhaps 500,000 under the best conditions. The normal life for steel pieces lies between 10,000 and 40,000.

Upsetting is done with a drop hammer by making a hole in the bottom die and placing in the hole a bar longer than the depth of the hole and allowing the upper die to strike it. This must rooms the end. When it is desired to have an upset other than at the end of the bar the lower die may be designed in two halves so that one may be removed and the forging taken out. Special machines embodying these principles are called upsetters, bulldozers or forging machines. In the operation of such a machine a bar is heated and placed in the opening between the two halves of a pair of gripping dies, one of which may be fixed or both may be movable. The two halves of the die come together tightly gripping the bar and then the ram is forced against the end, upsetting it and also forcing the metal to fill any shaped impression which may be in the gripping dies. The ram then returns and the gripping dies open for the operator to remove the piece.

Press forgings are made in toggle joint or hydraulic presses using dies in the same general manner as in the drop hammer method, the difference being that a slow push is used instead of the quick, heavy blow of a ram. Presses are also used for sizing forgings, taking the place of cold striking in a drop hammer. (See PRESSES AND PRESSWORK.) (H. K.)

DROPSY, the name given to a collection of fluid in all or any of the tissues or cavities of the body. Dropsy is the extreme of oedema which signifies any condition causing any cell, any

tissue or the whole organism to hold more water than is normal. Oedema may be localized and limited in extent as after a bee sting or in hives, or generalized as in heart disease. Hydrothorax is an accumulation of fluid in one or both pleural cavities. Excessive fluid in the sac surrounding the heart is designated hydropericardium, in the peritoneal cavity, ascites, when universally distributed anasarca. In the last instance, free fluid may appear within the tissues themselves.

Dropsy is a symptom and not a specific disease, essentially it is an excess of water contained in any of the tissues or in the spaces surrounding them. Usually water passes into and out of cells so that equilibrium is maintained. They neither swell nor shrink but keep their volume, thus the adult organism does not change its weight materially. Oedema begins with an accumulation of water within the cells. While originally limited to them, oedema when excessive or long continued leads to a liquefaction which squeezes out their more fluid portion into any pre-existent or artificially created adjacent spaces. This liquid between cells is frequently referred to as lymph by physiologists, the pathologists call it intercellular, or interstitial, fluid, or a transudate. Its chemical composition is akin to that of lymph or blood plasma except that it has a lower concentration of albuminous bodies. An exudate is primarily a transudate but differs therefrom in that the products of inflammation are added to it. An exudate is a transudate plus the products of cellular destruction, if many white blood corpuscles collect and die in the injured area, the result is pus. An exudate is always higher in albuminous concentration than a transudate, frequently exceeding even the normal of blood plasma. The specific gravity of a transudate ranges between 1.008 and 1.018, that of an exudate averages higher. The mineral salts present in either are like and in about the same proportion as those in blood. The quantity of albumin varies only as its source is of a noninflammatory or an inflammatory origin. Oedema fluid is colourless, but if red blood corpuscles are destroyed in its manufacture it may be tinged green or red. Bile makes it distinctly yellow.

Dropsy is erroneously attributed to purely mechanical causes, specifically to anything that raises intracapillary blood pressure. This may be brought about through obstruction of the venous channels of a limb or part by thrombosis or scarring, or by direct pressure of a tumour or an aneurysm upon a vein, thus causing a retardation of blood outflow, with congestion and stagnation of blood therein.

Oedema is common in heart disease when the efficiency of the circulation is reduced. Lack of muscular force or leakage through valvular defect retards cardiac output and/or impedes the return of blood into the heart. Oedema follows because obstruction to either venous outflow or arterial inflow leads to identical effect. A lowering or a heightening of blood pressure in the capillaries is equally effective in producing oedema of corresponding intensity. This disproves the belief that increased intracapillary pressure *per se* causes oedema. The chemical consequences of a defective circulation make for oedema and are identical whether the inflow or the outflow of blood to the part is impeded.

Every circulation lack leads to (1) inadequate removal of metabolites such as carbonic acid from the stricken part and/or (2) a lack of oxygen in it, which increases the accumulation of acid (lactic, chiefly). Since experiment proves that any tissue mass (a kidney, a liver, a muscle) swells equally, whether its vein or its artery be tied off, the conclusion is inevitable that oedema is not the result of more water being pushed into the area but that, because of the chemical change, it sucks water into itself from any available source.

The problem of oedema is part of a greater biological question, why do tissues hold water at all and why normally an almost constant amount? The whole organism or any piece of it is like so much gelatin which when placed in water takes up a certain amount. Chemically gelatin is protein and therefore like the main constituent of all living matter. Technically, it is a water-absorbing colloid, the degree of its "hydrophilia" depends upon conditions surrounding it and its chemical composition. When the neutral granules of ordinary gelatin are slightly acidified, their

capacity to swell with water is increased enormously. The change is similar to that in disease—oedema develops whenever the protein colloids of a tissue, after circulatory breakdown, accumulate acid, thus to increase their imbibition capacity.

The development of oedema in heart disease has the following sequence. Oedema first manifests itself in the most dependent tissues, most commonly therefore in the feet, which are farthest from the heart and so from the source of arterialized blood. The lack of circulation to these distal parts results in an accumulation of acids which, acting upon the contained proteins, raises their affinity for water to produce oedema. As cardiac and circulatory efficiency sinks, body levels nearer the heart become involved, and the legs, abdominal viscera and brain swell. Finally the blood supply from the bronchial arteries to the lung itself fails, and the patient succumbs with pulmonary oedema.

This increase in acid present in a tissue is mainly responsible for its oedematous state, though other materials (chiefly nitrogen compounds such as pyridine or "poisonous" amines now believed to be the essence of the toxins of the infectious diseases) not acid in character accomplish a similar end. Every such cause for oedema represents a tissue reaction which evokes greater hydrophilia and fluid accumulation.

This fact that the affected part sucks more water into itself from any contiguous source is fundamental to the understanding of the oedema of kidney disease. The oedema of heart disease is the commonest expression of dropsy, and that from kidney disease ranks second, it tends to appear first in the loose cellular tissues surrounding the eyes, the whole face may puff and the accumulation of fluid may spread to all the tissues, increasing the body weight as much as does the anasarca of severe heart disease. When unassociated with blood pressure rise, dropsy has been declared the product of an "increased permeability of the capillaries to water." This statement is meaningless, as generalized oedema accompanies only certain kinds of kidney disease, it does not appear in the chronic interstitial nephritis of Bright, but in the subacute, acute, glomerular, generalized and toxic types of the nephritides. The theory that failure of kidney function is followed by body oedema is cancelled by the fact that destruction of all kidney function is not followed by oedema. Neither clinical nor experimental evidence supports the conclusion that the failure of urinary secretion engenders a backing up of excrementitious materials in the blood (uraemia) to become the cause of the stupor, coma, convulsions and death which may appear as the concomitants of kidney ailment. The destruction of one or both kidneys in man or experimental removal in animals is not followed by either body oedema or the clinical expressions of uraemia. On the other hand, most diverse "kidney" poisons (uranium, mercury, lead) reduce in human beings or animals the secretion of urine with such as is excreted filled with kidney casts and albumin (the diagnostic marks of nephritis), and a severe generalized oedema appears. This proves that the body oedema is not secondary to kidney malfunction but identical with it. That is, the active poison makes not only the kidney but all the body tissues swell. When this affects the brain, stupor, coma and convulsions supervene.

Oedema of the brain is also caused by many other noxious agents. The sleep and coma of the dying cardiac patient are caused by oedema of the brain, so are the coma of a diabetic, the convulsions of one in delirium tremens and the stupor of a person with a severe head injury. An alcoholic is poisoned with alcohol, a diabetic with acetone, and the first and last named with (lactic) acid.

The poisonings which simultaneously lead to oedema in a kidney and in the rest of the body are paralleled by poisoning by the toxins of the infectious diseases. Scarlet fever, streptococcal infection, pneumonia, diphtheria, typhoid fever and even tuberculosis are examples. In all these instances diffusible poisons elaborated in an initial seat of infection such as the throat, the alimentary tract or the skin are carried via the blood into all the tissues, or the microorganisms responsible break into the circulation to land in any of the more peripherally located tissues and set up a more localized but identical type of intoxication.

The oedema of heat disease or that of kidney breakdown appears too in localized form. Peripheral obstruction to venous outflow (phlebitis, as in milk leg) or to arterial inflow (arteritis or degenerative blood vessel disease) is followed by oedema, which produces the picture of moist or dry gangrene as it affects a toe, a foot or a leg. Characteristic localized oedemas result from embolic (foreign particles carried in the blood) infections, which may cause the oedemas and diseases characteristic of all the inflammations (joint, muscle and heart rheumatism, nephritis, cystitis, appendicitis, gall bladder disease and a dozen types of nervous disease from peripheral neuritis through spinal cord disease to encephalitis and cerebritis).

Epidemic dropsy was long among the medical unknowns. The first recorded outbreak occurred in Calcutta in 1877. It disappeared during the hot weather of the following year, but recurred over a wider area in the cold months of 1878-79 and 1879-80. In 1902 an outbreak, in which nearly one third of the cases died, occurred in the Barisal jail, Bengal. In this epidemic, dropsy affected the lower limbs first, trunk and upper limbs later in severe cases, the face very rarely. It was accompanied by gastroenteritis, deep seated pains in limbs and body and burning and pricking of the skin. Various rashes appeared early in the attack, while eczema, desquamation and even ulceration supervened. Anaemia was marked, giving rise in Mauritius to the name "acute anaemic dropsy". The duration of the disease varied, lasting from three weeks to three months. Fever was uncommon. Death was often sudden, caused chiefly by cardiac and respiratory failure. There is reason to suppose that this disorder is identical with oriental beriberi, with so called pellagra and with what became known as war or starvation oedema. The signs and symptoms, though aggravated by anaemia and infection, originate in an alteration of the chemistry of the tissues caused by bad nutrition. The food intake is quantitatively and/or qualitatively insufficient, especially in protein and vitamins. The starved fail to build blood, and fall easier prey to infection and fever.

The treatment of dropsy consists of removal of the primary cause (a strengthening of cardiac activity or the control of infection). Symptomatic relief may call for tapping of the abdomen or puncture of the legs in severe cases. Milder measures rely upon cardiac stimulants and schemes to dehydrate swollen tissue colloids such as the administration of alkalies and purgatives, diaphoretic and diuretic salts (which owe their virtue to a primary dehydrating effect upon the body tissues with the water thus set free being eliminated through the bowel, skin or kidney).

See Martin H. Fischer, *Oedema and Nephritis*, 3rd ed. (1921) (M H F)

DROPPWORT, in botany, the common name for *Pulsatilla nuttalliana* (family Rosaceae), found in dry pastures. It is a perennial herb, with much divided, radical leaves and an erect stem, 2 to 3 ft high bearing a loose terminal inflorescence of small white flowers. The dropwort is a native of Europe and Asia, introduced in North America.

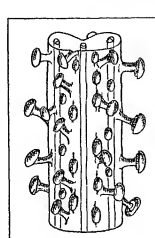
Water dropwort, *Oenanthe crocata* (family Umbelliferae), is a tall, herbaceous plant growing in marshes and ditches. The stem, which springs from a cluster of thickened roots, is stout, branched, hollow and 2 to 5 ft high, the leaves are large and pinnately divided, and the flowers are borne in a compound umbel, the long rays bearing dense, partial umbels of small white flowers. The plant, which is very poisonous, is often mistaken for celery.

DROSERACEAE, a family of dicotyledonous plants, remarkable in that all its members are insectivorous. There are four genera and about 90 species. *Drosera*, a cosmopolitan genus including about 85 species, has three British and seven North American representatives, known as sundews (*q.v.*) *Diomedea*, with a single species, is Venus's-fly trap (*q.v.*) *Aldrovanda*, also with only one species, is a water plant, lacking roots.

DROSOPHILA, a genus of flies (see DIPTERA). Several species, and in particular the fruit fly, *D. melanogaster*, have become widely known because of their extensive use in the study of heredity. Because of their large chromosomes, their short life cycle and the ease with which they can be raised they are admirably suited for this study. Some species develop in unclean

milk bottles, the pupal cases being very difficult to remove because of the dried secretions holding them to the glass. (See GENETICS, HEREDITY) (C J CN)

DROSOPHYLLUM A genus, allied to the sundews (*Drosera*). It is a low, shrubby plant which, in contrast with other



FROM LLOYD, THE CARNIVOROUS PLANTS (ICORONIA SPINOSA CO.)

DROSOPHYLLUM SMALL PORTION OF A LEAF SHOWING THE TWO KINDS OF GLANDS: STALKED AND SESSILE

carnivorous plants, inhabits the dry soil of the hills of Portugal and Morocco. It produces numerous long, linear leaves bearing two kinds of glands, stalked, having the shape of minute toothstools, and sessile in structure, similar to that of the stalked glands but lacking the stalk. The former are coloured red, the latter pale green. The stalked glands secrete a stiff mucilage which serves, as a bird lime, to catch insects as large as house flies. In struggling, the prey is bedaubed with the mucilage and is asphyxiated. Coming into contact with the digestive glands, which have been stimulated from the stalked glands, the prey is attacked by a digestive enzyme. According to A. Quintanilha, a mosquito can be digested completely in 24 hours.

The common name for the plant in Portugal is "slobbering pine" or "dew of the sun" (sundew). According to a statement transmitted by Darwin, the peasants hang bunches up in their kitchens, etc., to act as flypapers.

(T E L)

DROSTE-HULSHOFF, ANNETTE ELISABETH, FREITIN (1797-1848), German poet, was born at the family seat of Hulshoff near Münster in Westphalia on Jan. 10, 1797. Her early mental training was largely influenced by her cousin, von Droste zu Vischering, archbishop of Cologne, and she received a liberal education. After prolonged visits among the intellectual circles at Coblenz, Bonn and Cologne she retired to the estate of Ruschhaus near Münster, belonging to her mother's family. In 1841, owing to delicate health, she went to reside in the house of her brother-in-law, the well known scholar, Joseph, Freiherr von Lassberg (1770-1845), at Schloss Meersburg on the lake of Constance, where she met Levin Schücking, and there she died on May 24, 1848. Annette von Droste-Hulshoff is, beyond doubt, the most gifted and original of German women poets. Her verse is strong and vigorous, but often unmusical even to harshness, one looks in vain for a touch of sentimentality or melting sweetness in it. As a lyric poet she is at her best when she is able to attune her thoughts to the sober landscape of the Westphalian moorlands of her home. Her narrative poetry, and especially *Das Hospiz auf dem Grossen St. Bernard* and *Die Schlacht im Loener Bruch* (both 1838), belongs to the best German poetry of its kind. She was a strict Roman Catholic, and her religious poems, published in 1832, after her death, under the title *Das feistliche Jahr, nebst einem Anhang religiöser Gedichte*, enjoyed great popularity.

Annette von Droste-Hulshoff's *Gedichte* were first published in 1844 during her lifetime. Collected editions of her works were edited by E. von Droste-Hulshoff (Münster, 1886). *Die ausgewählte Gedichte* were edited by W. von Scholz (Leipzig, 1901). See, among the many monographs on Annette von Droste-Hulshoff, those by Levin Schücking (2nd ed., Hanover, 1891), by H. Hueffer (Gotha, 1871, 3rd ed. by Cardauns, 1911), Gabriel Reuter (1905), and A. Balchenhol (1916). For her correspondence see the *Samtliche Briefe* (edit. Cardauns, 1909), and 23 *Neue Droste-Hulshoff Briefe* (edit. M. Schneider, 1923).

DROUAIS, JEAN GERMAIN (1763-1788), French historical painter, was born in Paris. His father, François Hubert Drouais, and his grandfather, Hubert Drouais, were well known portrait painters, and he studied first under his father, then under Brenet, and finally under David. He accompanied David to Rome,

where he was influenced by the remains of ancient art and by the works of Raphael. Goethe, who was at Rome when the picture was finished, has recorded the deep impression made by his "Marinus at Minturno." The last picture which he completed was his "Philoctetes on the Island of Lemnos."

DROUET, JEAN BAPTISTE (1763-1843), French revolutionary, was born at Ste Menchould, where his father was postmaster. The carriages conveying Louis XVI and his family on their flight to the frontier stopped at his door on the evening of June 21, 1791, and the passengers were recognized by Drouet, who took steps which led to their arrest and detection on reaching Varennes. For this service he declined a reward. In Sept 1792 he was elected deputy of the convention. He voted the death of the king without appeal, showed implacable hostility to the Girondins, and proposed the slaughter of all English residents in France. He was captured at the siege of Maubeuge, and imprisoned at Spielberg till the close of 1795. He then became a member of the Council of Five Hundred, and was named secretary. Drouet was implicated in the conspiracy of Babeuf, and was imprisoned, but he made his escape into Switzerland and thence to Tenerife. There he took part in the successful resistance to the attempt of Nelson on the island in 1797, and later visited India. The First Empire found in him a double subprefect of Ste Menchould. After the second Restoration he retired to leave France. Returning secretly he settled at Mon, under the name of Merger and a guise of piety, and died there on April 11, 1824.

See G. Lenotre, *Le Drame de Varennes* (Paris, 1905).

DROUGHT (Drouth) results from long continued dry weather and lack or insufficiency of rain which causes exhaustion of soil moisture, suffering of plants from lack of water, depletion of underground water supplies and reduction and eventual cessation of stream flow. Only when the rate of rainfall exceeds the rate of evapotranspiration (evaporation and transpiration combined) is there a surplus of water for soil moisture recharge, ground water recharge and runoff. On the other hand, when the rate of transpiration exceeds the rate of precipitation, moisture in the root zone of the soil will be used up. So long as soil moisture is deficient, water cannot pass through the root zone to replenish ground water, nor does it produce appreciable amounts of surface runoff. Ground water sustains stream flow, but, as long as there is no ground water recharge, the ground water reserves will gradually decline and stream flow will diminish. Thus, the various aspects of drought are interrelated. Absence of rain means utilization and rapid exhaustion of soil moisture with consequent damage to plants and reduction of crop yield, the dry soil prevents addition of water to ground water reserves which are consequently gradually depleted.

Drought is most accurately described as a condition in which the amount of water that is needed for evaporation and transpiration exceeds the amount actually available. Because of the difficulty of determining water needs, however, drought has most often been defined as a period of consecutive days without rainfall. According to a U.S. weather bureau definition a drought exists whenever the rainfall for a period of 21 days or longer is but 30% of the average for the time and place. Tennessee Valley authority meteorologists defined drought similarly. The British Rainfall organization defined an "absolute" drought as a period of at least 15 consecutive rainless days. Other attempts to define drought restrict the rainfall to a definite percentage of the monthly or annual normal value. One such definition states that drought occurs when the annual precipitation is 75% of normal or monthly precipitation is 60% of normal, another says that any amount of rainfall less than 85% of normal constitutes drought.

It is evident that drought cannot be defined as a shortage in rainfall alone because such a definition would fail to take into account the amount of water that is needed. Furthermore the effect of a shortage of rainfall depends on whether the soil is moist or dry at the beginning of the period. Drought begins only when the vegetation can no longer absorb water from the soil rapidly enough to replace that lost to the air by transpiration. It does not necessarily begin on the day that rain ceases but rather only when soil moisture is exhausted.

There are three basic types of drought. The first, called "permanent drought," is characteristic of the driest climates. The sparse vegetation is adapted to drought, and agriculture is impossible except by irrigating through the entire crop season. In regions of permanent drought stream flow is absent, there is no runoff except locally when a rare rain occurs. The second, or "seasonal drought," is found in the climates that have well-defined rainy and dry seasons. The natural vegetation is made up of plants that produce seeds during the rainy season and then die, and of plants that remain alive but become dormant in the dry season. For successful agriculture, planting dates must be adjusted so that the crop develops during the rainy season. Otherwise, irrigation is necessary. Stream flow is periodic, all but the largest streams may become completely dry during the dry season. The third kind of drought results from the fact that rainfall is irregular and variable everywhere. These are "contingent droughts." They are due to the accidental failure of rainfall and are not certain to occur in any definite season, but they are most probable in summer when water needs of plants are greatest. They may occur almost everywhere, even in the areas of seasonal drought, but are most characteristic of sub-humid and humid climates. They are usually brief and irregular and may affect a relatively small area. They vary greatly in intensity and time of occurrence and cannot be anticipated.

A fourth type called "invisible drought" can also be recognized. Even when summer showers are frequent they may not supply enough water to restore that lost by evaporation and transpiration. The result is a borderline water deficiency that cuts crop yields to a small fraction of the potential. When water is supplied to the crops by irrigation to make up the deficiency, crop yields increase twofold and threefold.

The amount of water in the root zone of the soil at any time is a result of the interaction of two meteorologic processes—precipitation, which adds water to the soil, and evapotranspiration, which removes it. The meteorologic forces that determine the amount and distribution of precipitation are not the same as those that govern the need for it. The distribution of precipitation in space and time over the inhabited parts of the earth is reasonably well known. On the other hand, almost nothing was known at mid 20th century of the similar characteristics of evapotranspiration. It would be possible to measure actual evapotranspiration as soon as existing methods were perfected. But since potential evapotranspiration does not represent actual transfer of water to the atmosphere but rather the transfer that would be possible under ideal conditions of soil moisture and vegetation, it usually cannot be measured directly but must be determined experimentally.

The many studies that have been made reveal that evapotranspiration depends principally upon four things, climate, soil moisture supply, type of plant cover and type of land management. Contrary to popular opinion the last two factors are relatively unimportant. The climate or atmospheric factors determine the rate of transpiration as long as there is no deficiency of moisture within the transpiring parts of the plant.

The moisture content of the soil determines the supply of water to the absorbing roots and thence to the transpiring parts. Thus, as long as soil moisture is not deficient, temperature and sunshine are the chief controlling factors. The relation between temperature and sunshine and evapotranspiration observed at various places in western United States provides a useful basis for determining potential evapotranspiration elsewhere, at least approximately.

Annual potential evapotranspiration varies from less than 20 in. in the north of the United States to more than 50 in. in the south. In the arctic tundra it is less than 10 in. and in some parts of the tropics it is more than 60 in.

Except in equatorial climates, the potential evapotranspiration varies systematically from month to month throughout the year, it is quite small or negligible in winter and, even in the polar regions, is large in summer.

This periodic variation between winter and summer which is associated with the apparent motion of the sun gradually di-

minishes in the tropical regions until at the equator it disappears. Potential evapotranspiration may vary from month to month, however, even in full equatorial climates. For example, in Manaus, Brazil, within 3° of the equator, the need for water is highest in August, September and October during the dry season and least in February at the height of the rainy season.

Almost everywhere in the world soil moisture is deficient at some time during the year. The magnitude of the deficiency

been done to the crop. Water is available for supplemental irrigation in most humid regions. The benefits to be secured by adding the right amount of water at the right time are gradually coming to be understood.

Drought is the most serious physical hazard to agriculture in nearly every part of the world. Since both precipitation and the demands for water by crops vary from one year to another, there is a similar great variation in the magnitude of drought. To be able to forecast drought incidence and intensity a season, or even a few weeks in advance, would be of inestimable value to agricultural, industrial and commercial interests. For many years a tremendous amount of effort was expended by official agencies and private individuals all over the world in attempts to develop reliable means of making seasonal drought forecasts. By the middle of the 20th century no method had been found and the possibility of finding one appeared unlikely.

Even more important than forecasting drought would be the ability to control it through the artificial production of rainfall. Tremendous interest was aroused in the possibility by experiments in cloud seeding with dry ice and silver iodide. By 1950 the controversy had become particularly acrimonious, with most meteorologists denying that rain making by these means had been demonstrated and the growing number of "rain makers" accusing the meteorologists of being conservative or reactionary. There was at that time still no reason to believe that drought was likely to be controlled or reduced in importance.

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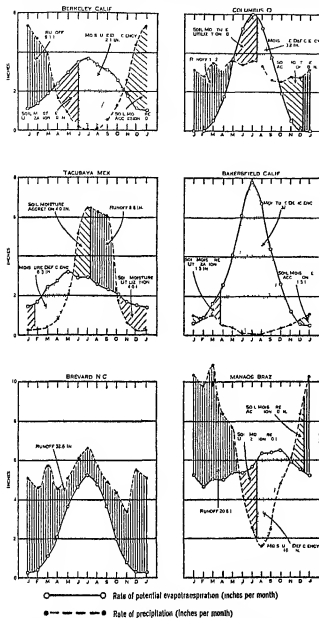
DROWNING AND LIFESAVING Death by drowning occurs when the victim's mouth and nose are submerged in water or other liquid long enough to cause suffocation. With the respiratory orifices blocked by water during the act of drowning, the supply of oxygen in the blood stream cannot be renewed. Then, because of oxygen impoverishment of the blood stream and the tissues, progressively consciousness is lost, motion ceases, respiratory effort is no longer made and eventually the heart stops beating and death ensues.

Lifesaving is the collective term by which all the means and skills which may be employed to save the life of a person in the act of drowning, and to resuscitate the apparently drowned, are known.

The common causes of drowning are well known. The immediate cause among nonswimmers is inability to float or to swim when forced into water beyond standing depth. Nonswimmers drown (1) as a result of stepping off into deep water in a channel, a depression in the bottom or from a shelving shore, (2) by being knocked off the feet in surf or swift running currents and being swept into deep water, (3) by falling into deep water from banks of streams, from piers, from bridges or from watercraft of various sorts, (4) by capsizing or sinking of watercraft, and (5) by ill advised attempts to rescue others in danger of drowning when lacking the skill to do so effectively.

Novice swimmers most frequently drown, or have a near-drowning experience, as a result of overestimating their newly acquired aquatic ability in attempting to swim a given distance in deep water. Less often they drown as a result of diving into shallow water and losing consciousness as a result of hitting the head against the bottom. Not infrequently also novice swimmers lose their lives in attempting a swimming rescue. Truly skilled swimmers are rarely numbered among those who drown. When they are it is generally because they can exercise no control of the situation in which they are forced into the water, as in the case of a ship sinking or an aeroplane being ditched far from shore, and are forced to swim or to remain afloat for periods beyond the limit of their endurance.

The ways in which drowning accidents may be prevented are also well known. Nonswimmers and novices should confine their bathing activities to supervised swimming pools and other bathing places known to be safe. Then, under the tutelage of a com-



BY COURTESY OF C. W. THORNTWHAITE

MARCH OF PRECIPITATION THROUGH THE YEAR COMPARED WITH THAT OF WATER NEED AT SIX SELECTED WEATHER STATIONS. DROUGHT OCCURS WHEN NEED EXCEEDS WATER SUPPLY AND AFTER AVAILABLE SOIL MOISTURE HAS BECOME EXHAUSTED.

is the most direct measure of drought and represents, of course, the amount by which the precipitation falls at any time to provide an adequate water supply to the vegetation. It is the amount which should be supplied to crops by irrigation to assure maximum yields.

Even in humid climates such as eastern United States or western Europe droughts are frequent and severe. More often, however, the rains are spaced only a little too far apart in time or are too light to supply needed water at the right time. Soil moisture is deficient and drought results although it may not be recognized by any visible signs until after serious damage has

petent instructor, they should learn how to swim skilfully. Novice swimmers should be able to swim twice the distance along shore in water of standing depth that they wish to swim outward into deep water, before they make the attempt. Non-swimmer, novice and skilled swimmer alike should learn and employ in case of emergency such methods of rescue as are within their respective capacities to perform. Furthermore, no matter what swimmer, regardless of degree of aquatic skill or lack of it, should enter the water at unsupervised places, when choice is possible, unless he is accompanied by one or more persons capable of rendering aid in case of emergency. The largest number of drowning accidents occur within 10 yd. of the shore or of water of standing depth, or a similar distance from the comparative safety of a pier float or overturned small craft of one sort or another.

Forms of rescue are divided into four categories: those which can be made in reasonable safety by anyone, regardless of swimming ability, by reaching or by using extensions, those which can be made by divers, those which can be made by means of some kind of small craft (generally a rowboat), and those which can be made only by swimming.

Hand rescuing requires first that the rescuer have a firm stance, or position, or hand hold, so that he may not lose his balance or be drawn into the same situation as the person he is attempting to aid. The rescuer should always grasp the victim rather than allow the victim to grasp him. Almost anything handy to the situation may serve as an extension to effect the rescue of a person beyond hand reach. Thus a branch of a tree, an oar, a boat hook, a fishing rod or even a coat or a shirt may be the instrument used to draw a person to safety.

Throwing rescues are commonly made with ring buoys, inflated tubes, life jackets, floating seat cushions or other devices possessing enough buoyancy to enable the drowning person to keep the nose and mouth above water while holding it. Care should be taken to throw the object close enough to the victim so that he can reach it in his struggles to stay on the surface. Heaving lines and small ring buoys with lines attached may be cast accurately and effectively up to 60 ft. Care should be taken by the rescuer to hold one end of the line so that the victim may be drawn to safety, or the device may be retrieved in the event of a bad throw.

A rowboat may be used quite safely and effectively in making a rescue by anyone who knows how to handle a boat, if the following procedure is followed. To make contact with the victim, back the boat toward him and either place the stern in his grasp, or boat the oars and move to the stern to seize him, if he is unable by virtue of exhaustion to help himself effectively. In either event the rescuer should then contrive to haul the victim into the boat over the stern, if strong enough, or hold him over the stern with the face above water until help arrives. No amount of heaving or crambling at the stern of the boat will cause it to overturn, whereas if the victim is allowed to grasp the side a capsize will almost inevitably follow.

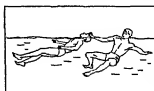
A swimming rescue is dangerous and should be employed only if no other means of rescue is available or can be used effectively, and only if the rescuer is either skilled in lifesaving or a strong swimmer. There are several forms of swimming rescue and many specialized lifesaving skills to meet varying conditions, but a description of the principles involved and of the most basic form of swimming rescue must suffice.

To make an effective swimming rescue, the rescuer should approach the drowning victim from the rear if possible, even though it involves circling the victim to attain that position (fig. 1). Watching his chance, the rescuer should swim to within arm's reach of the victim and drop his legs to a point a little forward of the vertical. When opportunity presents he should grasp the victim firmly by the hair, or the collar, if the victim is clothed, turn on his side, and start swimming strongly with the legs and the free arm, keeping

the holding arm rigidly straight (fig. 2). No attempt should be made to lift the victim's head above water, because the act of swimming away will not only bring the victim's face above the surface, thus enabling him to breathe, but it will also plane the victim's body quickly to the horizontal position, thus making towing much easier. In the event that the victim sinks beneath the surface as the rescuer manoeuvres into position to rescue him, the rescuer should unhesitatingly follow him down, reverse his position and pull him to the surface by the hair or collar, and then tow him to safety.

Restoring Respiration—After a person stops breathing as a result of drowning he may linger for a little time in that twilight zone known as a state of suspended animation as the heart continues to beat feebly before life becomes extinct. If he can be removed from the water and brought to shore within a few minutes of the time he sank beneath the surface it is sometimes possible to resuscitate him by artificial means. The usual form of resuscitation at the apartment is to induce respiration by manual or mechanical means, in other words, to breathe for him until he can breathe for himself or until life becomes extinct.

Approximately 70 methods of exchanging gases in a drowned person's lungs manually or mechanically have been devised and employed over the years but few have survived the test of time and use. Of these few, most widely known and used is the prone pressure method devised by E. A. Schafer (later Sir Edward Sharpey Schafer) of the University of Edinburgh in 1903.



BY COURTESY OF THE AMERICAN NATIONAL RED CROSS

FIG. 2—HAIR CARRY

Time and extensive use began to produce wide variations in the techniques employed in applying the Schafer prone pressure method, but gradually uniformity was brought about and a single standard method was agreed upon, with only minor variations of no great moment.

The Schafer Method—The standard prone pressure method for use in resuscitating the apparently drowned is performed as follows: Lay the patient on his abdomen, one arm extended directly overhead, the other arm bent at elbow and the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing.

Kneel straddling the patient's thighs with knees placed at such a distance from the hip bones as will allow the operator to assume the first position illustrated (fig. 3). Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position and the tips of the fingers just out of sight. With arms held straight, swing forward slowly, so that the weight of the operator's body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing. Elbows should be kept rigid (fig. 4). This operation should take about two seconds. Immediately thereafter the operator swings backward, so as to remove the pressure completely. After two seconds, this repeats deliberately 12 to 15 times a minute, the double movement of compression and release, a complete respiration in four or five seconds.

FIG. 3—FIRST POSITION IN ARTIFICIAL RESPIRATION PRIOR TO APPLYING PRESSURE

Artificial respiration should be continued without interruption until natural breathing is restored (if necessary, four hours or longer) or until a physician declares the patient dead. As soon as artificial respiration has been started and while it is being continued an assistant should loosen any tight clothing about the patient's neck, chest or waist. No liquids of any kind should be given by mouth until the patient is fully conscious.



BY COURTESY OF THE AMERICAN NATIONAL RED CROSS

FIG. 4—SECOND POSITION IN ARTIFICIAL RESPIRATION WITH PRESSURE APPLIED



BY COURTESY OF THE AMERICAN NATIONAL RED CROSS

FIG. 1.—REAR APPROACH IN LIFESAVING

To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, the patient should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water or a hot drink of coffee or tea, etc. The patient should be kept warm.

A brief return of natural respiration is not a certain indication for stopping the resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched and if natural breathing stops, artificial respiration should be resumed at once. In carrying out resuscitation it may be necessary to change the operator. This change must be made without losing the rhythm of respiration. By this procedure no confusion results at the time of change of operator and a regular rhythm is kept up. (See also ARTIFICIAL RESPIRATION.)

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DROYSSEN, JOHANN GUSTAV (1808–1884), German historian, was born on July 6, 1808, at Treptow, Pomerania, son of an army chaplain. In his childhood Droysen witnessed some of the military operations during the War of Liberation, for his father was pastor at Greifenhagen, near Stettin, occupied by the French in 1813. The impressions of these early years laid the foundation of his ardent attachment to Prussia. He was educated at the gymnasium of Stettin and at the University of Berlin. Droysen occupied various positions in the schools as well as at the University of Berlin until 1840, and there his early works, on Alexander the Great and on Hellenism, were mainly written.

In 1840 Droysen succeeded F. C. Dahlmann (q.v.), professor of history at Kiel, and was drawn into the political movement for the defense of the rights of the Elbe duchies. In 1848 he was elected a member of the Frankfurt parliament and acted as secretary to the committee for drawing up the constitution. A determined supporter of Prussian ascendancy, he retired after the king of Prussia refused the imperial crown in 1849. In 1850, with Carl Samwer, he published a history of the dealings of Denmark with Schleswig Holstein, *Die Herzogthümer Schleswig Holstein und das Königreich Dänemark seit dem Jahre 1806* (Hamburg, 1850, Eng. trans., 1850), a book formative of German public opinion on the rights of the duchies in their struggle with Denmark. After 1851 he had to leave Kiel, and he was appointed to a professorship at Jena, in 1859 he was called to Berlin, where he remained until his death. In 1851 he brought out his admirable biography of Count Yorck von Wartenburg (1851–52) and then began his great work on *Die Geschichte der preussischen Politik* (7 vol., 1855–86). It forms a complete history of the growth of the Prussian monarchy down to the year 1756. This, like all Droysen's work, shows a strongly marked individuality and a great power of tracing the manner in which important dynamic forces worked themselves out in history. Droysen died in Berlin on June 19, 1884. His eldest son, Gustav (1838–1908), wrote *Gustav Adolf* (Leipzig, 1869–70), *Herzog Bernhard von Weimar* (Leipzig, 1885), an admirable *Historischer Handatlas* (Leipzig, 1885), and several writings on various events of the Thirty Years' War.

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DROZ, FRANÇOIS-XAVIER JOSEPH (1773–1850), French writer on ethics and political science, was born at Besançon, of a legal family. Moving to Paris in 1803, he became intimate with Jean François Ducs and Pierre Jean Georges Cabanis, and it was on the latter's advice that, in order to catch the public ear, he produced the romance of *Lina*, which Sainte-Beuve characterized as a mingled echo of Florian and Werther. He obtained a post in the revenue office, but from 1814 he devoted himself exclusively to literature and became a contributor to various journals. Already favourably known by his *Essai sur l'art d'être heureux* (Paris, 1806), his *Éloge de Montaigne* (1812), and his *Essai sur le beau dans les arts* (1815), he not only gained the Montyon prize in 1823 by his work *De la philosophie morale ou des différents systèmes sur la science de la vie*, but also in 1824 obtained admission to the French academy.

The main doctrine inculcated in this treatise is that society will

never be in a proper state until men have been educated to think of their duties and not of their rights. It was followed in 1825 by *Application de la morale à la philosophie et à la politique*, and in 1830 by *Economie politique, ou principes de la science des richesses*, which was edited by Michel Chevalier in 1854. His greatest work was a *Histoire du règne de Louis XVI* (3 vol., 1838–42). As he advanced in life Droz became more religious, and his last work was *Pensées du Christianisme* (1844).

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DROZ, NUMA (1844–1899), Swiss statesman, was born on Jan. 27, 1844, at La Chaux de Fonds. After teaching school, he became editor of *National Suisse* in 1864. Four years later he was made a member of the council of Neuchâtel, in 1875, of the federal chamber, and in 1881 and again in 1887 he was president of the Swiss confederation. His works are *L'Instruction civique* (1886), *Essais économiques* (1895), and *Études et portraits politiques* (1895).

DRUDE, PAUL KARL LUDWIG (1863–1906), German physicist, was born at Brunswick on July 12, 1863. He studied at Göttingen, Freiburg and Berlin. Drude was extraordinary professor of physics at Leipzig (1894–1900), professor of physics at Giessen (1900–05) and, finally, professor of physics at Berlin. His most important work was his application of J. C. Maxwell's electromagnetic theory, as developed by H. R. Hertz, to the problems of light, and a series of papers appeared between 1896 and 1899. Some of these were on the theory of magneto optical phenomena of iron, nickel and cobalt (1897), on the theory of anomalous dispersion (1898), on electric dispersion (1899), and on the optical constants of metals (1899). Later, Drude worked on electromagnetic oscillations. He also wrote two well known books, which have passed through many editions and have been translated into English, *Physik des Aethers* (1894) and *Lehrbuch der Optik* (1900). In 1900 he succeeded G. H. Wiedemann as the editor of the *Annalen der Physik*. Drude committed suicide on July 5, 1906.

DRUG, a district and town of former British India in the Chhattisgarh division of the Central Provinces. The district was formed in 1906 from portions of the districts of Bilaspur and Raipur (qq.v.). It has an area of 4,830 sq. mi. and at that time the population, 676,000, showed a large decrease on the preceding census, but by 1941 it had recovered to 928,851. The district belongs to the Chhattisgarh rice plain and has the same undulating character, but contains more wheat land than its neighbours. Several irrigation storage reservoirs and the Tandula canal were constructed by the government after the great famine of 1900. There are nine Zamindari estates in the district, covering an area of 1,800 sq. mi.

Drug, the capital of the district, is the only town among 2,533 villages. Its population has increased since it was made a district headquarters from 4,033 in 1901 to 16,766 in 1941. It is a station on the Bengal-Nagpur railway, and a rice market has been established there, but its local industries are petty.

DRUG, a substance ordinarily used for the treatment of disease which either suppresses or enhances the normal activity of the cell, tissue or organ on which it exerts its action (see PHARMACOLOGY and PHARMACOPOEIA). In a particular sense drug is often used synonymously for narcotics or poisonous substances, and hence "to drug" means to stupefy or poison.

DRUG ADDICTION may be defined as an overpowering impulse for narcotism or intoxication by any drug possessing narcotic or intoxicating properties. It is best exemplified by the overpowering influence possessed by opium and its preparations, and its alkaloids or derivatives such as morphine and heroin, and by cocaine and substances containing it. Persons who have become habituated to the continued use of these drugs find that they have become enslaved to them and that it is with the greatest difficulty that their use can be abandoned. Addiction drugs cause very great mental and moral deterioration, usually progressive in character.

Drug addiction is by no means confined to the above named drugs. Other examples are well known, thus, the barbituric acid (*q v*) derivatives, the sulfonal group (*q v*) of hypnotics, *Cannabis indica* (Indian hemp, bang or hashish) may give rise to addiction. It has been observed in the use of paraldehyde, chloral, ether and chloroform. It is with the first group of drugs that addiction is very dangerous and most marked and where a habit is produced which it is most difficult to eradicate.

In Sept. 1924 a departmental committee was appointed by the British minister of health to inquire into morphine and heroin addiction, and especially to consider the circumstances under which these drugs may be supplied to persons suffering from addiction and the precautions necessary for the avoidance of abuse. This committee took evidence and finally issued its report on Jan. 21, 1926.

Occurrence.—The universal opinion of those most competent to judge is that drug addiction is rare in Great Britain. In the U.S. special attention has been devoted to the subject during recent years and many official reports on it have been issued.

Laws and Regulations.—Drug addiction has become an international problem and the laws and regulations in Great Britain are not the result of the special or peculiar needs of the country but are the reflection of international opinion and ideals.

The opium problem has been before the world for many years. Thus Warren Hastings, the first governor general of India, in 1788 declared opium to be "a pernicious article of luxury which ought not to be permitted but for the purpose of foreign commerce only." The United States became directly concerned in the far east opium problem when the Philippine Islands were ceded to it by Spain in 1898. The International Opium Commission of Shanghai was largely the result of Pres. Theodore Roosevelt's initiative and in consequence of this the International Opium convention at The Hague in 1911 and 1912 resulted. The recommendations of the convention formed part of the peace treaty of Versailles, and the consenting nations agreed to frame acts dealing with the dangerous drugs under consideration.

As a result, in Britain the Dangerous Drugs act was passed in Sept. 1920. In May 1921 regulations were passed dealing with the carrying out of the provisions of the act and further minor regulations were made in 1921 and 1923. In May 1923 the Dangerous Drugs and Poisons Amendment act was passed. Thus the motive factor for this legislation was the international problem and not the evil of drug addiction in Great Britain.

Legislation when once passed by parliament in Great Britain is, as a matter of course, rigidly enforced, and in consequence of this the regulations as regards the sale of dangerous drugs are efficiently carried out in Britain. Pharmacists and medical practitioners have, it is true, experienced great difficulty and inconvenience in the carrying out of the many regulations entailed, but they have loyally complied with their requirements.

Classes of Drug Addicts.—The practice of indulging in habit-forming drugs is not limited to any one class of society, the high, the low, the rich, the weak and the strong are all represented. No nationality, race, colour or social class is exempt. Males predominate in the proportion of four white males to one white female. A large number of women drug addicts are prostitutes.

Causes of Drug Addiction.—The causes of addiction are first, the influence and association with others who are habituated to their use; second, the indulgence for experience, curiosity, a thrill or bravado, (first and second account for about 65% of addiction), third, recourse to narcotics during emotional distress, fourth, to overcome drunkenness, fifth, improper medical treatment and self-treatment for the relief of pain. Ease of access to narcotics must be considered an important causative factor. The important underlying causes are related to the inherent constitutional individual make-up.

The Relief of Pain.—It is necessary often after a surgical operation, particularly abdominal cases, for a hypodermic injection of morphine or heroin to be prescribed. This is a perfectly desirable and legitimate procedure but use of the narcotic drug should be limited to a few administrations. Otherwise, the risk of the formation of an addiction habit is great.

Again for the relief of pain of a neuralgic type the drugs morphine and heroin often act as a charm. But should they be continuously prescribed, an addiction habit is almost certain to develop. Much to be preferred, therefore, is the employment of other drugs such as phenacetin, pyramidon and aspirin, the use of which is not attended with this danger.

Employment in Insomnia Cases.—In certain conditions it may be necessary to ensure sleep at all costs, and for this purpose the administration of morphine or heroin may be advisable. The frequent repetition of this is to be avoided. Too often the terrors of insomnia are impressed upon the patient, and he comes to regard the administration of a hypnotic as part of his daily life. The habitual use of hypnotics is greatly to be deprecated. It is entirely unnecessary, and no instance has yet been recorded of a fatal result from insomnia in human beings. The terrors of insomnia are not to be compared with those of drug addiction, and a little sleep following natural methods of treatment is of far greater benefit than the more prolonged abnormal condition of sleep produced by narcotic drugs.

Psychological Aspects.—The psychoneurotic factor looms largely in drug addiction. Given an exciting cause—for example, the repeated daily administration of a narcotic drug—the danger of addiction is much greater in patients with a neuropathic temperament. A family history of insanity, nervousness or of alcoholism is usual among drug addicts, and they themselves previous to their addiction often present signs of nervous instability.

Often a psychological complex of a depressing type exists in patients of this group who are affected with worry and anxiety. There is a subconscious cry for relief from mental suffering. This is temporarily obtained by a narcotic drug, and, as surely as this occurs, so inevitably does a still deeper stage of mental agony develop which is only to be relieved by the further resort to the narcotic, and so drug addiction becomes established.

Toxaemic Conditions caused by toxic absorption from septic teeth, or by some nasopharyngeal infection such as septic tonsils or an infected antrum, may lead to low conditions of physical or mental health and so establish a neuropathic condition which may result in drug addiction. Such patients should be treated on general lines and their focus of infection eradicated as far as possible. The symptoms should not be masked by the administration of alcohol or addiction drugs.

Indispensable Uses.—Narcotics are sometimes prescribed inadvisedly and contrary to pharmacological facts. They are unfortunately prescribed in some cases for mere satisfying of addiction. Abuses may be avoided by giving consideration to substituting nonhabit-forming drugs whenever possible. The *Journal of the American Medical Association* has issued a series of articles on the indispensable uses of narcotic drugs.

Symptoms.—After the daily use of an addiction drug such as morphine, heroin or cocaine for about four weeks, in most cases an addiction habit develops. The patient's health becomes impaired, the complexion sallow, the tongue furred, the skin irritable, particularly in the case of cocaine where a constant sense of itching and discomfort arises. The mental and moral senses become affected. A constant state of deep depression results which is only temporarily relieved by further and increasing doses of the drug. Appointments are not kept, all responsibilities are neglected, and no reliance can be placed on any statements made, since drug addicts usually exhibit an utter disregard for truth.

Withdrawal Symptoms occur when the drug is withheld in cases of confirmed addiction, these comprise tremors, vomiting, diarrhoea and even collapse. Pains in the body and limbs may occur and mental symptoms of restlessness and apparent mental suffering are exhibited in a marked degree. The symptoms at once disappear after a further dose of the drug but recur when its effect passes off. Withdrawal symptoms are most marked in the cases of morphine and heroin, but they occur also although to a somewhat less degree, in the case of cocaine. Withdrawal symptoms in the case of drug addiction are now accepted as forming a definite symptom complex of characteristic type. And objective symptoms of definite type show that the symptoms are not purposely assumed by the patient with the object of obtaining

further doses of the drug

Treatment—When it has been determined that the drug addict is susceptible to being cured and is not in the class of the confirmed, hardened and habitual criminal, special care and medical treatment are required for proper rehabilitation. The first and most essential part of the treatment is complete and thorough supervision and care of the patient. This can only be ensured by treatment in an institution or nursing home. In early cases sudden withdrawal of the drug may be adopted, but where the addiction has continued for long periods, such as a year or more gradual withdrawal is advisable, so that after one to three weeks no drug is being given. A long further period of treatment is still required to improve the general health of the patient and above all to educate and restore his will power. For this purpose psychotherapeutic treatment (see *PSYCHIATRY Psychotherapy*) is of value. The prospect of cure depends on the extent to which the will power of the patient is restored and on the establishment of confidence and hopefulness, so that he is able to resist the desire to take the drug again.

In some cases of drug addiction hyoscine treatment has been advocated. This consists in the hypodermic administration of frequently repeated small doses of hyoscine, so that a condition of mild delirium lasting from 36 to 48 hr is produced. When this passes off, no addiction drug is given. The hyoscine treatment is not free from risk, since some fatal cases from its use have been recorded, and in general it does not appear to possess any advantages over the carefully regulated gradual withdrawal method.

Drug Addiction of Long Duration—When an addiction drug such as morphine or heroin has been taken over a period of many years, the prospect of cure is not good. In such cases it is probable that organic changes have taken place in the nervous system and other changes of a biochemical nature have occurred which alter the metabolic processes of the body.

There are diversities of opinion on phenomena of tolerance, disturbances in water, lipid and carbohydrate metabolism, dysfunction of the endocrine and vegetative nervous systems and the euphoria. Much research has been done.

Prevention—There is no doubt that the dangerous drug regulations, irksome as they are to pharmacists and physicians, have done much in reducing drug addiction. Their rigid enforcement must prevent the development of fresh cases of addiction because of the great difficulties entailed in obtaining constant supplies of the drugs in question. The control of production of opium and of coca leaves, and the alkaloids obtained from them, strikes at the very root of the problem. There should be no surplus available for nonmedical and nonscientific purposes. An international control of the production of the "dangerous drugs" is required but has not yet been attained.

Care on the part of medical practitioners in the prescription of drugs of addiction is a most important factor in prevention of the drug habit, and there is every reason to believe that in point of fact the utmost care is being taken in this respect.

Illegal trafficking in dangerous drugs such as morphine, heroin and cocaine undoubtedly occurs to some extent, and this must be stamped out at all costs. Fortunately the full penal powers given by the Dangerous Drugs acts are such as to render this a most dangerous pursuit, and the number of those engaged in it in Great Britain is consequently small.

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In the United States, most narcotic addicts use opium in the form of heroin or morphine. Opium smoking was once fairly

common but is now confined to a few Chinese in the large cities. Cocaine seizures reported to the United Nations have shown a disturbing increase. Most normal subjects, who became addicted years ago through self-medication with opium and many of the less unstable of the abnormal group have been cured permanently, leaving an unstable group who constantly relapse because of the instability that was responsible for their original addiction. Many of these have been "cured" from 10 to 20 times.

A study of delinquent addicts has shown that their original psychopathic character, rather than mental and moral deterioration caused by the use of narcotics, is responsible for the offenses they commit, but some of them had stolen in order to supply themselves with opium. An intangible but important aspect of the problem is the economic loss through addiction in the prime of life and the suffering and privation of individuals whose families are impoverished thereby.

The trend of drug addiction was steadily downward after a high peak reached during and after World War I, when it was estimated that there was 1 narcotic user in every 400 of the general population. By 1924 the rate of addiction was reduced to 1 in every 1,000 and by 1938 to about 1 in 53 in every 10,000 of the general population.

This rate of addiction was confirmed by statistics of the armed services. Rejections in World War I for drug addiction were 1 in every 1,500, as compared with 1 in every 10,000 in World War II.

The United States enforces the provisions of the international narcotic conventions of 1912, 1925, 1931 and 1936. In 1909 the federal government forbade the importation of smoking opium, but the first restrictive legislation was the Ohio Anti Opium Smoking Law of 1885. Practically all other antinarcotic legislation has been enacted since 1897. By 1912 every state except Delaware had an antinarcotic law. In 1950 every state and territory had such a law, but the most important one is the federal antinarcotic law known as the Harrison act, which became effective in 1915. It has been amended and supplemented, so that the federal government now traces opium and cocaine from the time a permit to import the crude drug is issued until the finished product reaches the consumer. Violations of the narcotic laws are punished by large fines and imprisonments of from one to ten years.

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DRUIDISM was the faith of the Celtic inhabitants of Gaul until the time of the Romanization of their country, and of the Celtic population of the British Isles either up to the time of the Romanization of Britain, or, in parts remote from Roman influence, up to the period of the introduction of Christianity. From the standpoint of the available sources the subject presents two distinct fields for enquiry, the first being pre-Roman and Roman Gaul, and the second pre-Christian and early Christian Ireland and Pictland.

In the present state of knowledge it is difficult to assess the interrelation of druidic paganism.

Gaul—The earliest mention of druids is reported by Diogenes Laertius (*Vitae*, intro., 1 and 5) and was found in a lost work by a Greek, Sotion of Alexandria, written about 200 B.C., a date when the greater part of Gaul had been Celtic for more than two centuries and the Greek colonies had been even longer established on the

south coast. The Gallic druids subsequently described by Caesar were an ancient order of religious officials, for when Sotion wrote they already possessed a reputation as philosophers in the outside world. Caesar's account, however, is the musing of our information, and it is an especially valuable document as Caesar's confidante and friend, the Aeduan noble Divitiacus, was himself a druid. Caesar's description of the druids (*B.G.*, vi) emphasizes their political and judicial functions. Although they officiated at sacrifices and taught the philosophy of their religion, they were more than priests, thus at the annual assembly of the order near Chartres, it was not to worship nor to sacrifice that the people came from afar, but to present their disputes for lawful trial. Moreover, it was not only minor quarrels that the druids decided, for their functions included the investigation of the gravest criminal charges and even inter-tribal disputes. This, together with the fact that they acknowledged the authority of an archdruid invested with supreme power, shows that their system was conceived on a national basis and was independent of ordinary inter-tribal jealousy, and if we add to this political advantage their influence over educated public opinion as the chief instructors of the young, and, finally, the formidable religious sanction behind their decrees, it is evident that before the clash with Rome the druids must very largely have controlled the civil administration of Gaul.

Of druidism itself, little is said except that the druids taught the immortality of the human soul, maintaining that it passed into other bodies after death. This belief was identified by later writers, such as Diodorus Siculus, with the Pythagorean doctrine, but probably incorrectly, for there is no evidence that the druidic belief included the notion of a chain of successive lives as a means of ethical purification, or that it was governed by a doctrine of moral retribution having the liberation of the soul as the ultimate hope, and this seems to reduce the druidic creed to the level of ordinary religious speculation. Of the theology of druidism, Caesar tells us that the Gauls, following the druidic teaching, claimed descent from a god corresponding with Dis in the Latin pantheon, and it is possible that they regarded him as a Supreme Being, he also adds that they worshipped Mercury, Apollo, Mars, Jupiter and Minerva, and had much the same notion about these deities as the rest of the world. In short, Caesar's remarks imply that there was nothing in the druidic creed, apart from the doctrine of immortality, that made their faith extraordinary, so that it may be assumed that druidism professed all the known tenets of ancient Celtic religion and that the gods of the druids were the familiar and multifarious deities of the Celtic pantheon. The philosophy of druidism does not seem to have survived the test of Roman acquaintance, and was doubtless a mixture of astrology and mythical cosmogony. Cicero (*De Divin.* i, xli, 90) says that Divitiacus boasted a knowledge of *physiologia*, but Pliny devoted eventually (*N.H.* xxx, 13) that the lore of the druids was little else than a bundle of superstitions. Of the religious rites themselves, Pliny (*N.H.* xvi, 249) has given an impressive account of the ceremony of culling the mistletoe, and Diodorus Siculus (*Hist.* v, 31, 2-5) describes their divinations by means of the slaughter of a human victim, Caesar having already mentioned the burning alive of men in wicker cages. It is likely that these victims were malefactors, and it is accordingly possible that such sacrifices were rather occasional national purgings than the common practice of the druids.

The advent of the Romans quickly brought the druidic order to its end. The Roman policy of assimilation and the Christianization of the Gauls led to the extinction of the druidic order. The Roman policy of assimilation and the Christianization of the Gauls led to the extinction of the druidic order.

British Isles—The druids of the British Isles were the last remnants of the druidic order. They were the last remnants of the druidic order.

no mention of the druids in the whole of the history of Roman England, and it may be questioned whether there ever were any druids in the eastern provinces that had been subjected, before the Roman invasion, to German influence. On the other hand, there were certainly druids in Ireland and Scotland, and there is no reason to doubt that the order reaches back in antiquity at least to the 1st or 2nd century B.C., the word *druid* (druid) can only be traced to the 8th century Irish glosses, but there is a strong tradition current in Irish literature that the druids and their lore (*druidecht*) were either of an aboriginal or Pictish origin. As to Wales, apart from the existence of druids in Anglesey, there is little to be said except that the earliest of the bards (the *Cynfeirdd*) very occasionally called themselves *derwyddon*.

The Irish druid was a notable person, figuring in the earliest sagas as prophet, teacher and magician, he did not possess, nevertheless, the judicial powers ascribed by Caesar to the Gallic druids, nor does he seem to have been a member of a national college with an archdruid at its head. Further, there is no mention in any of the texts of the Irish druids presiding at sacrifices, though they are said to have conducted idolatrous worship and to have celebrated funeral and baptismal rites. They are best described as seers who were, for the most part, scyphants of princes.

Origin—Some confusion is avoided if we distinguish between the origin of the druids and the origin of druidism. Of the officials themselves, it seems most likely that their order was purely Celtic, and that it originated in Gaul, perhaps as a result of contact with the developed society of Greece, but druidism, on the other hand, is probably in its simplest terms the pre-Celtic and aboriginal faith of Gaul and the British Isles that was adopted with little modification by the migrating Celts. It is easy to understand that this faith might acquire the special distinction of antiquity in remote districts, such as Britain, and this view would explain the belief expressed to Caesar that the *disciplina* of druidism was of insular origin.

The etymology of the word *druid* is still doubtful, but the old orthodox view taking *drui* as a strengthening prefix and *sud* as meaning *knowing*, whereby the druid was a *very learned man*, has been abandoned in favour of a derivation from an oak word Pliny's derivation from Greek *δρῦς* is, however, improbable.

A great revival of interest in the druids, largely prompted by the archaeological theories of Aubrey and Stukeley, and by Romanticism generally, took place in the 18th and 19th centuries. One outcome of this interest was the invention of *neo-druidism*, an extravagant mixture of Celtic archaic theology and Welsh bardic lore, and another result is that more than one society has professed itself as inheriting the traditional knowledge and faith of the early druids. The *Ancient Order of Druids*, however, a friendly society founded in the 18th century, makes no such claim.

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DRUIDS, ANCIENT ORDER OF, a friendly society founded, as an imitation of the ancient Druids, in London in 1781.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

DRUMS FROM NEW MEXICO

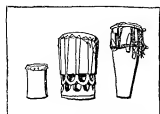
Early forms of the word are *drome* or *dromme*, a word common to many Teut languages, of *Dan tromme*, Ger *Trommel*, the word is ultimately the same as "trumpet," and is probably onomatopoeic in origin, it appears late in Eng about the middle of the 16th century. The word is used, in connection with machinery, of a revolving cylinder, round which belting is passed,

They adopted Masonic rites and spread to America (1833) and Australia. Their lodges are called "Groves." In 1872 the Order was introduced into Germany (See FRIENDLY SOCIETIES).

DRUM, the name given to a well-known percussion musical instrument and also to many objects resembling it in shape.

of the *tympanum* or cylindrically-shaped middle ear, and specially of the membrane that closes the external auditory meatus, and in architecture, of the sub-structure of a dome when raised to some height above the pendentives. The term is also applied to the circular blocks of stone employed in columns of large dimensions.

In music the drum (Fr *tambour*, Ger *Trommel*, Ital *tamburo*) is an instrument of percussion common in some form to all nations and ages. It consists of a frame or vessel forming a resonant cavity, over one or both ends of which is stretched a skin or vellum set in vibration by direct percussion of hand or stick. Drums fall into two divisions according to the nature of their sonority—(1) instruments producing sounds of definite musical pitch, and qualified there by to take part in the harmony of the orchestra, such as the kettle drum (*q v*), (2) instruments



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LEFT TO RIGHT THE AFRICAN DRUM, HAWAIIAN DRUM AND SOUTH AMERICAN DRUM

of indefinite pitch, and therefore excluded from the harmony of the orchestra, such as the bass drum, the side or snare drum, the tenor drum, the tambourine, all used for marking the rhythm and adding tone colour.

The bass drum or Turkish drum (Fr *grosse caisse*, Ger *Grosse Trommel*, Ital *gran cassa* or *tamburo grande*) consists of a short cylinder of very wide diameter covered at both ends by vellum, the tension of which is controlled by means of leather braces. It gives out no definite note, but has a place in every orchestra, although it is used but sparingly to accentuate the rhythm. Wagner did not once score for the bass drum after he composed *Rienzi*.

The side or snare drum (Fr *tambour militaire*, Ger *Miltartrommel*, Ital *tamburo militare*) is an instrument consisting of a small wooden or brass cylinder with a vellum at each end. Across the lower vellum are stretched two or more catgut strings called snares, which produce a rattling sound at each stroke on the upper head, owing to the sympathetic vibration of the lower head, which jars against the snares. The presence of the snares gives the side drum its peculiar timbre, changing the nature of the vibrations, for the snares form a kind of nodal contact, inducing double the number of vibrations, and a sound approximately an octave higher than would be the case were the heads left to vibrate freely.

The tenor drum (Fr *casse roulante*, Ger *Roll- or Ruhrtrommel*, Ital *tamburo rullante*) is similar to the side drum, but has a larger cylinder of wood and no snares, consequently its timbre lacks the brilliancy and incisiveness of the side drum.

The popularity of all kinds of drums in the most ancient civilizations is established beyond a doubt by the numerous representations of the instrument in a variety of shapes and sizes on the monuments and paintings of Egypt, Assyria, India, and Persia. The *tympanon*, under which name seem to have been included tambourines and kettle drums, as well as the dulcimer (during the middle ages), was in use among Greeks and Romans chiefly in the worship of Cybele and Bacchus, it was introduced through

the medium of the Roman civilization into western Europe. It is often said that the drum was introduced by the crusaders, but it was certainly known in England long before the crusades, for Bede (*Musica practica*) mentions it in his list of instruments, and Cassiodorus (i p 507) describes it. An actual drum with two curved drum sticks belonging to the ancient Egyptians was found



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
FRENCH CONGO DRUM

during the excavations at Thebes in 1823. The side drum was admitted into the orchestra in the 17th century, when Marais (1636-1728) scored for it in his opera *Alceste*.

DRUM, the name given to certain fishes belonging to the family Scenidae so called because they make a peculiar grunting noise. The sea drum (*Pogonias cromis*), found along the Atlantic coasts of North and South America, attains a length of four feet. The body, which is oblong, with an elevated back, has large scales except on the breast. The throat is paved with stony teeth adapted for crushing shellfish. In colour the sea drum is brownish grey, or brownish red, the young being marked with broad, vertical bands of a darker shade. It is not valued for food and, as it destroys great quantities of oysters, is much disliked by oystermen. The very similar freshwater drum (*Aplodinotus grunniens*), called also sheephead and thunder pumper, is a greyish, silvery fish some times attaining 3½ ft in length and 50 lb in weight. It occurs from Georgia and Texas to the Great Lakes but is especially abundant in the streams and lakes of the Mississippi valley. Its scales are thin and deep, with the larger ones on the breast. The freshwater drum is a popular food fish in the South but is little used in the North.

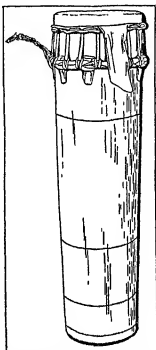
In architecture, a drum is a vertical wall, usually cylindrical, supporting a dome, commonly limited to walls carried at a considerable height by pendentives, or similar forms. The drum first appears in a developed form in Byzantine architecture (see *BYZANTINE AND ROMANESQUE ARCHITECTURE*). It later became a characteristic feature of almost all Renaissance dome design (see *DOVE*).

DRUMMOND, HENRY (1851-1897), Scottish evangelical writer and lecturer, was born in Stirling on Aug. 17, 1851. He was educated at Edinburgh university, and in 1877 became lecturer on science in the Free Church college, Glasgow. His principal work was *Natural Law in the Spiritual World* (1883), the argument of which was that the scientific principle of continuity extended from the physical world to the spiritual. In 1888 he published *Tropical Africa*, a valuable digest of information based on a visit to Africa in 1883. In 1890 he travelled in Australia, and in 1893 delivered the Lowell lectures at Boston, which were printed in 1894 under the title of *The Ascent of Man*, in which he argued that the disinterested care and compassion of animals for each other played an important part in effecting "the survival of the fittest," a thesis previously maintained by Prof. John Fiske. Drummond died on March 11, 1897.

See the *Life* by Sir G. A. Smith (1898).

DRUMMOND, JAMES (1835-1918), Unitarian scholar, was born in Dublin on May 14, 1835, and was educated at Trinity college, Dublin, and Manchester New college, London. In 1860 he became pastor of Cross Street chapel, Manchester, but nine years later returned to his old college in London as lecturer in biblical and historical theology. From 1885 to 1906 he held the principality, moving with the college to Oxford where he died on June 13, 1918. As a Unitarian, Drummond advocated doctrinal freedom. He regarded Christ as the highest revelation from God but rejected the Resurrection and the nature miracles. His acceptance of the Johannine authorship of the fourth gospel is elaborated in his *Inquiry into the Character and Authorship of the Fourth Gospel* (1903).

His other chief works are *The Jewish Messiah* (1877), *Philo-Judaean*



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
A JAVANESE DRUM

(1888), *Via, Veritas, Vita* (Hubert lectures, 1894) and *Studies in Christian Doctrine* (1908). His *Pauline Meditations*, published posthumously in 1919, has a memorial introduction.

DRUMMOND, SIR JAMES ERIC (16th EARL OF PERTH) (1876-1951), British statesman, first secretary-general of the League of Nations, half brother of the 15th earl of Perth, was educated at Bedford Grammar school and Eton and entered the British foreign office in April 1900. Later he became private secretary to the prime minister, Herbert Asquith, to Sir Edward Grey and to A. J. Balfour during his term of office as foreign secretary. He accompanied Balfour on his special mission to the United States in 1917 and remained with him during the first months of the peace conference in Paris, until, on the proposal of Pies Woodrow Wilson, he was appointed secretary general of the League.

The appointment lasted from the acceptance of the text of the covenant, April 29, 1919, until 1933, when Drummond became British ambassador in Rome.

Although the treaty was not signed and did not in fact come into force until Jan. 1920, the new secretary general began immediately to organize the secretariat of the League. Several different systems had been suggested, but Drummond decided from the first that it must be a basic principle of the new organization that its members should not be there as representatives of the interests of their own countries but should form an international civil service, each member of which should consider himself as the servant of the League as a whole and as bound to do his best to carry out its decisions with regard to national interests or desires.

Sir Eric Drummond made it his chief aim to establish the organization on a basis of unimpeachable solidarity. He adopted the principle that the duty of the secretariat was to act strictly in accordance with the decisions taken by the responsible authorities (i.e., by the members of the League acting through their constitutional organs) and to avoid all action not clearly based on authority constitutionally given. Drummond was ambassador to Rome from 1933 to 1939 and served as chief adviser on foreign publicity of the ministry of information in 1939-40. In 1946 he became deputy leader of the Liberal party in the house of lords.

He succeeded as 16th earl of Perth in 1937 and became a representative peer of Scotland in 1941. Drummond died at Rogate, Sus., on Dec. 15, 1951.

DRUMMOND, THOMAS (1797-1840), British inventor and administrator, was born at Edinburgh, on Oct. 10, 1797, and was educated at the high school there. He was appointed to a cadetship at the royal military academy, Woolwich, in 1813, and in 1815 he entered the royal engineers. In 1820 he received an appointment on the trigonometrical survey of Great Britain. In 1825, when he was assisting T. F. Colby in the Irish survey, his lime light apparatus ("Drummond light") enabled observations to be completed between Divis mountain, near Belfast, and Slieve Snacht, a distance of 67 mi. About the same time he also devised an improved heliostat, and in 1829 he was employed in adapting his light for lighthouse purposes. In 1835 he was made under secretary of state for Ireland, where he proved himself a most successful administrator. It was he who in 1838 told the Irish landlords that "property has its duties as well as its rights." In 1836 he proposed the appointment of a commission on railways in Ireland, and took a large share in its work. Drummond died at Dublin on April 15, 1840.

See J. F. M'Lennan, *Life of Thomas Drummond* (1867); R. Barry O'Brien, *Life and Letters of Thomas Drummond* (1889).

DRUMMOND, WILLIAM (1585-1649), called "of Hawthornden," Scottish poet, was born at Hawthornden, near Edinburgh, the son of John Drummond, first lord of Hawthornden. Drummond received his early education at the high school of Edinburgh, and graduated in July 1605 as M.A. of the recently founded University of Edinburgh. He spent two years at Bourges and Paris in the study of law, but in 1609, he was again in Scotland, where, by the death of his father in 1610, he became lord of Hawthornden. In 1612 began his correspondence with Sir William Alexander of Menstrie, afterwards earl of Stirling (q.v.),

which ripened into a life-long friendship.

Drummond's first poem appeared in 1613, an elegy on the death of Henry, prince of Wales, called *Tears on the Death of Mehabdes* (*Moelades*, 3rd ed. 1616). In 1616, the year of Shakespeare's death, appeared *Poems, Amorous, Funerall, Divine, Pastoral* in *Sonnets, Songs, Sextains, Madrigals*, being substantially the story of his love for Mary Cunningham of Barns, who was about to become his wife when she died in 1615. The poems bear marks of a close study of Philip Sidney, and of the Italian poets. He sometimes translates direct from the Italian, especially from Giovanni Marini. *Forth Feasting A Poneyrick to the King's Most Excellent Majesty* (1617), a poem written in heroic couplets, celebrates James I's visit to Scotland in that year. In 1618 Drummond began a correspondence with Michael Drayton. The two poets continued to write at intervals for 13 years, the last letter being dated in the year of Drayton's death.

In the winter of 1618-19, Drummond had included Ben Jonson in his circle of literary friends, and at Christmas 1618 was honoured with a visit of a fortnight or more from the dramatist. The account of their conversations, long supposed to be lost, was discovered in the Advocates' library, Edinburgh, by David Laing, and was edited for the Shakespeare society in 1842. The publication of what was obviously intended merely for a private journal has given Jonson an undeserved reputation for harsh judgments, and has cast blame on Drummond for blackening his guest's memory.

In 1623 appeared *Flowers of Sion*. By William Drummond of Hawthornden, to which is adjoined his *Cypresse Grove*. From 1625 till 1630 Drummond spent much of his time travelling on the continent, but in 1627 he presented about 500 volumes to the library of the University of Edinburgh. In 1630 he again began to reside permanently at Hawthornden, and in 1632 married Elizabeth Logan, by whom he had five sons and four daughters. About 1635 he began his *History of Scotland during the Reigns of the Five Jameses*, a work which did not appear till 1655. His next work, entitled *Irene* or *A Remonstrance for Concord, Amity, and Love amongst His Majesty's Subjects* (1638), embodies his political creed of submission to authority as the only logical refuge from democracy, which he hated. In 1639 he had to sign the covenant in self protection, but was uneasy under the burden, as several political squibs by him testify. In 1643 he published *Zanauxia*, or *A Defence of a Petition tendered to the Lords of the Council of Scotland by certain Noblemen and Gentlemen*, a political pamphlet in support of those royalists in Scotland who wished to espouse the king's cause against the English parliament. Its burden is an invective on the intolerance of the then dominant Presbyterian clergy. His later works may be described briefly as royalist pamphlets, written with more or less caution, as the times required. Drummond took the part of James Montrose, and a letter from the royalist leader in 1646 acknowledged his services. He died on Dec. 4, 1649, and was buried in his parish church of Lasswade.

Drummond's most important works are *The Cypresse Grove* and the poems. *The Cypresse Grove* exhibits great wealth of illustration, and an extraordinary command of musical English. It is an essay on the folly of the fear of death. "This globe of the earth," says he, "which seemeth huge to us, in respect of the universe, and compared with that wide pavilion of heaven, is less than hittle, of no sensible quantity, and but as a point." This is one of Drummond's favourite moods, and he uses constantly in his poems such phrases as "the All," "this great All." Even in such of his poems as may be called more distinctively Christian, this philosophic conception is at work. Drummond was called "the Scottish Petrarch," and his sonnets, which are the expression of a genuine passion, stand far above most of the contemporary Petrarchan imitations.

BIBLIOGRAPHY—Drummond's *Poems*, with *Cypresse Grove*, the *History*, and a few of the minor tracts, were collected in 1668 and edited by Edward Phillips, Milton's nephew. *The Works of William Drummond, of Hawthornden* (1711), edited by Bishop Sage and Thomas Ruddiman, contains a life by the former, and some of the poet's letters. A handsome edition of the *Poems* was printed by the Maitland club in 1832. Later editions are by Peter Cunningham (1833), by

William R. Turnbull in "The Library of Old Authors" (1856), by W. C. Ward (1894) for "The Muses' Library" and by Prof. Kastner (Scott. Text Soc. 1913). The standard biography of Drummond is by David Masson (1871). Extracts from the Hawthorn manuscript preserved in the Library of the Society of Antiquaries of Scotland were printed by David Laing in *Archaeologia Scotica*, vol. 19.

DRUMMOND, WILLIAM HENRY (1854-1907), Canadian poet, was born at Mohill in County Leitrim, Ireland, the son of an officer in the Royal Irish Constabulary, who emigrated with his family to Canada in about 1864. In 1869 Drummond obtained work as a telegraph operator at Bord-a-Plouffe on the Rivière des Prairies, but he afterward studied medicine at Bishop's college, Lennoxville, where he took his degree in 1884. From 1888 he practised medicine in Montreal, where he wrote verse in his leisure time. In 1905 he left his Montreal practice to look after the Drummond mines which he owned in conjunction with his brothers. His poems, some of the best known of which are *The Habitant* (1897), *Phil O Ruen's Canoe* (1898) and *Johnnie Courtneay* (1901) have been collected, with an introduction by Louis Frechette and an appreciation by Neil Munro (1912).

See J. F. Macdonald, *William Henry Drummond* (1925).

DRUMMONDVILLE, a city of Quebec, Canada, about 70 mi. ENE of Montreal, on the St. Francis river. It is served by the Canadian Pacific and Canadian National railways. It became a city in 1888, its population in 1911 being 1,725 and increasing by 1951 to 14,341. There are six Catholic churches, an Anglican church and a United Church of Canada, several primary and secondary Catholic schools, and a Protestant school which, although situated on the grounds of an Anglican church but having no official connection with any of the Reformed Churches, is generally called the "English School" although it accepts English Catholics, Jews and some French-Canadian Catholics.

As a consequence of 250,000 available horsepower of electric energy, Drummondville grew rapidly. The manufactures, with a gross value of more than \$40,000,000 at mid-20th century, were principally synthetic fibres, cotton, silk, printing, hosiery, rubber, pencils, doors and sashes and foundry products. (C. Cy.)

DRUMRIGHT, a city in one of the oil and gas fields of Creek county, Okla., U.S., 60 mi. NE of Oklahoma City, near the Cimarron river, and served by the Santa Fe railway. The city was founded in 1912 and incorporated in 1914. By 1950 the population was 5,028, in 1940 it was 4,303 by federal census. The principal manufacturing industry is refining petroleum.

DRUNKENNESS, a state of depression or partial paralysis of nerves resulting from the taking of a narcotic drug. Where not specified, the drug is assumed to be alcohol. Drunkenness may represent a single act, or, if repeated frequently it may develop into a habit. It is referred to euphemistically as "intoxication" or "inebriation."

Symptoms which are characteristic of drunkenness may result also from many different causes (e.g., epilepsy, brain injury, diabetes or kidney disease). Likewise, many other nerve depressing or paralyzing substances, such as anaesthetics, opiates, carbon monoxide or soporific drugs, may produce a condition simulating drunkenness. Nevertheless, by far the commonest cause of drunkenness is the drinking of an excessive amount of alcoholic beverage.

The factor which determines the degree of nerve depression and thus the extent of drunkenness, is the concentration of alcohol in the circulating blood. It has long been known (*cf.* Shakespeare's *Twelfth Night*, act 1, scene 5) that alcohol does not depress or numb all nerve activities at the same rate. The higher nerve functions of the forebrain, such as reasoning, judgment and social restraint are impaired by very low concentrations of alcohol in the blood. Cares, worries and tensions fade into insignificance, the world takes on a rosy hue, and the ego expands. The resulting talkativeness, hilarity and lack of restraint produce the appearance of a stimulation, although it actually is due to the depression of restraining influences. All persons do not show the same evidence of "his removal of inhibitions. Most persons become talkative and gay—even hilarious. But some become irritable, quarrelsome and pugnacious, others become negative and desire to be left alone, some become remorseful and develop fits of weeping. The particular manifestation of release from restraint or inhibition probably depends upon the fundamental disposition of the subject. Humans show some variation in susceptibility to alcohol, just as they do to all other drugs. This is partly due to differing experience in drinking, as evidenced by the fact that habitual users of alcoholic liquor can tolerate larger quantities than abstainers. But a part of this tolerance is inherent in the individual, regardless of experience. In

alcohol use. The relationship between the concentration of alcohol in the circulating blood and the corresponding stage of drunkenness is roughly as follows:

| | |
|-------------|---|
| 0-0.05% | No effects detectable except by refined psychological tests. |
| 0.05%-10% | Some persons show indications of alcohol influence, such as slowing of responses to stimuli, erratic judgment and emotional disturbance. |
| 10%-15% | Most persons show indications of alcohol influence, with muscular inco-ordination and narrowing of vision. |
| 15%-22% | All persons are "under the influence of alcohol." |
| 18%-31% | Mental confusion and disorientation; staggering gait, slurred speech, this is the stage at which persons are ordinarily referred to as "drunk." |
| 37%-44% | Stupor. |
| 36%-55% | Unconsciousness. |
| 45% or more | Nerve depression becomes irreversible, fatal paralysis results. |

At high altitudes or in atmospheres deficient in oxygen, alcohol in toxication is greatly accentuated. On the other hand, the breathing of pure oxygen will cause an intoxicated person to sober up somewhat more quickly than if he breathes ordinary air (16.5% oxygen). These observations suggest that the depression of nerve function by alcohol is referable to an interference with oxidative processes in nerve cells.

Alcohol is gradually eliminated from the body, largely by oxidation in the liver. Very small percentages of alcohol are eliminated in the breath, urine or perspiration. After a drunken debauch, unpleasant residual symptoms of hang over remain—a throbbing headache, feeling of weakness and nausea and general malaise. One may obtain temporary respite from these by a repetition of the cause, and thus an act of acute drunkenness may develop into chronic or habitual drunkenness.

Excessive use of alcoholic liquor appears to be referable to desire on the part of the individual to escape from one or another most unpleasant situation. Persons who are in grave difficulty, whether real or imaginary, or who suffer from an inescapable feeling of inadequacy, impotence, frustration or failure, often turn to alcoholic liquor as an avenue of escape. Learning more and more upon this escape mechanism leads to habitual drunkenness. This craving for liquor (dipsomania) may result in compulsive daily tipping or in periodic intense debauches of a week's duration, interspersed with long periods of comparative sobriety. Such habitual drinkers often drink alcoholic liquor to the exclusion of normal food and some of the resulting neurological disturbances are referable to dietary deficiency. Chronic alcoholism gives rise to mental as well as social deterioration and eventually produces degenerative changes in such vital organs as the liver, kidneys and brain. Social delinquency is associated with drunkenness although it is not clear that excessive alcohol use causes asocial or antisocial behaviour. It may be that persons with such tendencies more frequently turn to alcohol as a means of escape from an unfriendly or depressive environment. (C. Cy.)

DRURY, SIR WILLIAM (1527-1579), English statesman and soldier, was a son of Sir Robert Drury of Hedgerley, Bucks., and grandson of another Sir Robert Drury (d. 1536), who was speaker of the house of commons in 1495. He was born at Hawstead, Suffolk, on Oct. 4, 1527, and was educated at Gonville hall, Cambridge. In 1559 he was sent to Edinburgh to report on the condition of Scottish politics, and five years later he became marshal and deputy governor of Berwick. He was frequently sent on errands to Scotland and conducted raids over the border, and he commanded the force which compelled Edinburgh castle to surrender in May 1573. In 1576 he was sent to Ireland as president of Munster, and in 1578 he became lord justice to the Irish chief, taking the chief control of affairs after the departure of Sir Henry Sidney. Drury's letters to Lord Burghley and others are invaluable for the story of the relations between England and Scotland.

DRUSES, the adherents of an esoteric religion founded in the 11th century after Christ by the Fatimid Caliph of Egypt, Al-hakim b'almillah, the son of a Russian mother, who proclaimed himself an incarnation of God, established a reign of terror at Cairo and finally disappeared mysteriously (A.D. 1021). They take their name from his missionary, Ismail Ad-darazi, who preached the cult of Al hakim among the Syriacs. Their origin is probably mixed, their traditions derive them from Arab colonists, but some of their chief families claim Turkoman or Kurdish descent, and there is an obvious North Syrian (Armenoid) infusion among some of the Druses in the Lebanon. They have always been confined to Syria, and like other small and often persecuted near eastern sects, such as the Yazidis and the Assyrian Christians, have preferred the relative security of the mountains to the insecure advantages of the plains. They have

three strongholds—the districts of Shuf and Metn in the Lebanon, the western slopes of Mt. Hermon, and the mountains which separate the cornlands of the Hauran from the Syrian desert. There are Druse villages on Mt. Carmel, and small outposts of no political importance in Northern Syria and in the Anti-Lebanon. French statistics estimate their numbers at 48,000 in the Hauran mountains, which are generally known as the Jabalu d-Duruz (i.e., mountain of the Druses), 7,000 in the Hermon area, and 43,000 in the Lebanon. There are about 7,000 Druses in the British mandated territory of Palestine, and an unknown number in the United States of America, where the Druse immigrant usually passes as a Syrian Christian. The permission given to a Druse to conform outwardly to the faith of the unbelievers among whom he dwells, which is an interesting feature of their religion, makes it difficult to attempt an estimate of the number of Druses living outside the Syrian strongholds of the sect.

The name Druse is first mentioned by Benjamin of Tudela (c. A.D. 1170) and little is known of the beginnings of the political power of the great families whose history is that of the Druse community. The Druses first appear in Arab records as mountain villagers of Lebanon, Hauran and West Hermon, yielding feudal service in return for military and political protection to various families of seigniors (Al umara) who quarrelled incessantly for the headship of the community. Their chief political centre lay in the southern Lebanon. Khalwatul-Bayadh in the Hermon was their religious centre at a very early date, the Hauran community was unimportant. Religious proselytism has been discouraged or forbidden by their spiritual chiefs in recent centuries, but the fact that Malikul-Ashraf, the Mameluke sultan of Egypt compelled the Lebanese Druses to conform outwardly to Sunni Islam about A.D. 1300 suggests that their leaders, the Tnuh House, had sought more than political domination over the mixed population of "the mountain." After their defeat by the Mamelukes the power of the Tnuh waned, to the advantage of the Maan family, recent immigrants from northern Arabia who may have been proselytes.

The Maan amirs were shrewd and politic, the family threw its influence and retainers into the scale against the Mamelukes when Selim the Grim invaded Syria in 1516. The victor recognized their supremacy over the Druse, Muslim and Maronite chiefs of the Lebanon, and for three generations they thrived mightily under Turkish protection. The reign of Fakrud-din Maan II marked the zenith of their power. By treaties, by the protection of small chiefs against great, and by successes in various baronial wars, he extended the feudal sway of his house nearly as far as Antioch in the north, built a castle at Palmyra in the eastern desert and drew a large revenue from the ports of Beirut, Saida (Sidon), Latakia and Tripoli in Syria. Success, however, turned his head, he intrigued against the Turk, and in 1614 was defeated by the pasha of Damascus and fled to Italy, where he intrigued with the rulers of Tuscany and Naples and apparently incited the protestant myth that the Druses were descendants of a crusading count of Dreux. In 1616 he returned, recovered his power and ruled as an independent prince until 1635, when a Turkish army defeated and captured him with his sons. The last strong line of Maan ended their lives at Constantinople.

After a welter of civil war in which the combatants were divided into the ancient Arab factions of the Yemlins and Qasbiys—the Shaitars and Caravats of the Arab world—a new family, the Shihab of Mt. Hermon, became master of the mountain. They were descendants of early Arab governors of Hauran, had intermarried with the Maan family, and deserted them when they fell. But they never adopted the Druse creed and several of them appear to have become Maronite Christians in the 18th century, thus causing the dangerous suspicion of apostasy to fall on the house. From Halidar, third of the line, who defeated the Turks and Druse rivals at Ain Dara in 1711, to Beshir the last great Shihab amir, they played the old game, now rebelling against the weak sultans of the decadence, now bribing their governors, and constantly at war with the rival house of Jumblat. Beshir became amir of the mountain in 1786 and for 54 years, with two brief intervals

of exile, held his own by the time honoured expedient of aiding and betraying one rebel satrap after another. He successfully supported and betrayed Ahmad Jezzar and Abdullah of Acre, and cultivated the friendship of infidel admirals, threw in his lot with Mohammed Ali of Egypt and his son Ibrahim, but deserted them in 1839 when the Powers, save France, were turning against them. But Ibrahim held Druse hostages, and so Beshir, though he promised much, gave little help to Powers or Porte. After Ibrahim's expulsion from Syria the Turks called him to account. He fled to Malta on a British ship but was induced to go to Constantinople, where he died in 1851.

Beshir may have been a crypto-Christian, his successor Beshirul-Qassim openly joined the Maronites, hoping to defeat Druse rivals with their aid. It was a suicidal policy, even the Druses of the Shehab faction distrusted and disliked their Christian allies, the rest became perforce pro-Muslim, and the Turkish Government, which was carrying out the centralizing policy initiated by Mahmud the Reformer, saw danger in the alliance. For the next 20 years the history of the Lebanon is a monotonous record of murder, intrigue and civil war. The Maronites rebelled once, the Druses twice, against the Turks, who half heartedly attempted or pretended to impose reforms desired by the European Powers upon the turbulent mountain chiefs. Three constitutions were successively bestowed upon the Lebanon, which was twice "disarmed," European interference increased the exasperation of Druses and Muslims against the Maronites, and the scandal culminated in massacres of Christians which extended to the coast and to Damascus, where some 2,500 Christians were slaughtered and foreign consulates sacked (July 9, 1860). The Powers intervened. A French army occupied the Lebanon for nearly a year, and the Porte, after appointing a Christian governor general of the Lebanon, conferred a large measure of autonomy on the province by the Organic Statute of Sept. 6, 1864. The change made an end of the political importance of the Lebanese Druses. Beshirul-Qassim had been murdered, his family had lost wealth and prestige, and henceforth Druse political interests in Lebanon were mainly confined to such harmless subjects as the rivalry between a Jumblat or an Arslan for the governorship of a county. Those who found the change too distasteful migrated to the Hauran. The rest made the best of it, and till 1918 remained a conservative, rather aloof community, influential in the parish politics of the southern Lebanon.

The Hauran Druses.—By 1840 the influx of malcontents from the Lebanon had increased the small Druse community in the Hauran to 7,000 souls. For some time they remained independent and held out successfully in their stronghold, the lava field of the Leja, against Ibrahim Pasha's Egyptians in 1839, and Kibrisli Pasha's Turks in 1852. Their government was then theocratic under the *Rais* (chief) of the *Uqgala* (initiated) in Suwayda. In 1879 Midhat, the reforming governor general of the Damascus province, found them troublesome and formidable neighbours. Their numbers had increased to over 20,000 and their repression required an army corps. He imposed a qaimaqam (lieutenant-governor) upon them and the office after a while became vested in the house of Atrash (pl. Tushun), but the majority of the clans refused taxes and military service. In 1896 the contumacious clans were defeated and their country ravaged by a Turkish army, but the campaign was costly and the Turks agreed to a compromise whereby the Druses were to pay taxes and serve as frontier guards on the desert edge in their own territory. A governor with a small Turkish force was stationed at Sheikh Saad, outside Druse territory proper, and the clans were left to fight as they pleased with the Beduin whom they usually defeated. After the Turkish revolution of 1908 the Government decided to garrison points in Druse territory. Some of the Tushun revolted in 1910 but the rebels were defeated and their chief, Yahya, executed. (D G H, G B s.)

The French Mandate.—The Druse polity in the Hauran at the end of the World War remained feudal. The cultivated land attached to each village was communally owned and re-allotted at varying periods among the cultivators. The lords had prescriptive rights to the produce of certain demesne lands which

then peasants cultivated for them, but a peasant revolt late in the 19th century had restricted these demesnes. The ten noble families kept open house and maintained armed retainers. Clan solidarity and the sense of obligation between nobles and peasants were strong, but family jealousies usually prevented the chiefs from acting in unison.

During the World War the Druses, who had gained economic advantages by the opening of the Hejaz railway on the western edge of their territory, sat prudently on the fence and made money out of their crops until Sept. 1, 1918, when a section led by Sultan Pasha Al Atrash assisted Feisal and Col. Lawrence during their advance on Damascus. There Sultan Pasha gave the Sherfians trouble, and Lawrence has recorded that he was well nigh strangled during a conference by the redoubtable Audu abu-Tayy. The Druses maintained an attitude of reserve towards the Sherfian Government and after its overthrow by the French under Gen. Gouraud in July 1920, refused to join the Hauran Muslims in resisting the French mandate. Late in the year they entered into negotiations with the French, and on March 4, 1921, an agreement was signed by the acting high commissioner, M. de Caix, and sealed by a number of Druse spiritual and temporal chiefs, where by the Druse mountain (Jabal'd-Duruz) was granted an independent national government headed by an elected native governor under the French mandate. On May 1 an informal assembly of notables elected Salim Pasha Al Atrash governor at Suwayda, the capital of the new state. His relatives gave trouble, and in the same year his kinsman, Sultan Pasha, exasperated by the arrest in his house of a suppliant who had attempted to murder Gen. Gouraud and was seeking asylum, revolted with his retainers. Next year he was amnestied after some skirmishing. In Sept. 1923 Salim died, and the Druse council, which had not been constitutionally elected but appointed by private understanding among the lords, could not agree concerning the election of a governor, and unconstitutionally elected Capt. Carbillot the French adviser to the Druse state as their provisional governor.

War with France.—In Prof. Toynbee's words (Toynbee, *Survey of International Affairs*, vol. 1, pp. 412-413, 1925), the new governor, while sincere, disinterested and energetic, was "tyrannical in his methods and psychologically blind to a degree which made it inevitable that his well-meant efforts should end in disaster." He filled the treasury, supplied the country with roads, schools, irrigation channels, reservoirs, and justices of the peace, founded a museum, and in the autumn of 1924 gave effect to Article 4 of the de Caix Agreement by conducting elections for a new council, which promptly violated Article 3 of the agreement by electing him as the regular governor. Capt. Carbillot's policy was directed against the chiefs, notably the Turshun, but his strict imposition of forced labour and of a rigid system of passes, and his imprisonment of recalcitrants, who were occasionally incarcerated in his coal-cellar, exasperated the peasantry.

In April 1925 Druse delegates waited on Gen. Sarraïl, the new French high commissioner in Syria, to complain of their governor, and to point out that his election was a violation of the de Caix Agreement. The general brusquely dismissed them, and subsequently stated in writing that he repudiated the agreement. Meanwhile the governor went on leave. His French *locum tenens* warned Sarraïl of the growing excitement among the Druses and was dismissed. Druse petitions remained unheard, and another delegation was rebuffed. On July 11 Gen. Sarraïl ordered his delegate at Damascus to summon the Druse "conspirators" on the pretext of receiving their demands "and then hold them as hostages. Three confiding notables appeared, and were exiled to Palmyra. On July 20 Sultan Pasha rebelled, and having surprised and defeated a small French force next day, invested Suwayda on July 22. Gen. Sarraïl made light of the revolt, and on Aug. 2-3 a column 3,000 strong, comprising some unreliable colonial troops, was attacked near Azra' while marching to relieve Suwayda, and lost its transport, most of its guns, and more than a quarter of its men. A general Druse rising followed.

The rebels promptly established contact with the pro-Sherfian elements in Damascus and with the nationalist and anti-French "People's Party." Its leader Dr. A. Shabbandar, and other chiefs

fled to the Druses to avoid arrest, and early in September proclaimed a "National Syrian Government." The French repulsed a Druse raid on Damascus on Aug. 24 and relieved Suwayda a month later, but were unable, owing to transport difficulties, to force the Sultan to a general action. The retreats that followed their advances encouraged the hostile Muslim elements in their rear, and the revolt in Damascus and the bombardment of the city (Oct. 13-20) marked the beginning of the Syrian Nationalist revolt, the history of which is narrated elsewhere (See *SYRIA. Modern History*). During this unequal struggle the Druses proved themselves far better fighters than the Muslim insurgents, and they were the last to submit. At one moment they seemed likely to inflict a grave disaster upon the French. The Hermon Druses joined the revolt late in Sept. 1925, Zaydu'l Atrash son of the Sultrn came to their aid, surprised Hasbayya on the night of Nov. 9-10, and prepared to invade the Lebanon, where he expected to be joined by the local Druses and the Shah Muslims (Matawilah) of the Sidon hinterland. The heroic defence of Hasbayya by a handful of troops saved the situation, and French reinforcements cleared the Hermon region in December. Thenceforward the Hauran Druses fought a losing battle. Abdu'l Ghaffar Al Atrash and other chiefs opened negotiations with Gen. Andrea in Oct. 1926, which ended after some months in their surrender on honourable terms. The Leja was conquered in the spring of 1927, and Sultan, who had established a camp at Qasru'l Azraq in the British mandatory territory of Transjordan, was compelled by British armoured cars and Transjordanian police to withdraw into Ibn Sa'ud's desert dominions with the remnant of his followers, and their families. He settled at Qurayyatul-Milh in the Wadi Sirhan with, perhaps, 500 families, who were well received by the Wahabi Ling, though a lasting friendship between the "Puritans of Islam" and the non-Muslim Druses seems improbable. Col. Clement Grandcourt was appointed governor of the Hauran in 1927 and the French military chiefs, who respected Druse valour, did their best to restore good relations.

Customs.—The Hauran Druses have some of the vices and all the virtues of oriental mountaineers. They are intelligent, self-respecting, and hospitable, but cruel and, by Western standards, treacherous. The women enjoy much consideration, polygamy is forbidden, and they join the men in religious functions. Divorce may be initiated by the wife. The veil is obligatory, some Druse women, indeed, will not unveil in the presence of a foreign woman. Feminine dress is black, with red slippers. The men usually wear a black under-robe with white girdle, and a white roll round the red fez, which is now almost the sole distinguishing mark of the Lebanon Druses. (For religious observances see above.)

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RELIGION

Druses, a term for the Muwahhidin (Unitarians), as the Druses call themselves, who believe that there is one and only one God, indefinable, incomprehensible, ineffable, passionless. He has made himself known to men by successive incarnations, of which the last was Hâkim, the sixth Fatmide caliph. How many these incarnations have been is stated variously, but 70, one for each period of the world, seems the best-attested number. Jesus appears to be accepted as one such incarnation, but not Muhammad. No further incarnation can now take place in Hâkim a, final appeal was made to mankind, and after the door of mercy had stood open to all for 26 years, it was finally and for ever closed. When the tribulation of the faithful has reached its height, Hâkim will reappear to conquer the world and render his religion supreme. Druses, believed to be dispersed in China, will return to Syria. The combined body of the Faithful will take Mecca, and finally Jerusalem, and all the world will accept the Faith. The first of the creatures of God is the Universal Intelligence or Spirit, impersonated in Hamza, Hâkim's vizier. This Spirit was

the creator of all subordinate beings, and alone has immediate communion with the Deity. Next in rank, and equally supporting the throne of the Almighty, are four Ministering Spirits, the Soul, the Word, the Right Wing and the Left Wing, and beneath these again are spiritual agents of various ranks. The material world is an emanation from, and a "mirror" of, the Divine Intelligence. The number of human beings admits neither of increase nor of decrease, and a regular process of metempsychosis goes on continually. The souls of the virtuous pass after death into ever new incarnations of greater perfection, till at last they reach a point at which they can be re-absorbed into the Deity itself, those of the wicked may be degraded to the level of camels or dogs. All previous religions are mere types of the true, and their sacred books and observances are to be interpreted allegorically. The Gospel and the Qur'an are both regarded as inspired books, but not as religious guides. The latter function is performed solely by the Druse Scriptures. As the admission of converts is no longer permitted, the faithful are enjoined to keep their doctrine secret from the profane, and in order that their allegiance may not bring them into danger, they are allowed to make outward profession of whatever religion is dominant around them. To this latter indulgence is to be attributed the apparent indifference which leads to their joining Muslims in prayers and ablutions, or sprinkling themselves with holy water in Maronite churches. Obedience is required to the seven commandments of Hamza, the first and greatest of which enjoins truth in words (but only those of Druse speaking with Druse), the second, watchfulness over the safety of the brethren, the third, absolute renunciation of every other religion, the fourth, complete separation from all who are in error, the fifth, recognition of the unity of "Our Lord" in all ages, the sixth, complete resignation to his will, and the seventh, complete obedience to his orders. Prayer, however, is regarded as an impertinent interference with the Creator, while, at the same time, instead of the fatalistic predestination of Islam the freedom of the human will is distinctly maintained. Not only is the charge of secrecy rigidly obeyed in regard to the alien world, but full initiation into the deeper mysteries of the creed is permitted only to a special class designated 'Aqls (Arabic *Aql*, intelligence), in contradistinction from whom all other members of the Druse community, whatever may be their position or attainments, are called *Jāhls*, the Ignorant. About 15% of the adult population belong to the order of 'Aqls. Admission is granted to any Druse of either sex who expresses willingness to conform to the laws of the society, and during a year of probation gives sufficient proof of sincerity and stability of purpose. There appears to be no formal distinction of rank among the various members. Exceptional influence depends upon exceptional sincerity or ability. All are required to abstain from wine and wine, the women used not to be allowed to wear gold or silver, or silk or brocade, but this rule is commonly broken now, and although neither celibacy nor retirement from the affairs of the world is either imperative, or customary, unusual respect is shown to those who voluntarily submit themselves to ascetic discipline. The 'Aqls are distinguished by the wearing of a white turban, emblematic of the purity of their life. Their food must be purchased with money lawfully acquired, and lest they should unwittingly partake of any that is ceremonially unclean they require those *Jāhls*, whose hospitality they share, to supply their wants from a store set apart for their exclusive use. The ideal 'Aql is grave, calm and dignified, with an infinite capacity of keeping a secret, and a devotion that knows no limits to the interests of his creed. On Thursday evening, the commencement of the weekly day of rest, the members of the order meet together in the various districts, probably for the reading of their sacred books and consultation on matters of ecclesiastical or political importance. Their meeting-houses, *kha'was*, are plain, unornamented edifices, in which the women assemble at the same time as the men, a part of the space being fenced off for them by a semi-transparent black veil. It has been frequently asserted that the image of a calf is kept in a niche, and traces of phallic and gynaeceocratic worship have been vaguely suspected, but there is no authentic information in support of either state-

ment, and it is certain that the sacred books of the religion contain moral teaching of a high order on the whole.

As a formulated creed, the Druse system is not a thousand years old. In the year A.D. 996 (386 A.H.) Hākim Bismillāh (see he who judges by the command of God), sixth of the Fatimite caliphs (third in Egypt), began to reign, he believed that he held direct intercourse with the deity, or even that he was an incarnation of the divine intelligence, and in A.D. 1016 (407 A.H.) his claims were made known in the mosque at Cairo, in 1017 (408 A.H.) the new religion found a successful apostle in the person of Hamza ibn 'Ali ibn Ahmad, a Persian mystic, who became Hākim's vizier, gave form and substance to his creed, and by an ingenious adaptation of its various dogmas to the prejudices of existing sects, finally enlisted an extensive body of adherents. In 1020 (411 A.H.) the caliph was assassinated, but it was given out by Hamza that he had only withdrawn for a season, and his followers were encouraged to look forward with confidence to his triumphant return.

It is possible, even probable, that the segregation of the Druses as a people dates only from the adoption of Hamza's creed. But when it is recalled that other inhabitants of the same mountain system as the Maronites, the Ansariyya, the Metawālī and the Isma'ilites, also profess creeds which, like the Druse system, differ from Sunni Islam in the important feature of admitting incarnations of the Deity, it is impossible not to suspect that Hamza's emissaries only gave definition and form to beliefs long established in this part of the world. Many of the fundamental ideas of Druse theology belong to a common West Asiatic stock, but the peculiar history of the Mountain is no doubt responsible for beliefs, held elsewhere by different peoples, being combined there in a single creed. Some allowance, too, must be made for the probability that Hamza's system owed something to doctrines, Christian and other, with which the metropolitan position of Cairo brought Fatimite society into contact. (See *Encyclopaedia of Islam*, II, 755.)

DRUSUS, MARCUS LIVIUS, Roman statesman, was colleague of Gaius Gracchus in the tribuneship, 122 B.C. The proposal of Gracchus (q.v.) to confer the full franchise on the Latins had been opposed not only by the senate but also by the mob, whose privileges would thereby be diminished. Drusus threatened to veto the proposal. Encouraged by this, the senatorial party put up Drusus to outbid Gracchus. Gracchus had proposed to found colonies abroad, Drusus provided twelve in Italy, to each of which 3,000 citizens were to be sent. Gracchus had proposed to distribute allotments to the poorer citizens subject to a state rent charge, Drusus promised that they should be free, and saleable. In addition to the franchise, immunity from corporal punishment (even in the field) was promised the Latins. The absence of Gracchus, and the inefficiency of his representative at Rome, led to the acceptance of these proposals, which were never intended to be carried. Drusus himself declined all responsibility in connection with carrying them out. He was rewarded for his services by the consulship (112), and the title of *patronus senatus*. He received Macedonia for his province, and he was the first Roman general to reach the Danube. He is possibly the Drusus mentioned by Plutarch as having died in 110, the year of his censorship.

See Appian, *Bell. Civ.* I, 23, Plutarch, *Causa Gracchorum*, 8-17, Florus in 4, A. H. J. Greenidge, *Hist. of Rome*, vol. I (1904).

Marcus Livius Drusus, son of the former, tribune of the people in 91 B.C. was a man of high integrity and recognized the need of reform. At that time an agitation was going on for the restoration of the judicial functions from the *equites* to the senate, Drusus proposed as a compromise a measure which restored to the senate the office of *iudices*, while its numbers were doubled by the admission of 300 *equites*. Further, a special commission was to be appointed to try all *iudices* guilty of taking bribes. But the senate was lukewarm, and the *equites* offered violent opposition. In order, therefore, to catch the popular votes, Drusus proposed the establishment of colonies in Italy and Sicily and an increased distribution of corn at a reduced rate. By help of these measures the bill was carried. Drusus then sought a closer alliance with the Italians, promising them the long coveted boon of the Roman franchise.

The senate broke out into open opposition. His laws were abrogated as informal, and each party armed its adherents for the civil struggle which was inevitable. Drusus was murdered, and his assassin was never discovered.

See *Rome History*, also Appian, *Bell. Civ.* 1.35, Florus III, 17, Dio Cass. *xxxvii* 10, Livy, *Ept.* 70, Vell. Pat. II, 13.

DRUSUS, NERO CLAUDIUS (38-9 B.C.), Roman general, son of Tiberius Claudius Nero and Livia Drusilla, stepson of Augustus and younger brother of the emperor Tiberius. In 13 B.C. in conjunction with Tiberius he subdued the Raeti and Vindelici. The credit of the decisive victory, however, must be assigned to Tiberius. (See Horace, *Odes* IV, 4 and 14.) In 13 A.C. Drusus was sent as governor to the three Gauls, where discontent had been aroused by the exactions of the Roman governor Iulius. Drusus made a fresh assessment for taxation purposes, and summoned the Gallic representatives to a meeting at Lugdunum to discuss their grievances. It was important to pacify the Gauls, in order to have his hands free to deal with the German tribes one of which the Sugambri, on the right bank of the Rhine, had seized the opportunity, during the absence of Augustus, to cross the river (12). Drusus drove them back and pursued them to their own territory, which he devastated. Sailing down the Rhine he subdued the Frisii and, in order to facilitate operations against the Chauci, dug a canal (Fossa Drusiana) leading from the Rheenus (Rhine) to the Isala (Yssel) into the lacus Flevis (Zuider Zee) and the German ocean. Making his way along the Frisian coast, he conquered the island of Burchum (*Borkum*), defeated the Bructen in a naval engagement on the Amisia (*Ems*), and went on to the mouth of the Visurgis (*Weser*) to attack the Chauci. On the way back his vessels grounded on the shallows, and were only got off with the assistance of the Frisii.

In his second campaign (11), Drusus defeated the Usipetes, threw a bridge over the Luppia (*Lippe*), attacked the Sugambri and advanced to the Weser, where he defeated the Cherusci. While making his way back he fell into an ambush but managed to defeat his enemy. In view of future operations, he built two forts, one at the junction of the Luppia and Aliso (*Ame*), the other in the territory of the Chatti on the Taunus, near Moguntiacum (*Mainz*).

The third campaign (10) was of little importance, and, after some insignificant successes, Drusus returned to Rome, and was elected consul for the following year.

In 9 B.C. he defeated the Chatti, Suebi, Marcomanni and Cherusci, and penetrated as far as the Albis (*Elbe*). Here trophies were set up to mark the farthest point ever reached by a Roman army. To secure the conquered territory, fortresses were erected along the Elbe, Weser and Maas (*Meuse*, *Moselle*), a flotilla was placed upon the Rhine, and a dam built upon the right arm of its estuary to increase the flow of water into the canal mentioned above. On his return, his horse threw him, and he died thirty days after the accident (Sept. 14). The body was carried to the winter quarters of the army, whence it was escorted by Tiberius to Rome, the procession being joined by Augustus at Tictum (Pavia). Tiberius delivered the funeral oration.

Drusus was one of the most distinguished men of his time. His agreeable manners, handsome person and brilliant military talents gained him the affection of the troops, while his liberal principles endeared him to the people. He married Antonia, the daughter of Marcus Antonius the triumvir, by whom he had three children: Germanicus, adopted by Tiberius, Claudius, afterwards emperor, and a daughter Livilla.

The chief ancient authorities for the life of Drusus are Dio Cassius, the epitomes of Livy, Suetonius (*Claudius*), Tacitus (*Portions of the Annals*), Florus (whose chief source is Livy), Velleius Paterculus and the *Consolato ad Liviam*. The German campaigns were described in the last books of Livy and the lost *Bella Germaniae* of the elder Pliny. They have produced an extensive literature, in Germany, J. Asbach's "Die Feldzüge des Nero Claudius Drusus" (*Rhein-Jahrb.* lxxvii, 14-30) being especially recommended, see also Mommsen's *History of the Roman Provinces*, I, Mervale, *History of the Romans under the Empire*, ch. 36, A. Stein in Pauly-Wissowa's *Realencyclopädie* (1899), where other authorities are given, J. C. Tarver, *Tiberius the Tyrant* (1902).

7—C.

DRUSUS CAESAR (c. 15 B.C.—A.D. 23), commonly called Drusus junior, to distinguish him from his uncle Nero Claudius Drusus, was the only son of the Emperor Tiberius. He was consul elect in A.D. 14, and on the accession of Tiberius was sent to put down a mutiny of the troops in Pannonia (Tacitus, *Annals*, I, 24-30). As governor of Illyricum (17 A.D.), he set the Germanic tribes against one another. On his return Drusus was consul a second time (21 A.D.) and in the following year received the tribunician power which indicated him as heir to the throne. Senatus, who also aspired to the supreme power, determined to remove Drusus. He seduced Drusus's wife and persuaded her to assist him in murdering her husband. A slow poison was administered, from the effects of which Drusus died after a lingering illness. Drusus was a man of violent passions, but not entirely devoid of better feelings, as is shown by his undoubtedly sincere grief at the death of Germanicus.

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DRYADES or **HAMADRYADES**, in Greek mythology nymphs of trees and woods. It is sometimes said by late authors that a dryad is a nymph who lives among trees (Gr. *δρῦς*, tree, especially oak), a hamadryad the spirit of a tree, living and dying with it.

DRYANDER, JONAS CARLSSON (1748-1810), Swedish botanist, born at Gothenburg on March 3, 1748, was educated at Gothenburg Lund and at Uppsala under Linnaeus. He visited England in 1782 and became librarian to Sir Joseph Banks. He was librarian to the Royal society and to the Linnean society, of which he was one of the founders in 1788. He was vice-president of the society from 1794 till his death in London Oct. 19, 1810. Besides various papers, Dryander published *Dissertatio gradus linguae regno vegetabilis vindex* (Lund, 1776) and *Catalogus bibliothecae historico naturalis Josephi Banksi*, *Part* 5 vol. (London, 1796-1800), and edited Anton's *Horius Kewensis* and Roxburgh's *Plants of the Coast of Coromandel*.

DRYBURGH ABBEY, a monastic ruin southwest of Berwickshire, Scot., on the Tweed river, about 5 mi. southeast of Melrose. The abbey occupies the spot where, about A.D. 522, St. Modan, an Irish monk, established a sanctuary. Founded in the middle of the 12th century, it prospered until 1325, when it was partially destroyed by the English under Edward II. It suffered again at the hands of Richard II in 1385, and was reduced to ruin during the expedition of Edward Seymour earl of Hertford, in 1544.

After the Reformation, the estate was erected into a temporal lordship, and in 1604 James VI gave it to John Erskine, earl of Mar. In 1700 the abbey lands belonged to Thomas Haliburton, Sir Walter Scott's great grandfather, but an extravagant granduncle became bankrupt and had to part with the property. It reverted to a branch of the Erskines in 1785, when it was acquired by the 11th earl of Buchan. Lord Glenconner later purchased it, and in Jan. 1918 he gave it to the nation.

At mid 20th century a number of the monastic buildings were represented by fragments. The church was originally 190 ft. long and 75 ft. wide at the transepts. Remains include the west front, the east aisle of the north transept, called St. Mary's Aisle, parts of the south transept and segments of the choir and nave. Scott was buried in St. Mary's Aisle on Sept. 26, 1832. His tomb is a plain block of polished Peterhead granite, inscribed only with his name and the dates of his birth and death.

DRY CLEANING Dry cleaning is the process of cleaning wearing apparel, household furnishings and other articles made of wool, silk, rayon and related fabrics. Dirt, stains and spots are removed by the chemical action of organic solvents and special detergents, as contrasted with laundering in soap and water.

Striving with crude hand methods and uncertain results, the technique of dry cleaning was developed to a high technological degree of efficiency, speed and safety to fabrics.

Formerly, dry cleaning was done with petroleum solvents (naphtha, Stoddard solvent, etc.). Initial cost was low but fire hazards were ever-present.

The modern trend favours dry cleaning with synthetic solvents,

such as carbon tetrachloride, trichlorethylene, perchlorethylene and blends of chlorinated hydrocarbons. Most of the spots and stains on clothing are oily. These solvents dissolve oils, greases, waxes and tars almost instantly, partly because of their low surface tension and high wetting power. Other properties make these cleaning fluids useful: they are nonflammable, they leave garments free from odour, they have high volatility, they permit rapid drying, they do not injure or shrink the most delicate fabrics, their low boiling points permit ease in reclaiming, and they impart a lustre and soft feel to garments.

When a load of dirty clothing is placed in the dry-cleaning machine, the solvent dissolves much of the soil at once, while insoluble dirt particles are loosened from the fibres. Insoluble soil consists largely of lint, earth, dust, ashes, carbon particles and face powder. By a continuous flow of solvent through the fine openings in the fabric, loosened dirt is flushed out, washed free to the surface of the fabric and passed into suspension in the solvent. Remaining insolubles require later treatment by special soaps and spotting agents. All the contaminated solvent must be rinsed out to obtain good results. The clothes can be only as clean as the solvent used in the final rinse. By means of a proper reclamation system, suspended and dissolved impurities are removed from the solvent by processes of filtration, clarification and distillation. Although the amount of soil in garments varies widely, the average is approximately 0.8% by weight. One thousand pounds of garments leave about eight pounds of sludge.

Some stains are water soluble and call for wet cleaning in a washing machine.

The dry cleaner's skill is applied in spotting. In this process stains are diagnosed and removed by application of specific chemicals, steam, scraping with a bone spatula or dry brushing. The quality of dry cleaning depends on the effectiveness of spotting techniques. Finishing includes many varied operations: the dry cleaner must sew on buttons, do minor tailoring repairs, press the garment so that it resumes its original lines, shape, drape and appearance, bring up the nap by steam, hand iron fragile silks, etc.

The modern dry cleaning plant requires high pressure steam and many intricate and highly specialized machines and appliances. A partial list of equipment includes marking machines, washers, stills, pumps, extractors, dry tumblers, wind whips, blow dryers, drying cabinets, presses, puff irons, scrub and steam tables, sleeves, glove units, steam irons, bagging and assembling racks and sewing machines. Special utility presses in assorted shapes are used for the finishing of different types of garments. The total investment in machinery is substantial.

In 1950 the U.S. department of commerce (census of business) reported a total of \$1,300,000,000 of dry-cleaning business for the year, or \$8.70 dry-cleaning sales per capita for the country. From 1939 to 1950 the increase of dry-cleaning volume had showed a phenomenal growth. In 1950 there were in the U.S. 28,000 dry-cleaning plants, with an investment in equipment of \$750,000,000.

The small press shops receive garments from customers, send them to large wholesale dry-cleaning plants for actual cleaning and upon their return remove spots, do minor repairs and press the garments. Small independent press shops flourish in the larger cities.

During and after World War II a significant development was the rapid growth of chain-store cleaners. These companies operate large-scale, mechanized cleaning plants, reach their customers through company owned neighbourhood stores, and sell the service at low prices on a cash-and-carry basis. They obtain their profits through great volume handled in mass production.

The retail dry cleaner operates his own plant, serving customers through "drive-in," stores or delivery routes. The National Institute of Cleaning and Dyeing, Silver Spring, Md., was founded in 1907, to serve member dry-cleaning firms with technical bulletins, scientific garment analyses, field and engineering service and management courses. It established research laboratories and a model plant and dry-cleaning school with students enrolled from many countries of the world.

(V. K. J.)

DRYDEN, JOHN (1631-1700), English poet, born at Ald-

winkle, in Northamptonshire, of a family with Puritan and anti-monarchical leanings, was educated at Westminster school under Richard Busby, and at Trinity college, Cambridge where he took his degree in 1654. In that year his father died, leaving him a small estate worth about £60 a year, and he seems to have remained in Cambridge another three years before establishing himself in London, where he is said to have lived in the house of his publisher, Herrington, with whom he was connected until 1679, when Jacob Tonson became his publisher.

He had written some elegant and commendatory verses while he was at school, but the first work which showed the measure of his genius was the *Heroic Stanzas* (1659) to the memory of Oliver Cromwell. This is a fine tribute to the Protector, and shows Dryden as a disciple of John Donne indeed, but as a direct student of the Latin classics. With the coronation of Charles II Dryden, the hereditary Puritan and the coneyryst of the Protector hailed the new order in his *Astraea Redux* (1660), followed by a *Panegyric on the Restoration* (1661).

For a livelihood Dryden turned to the stage. Having failed with a tragedy on the fate of Henry, duke of Guise, he turned to comedy, for which he admitted he had little taste. The age demanded comedies, and he endeavoured to supply the kind of comedy that the age demanded. His first attempt was unsuccessful. He then wrote *The Wild Gallant*, acted in Feb. 1663, by Thomas Killgrew's company in Vere street. Peppys showed good judgment in pronouncing the play "so poor a thing as ever I saw in my life." Dryden never learned moderation in his humour, but he took a lesson from the failure of *The Wild Gallant*, his next comedy *The Royal Ladies*, produced before the end of 1663, and printed in the next year, as correctly described by Peppys as "a very innocent and most pretty witty play." But he never quite conquered his tendency to extravagance. *The Assignment, or Love in a Nunnery*, produced in 1673, was another failure, and even in 1680, after 20 years' experience to guide him, *The Kind Keeper, or Mr Limberham*, was prohibited after three representations as being too indecent for stage presentation.

The undisciplined force of the man carried him to an excess from which more dexterous writers held back. After the production of *The Royal Ladies* in 1663, Dryden assisted Sir Robert Howard in the composition of a tragedy in heroic verse *The Indian Queen*, produced with great splendour in Jan. 1664. Its success, one of the greatest since the reopening of the theatres, was largely due to the magnificent scene accessories—the battles and sacrifices on the stage, the spirits singing in the air, and the god of dreams ascending through a trap. Dryden followed it up with *The Indian Emperor, or the Conquest of Mexico by the Spaniards*, acted in 1665. Immediately after the success of *The Indian Queen*, in the preface to an edition (1664) of *The Royal Ladies*, Dryden took up the question of the propriety of rhyme in serious plays. Rhyme was not natural, some people had said, to which he answered that it is as natural as blank verse, and that much of its unnaturalness is not the fault of the rhyme but of the writer. Rhyme at once stimulates the imagination, and prevents it from being too discursive in its flights.

In 1668 he published his *Essay of Dramatick Poesie*. The essay takes the form of a dialogue between Neander (Dryden), Eugenius (Charles, Lord Buckhurst, afterward earl of Dorset), Crites (Sir R. Howard) and Lisideus (Sir C. Sedley), who is made responsible for the definition of a play as a "just and lively image of human nature, representing its passions and humours, and the changes of fortune to which it is subject, for the delight and instruction of mankind." Dryden's form is of course borrowed from the ancients, and his main source is the critical work of Corneille in the prefaces and discourses contained in the edition of 1660, but he was well acquainted with the whole body of contemporary French and Spanish criticism. Crites maintains the superiority of the classical drama, Lisideus supports the exacting rules of French dramatic writing, Neander defends the English drama of the preceding generations, including, in a long speech, an examination of Ben Jonson's *Silent Woman*. Neander argues, however, that English drama has much to gain by the observance of exact methods of construction without abandoning entirely

the liberty which English writers had always claimed. He then goes on to defend the use of rhyme in serious drama. How-aid had argued against the use of rhyme in a "preface" to *Four New Plays* (1665), which had furnished the excuse for Dryden's essay. Howard replied to Dryden's essay in a preface to *The Duke of Lerna* (1668). Dryden at once replied in a masterpiece of sarcastic retort and vigorous reasoning, *A Defence of an Essay of Dramatique Poetrie*, prefixed to the second edition (1668) of *The Indian Emperour*. It is the ablest and most complete statement of his views about the employment of rhymed couplets in tragedy.

Before his return to town at the end of 1666, when the theatres (which had been closed during the disasters of 1665 and 1666) were reopened, Dryden wrote a poem on the Dutch war and the Great Fire entitled *Annus Mirabilis* (ptd. 1667). The poem is in quatrains, the metre of his *Heroic Stanzas* in praise of Cromwell, which Dryden chose, he tells us, "because he had ever judged it more noble and of greater dignity both for the sound and number than any other verse in use amongst us." From the reopening of the theatres in 1666 till Nov. 1681, the date of his *Absalom and Achitophel*, Dryden produced nothing but plays. The stage was his chief source of income. *Secret Love*, or *the Maiden Queen*, a tragic comedy, produced in March 1667, was based on an episode in the *Artamene*, ou le Grand Cyrus of Mlle de Scudéry, the historical original of the "Maiden Queen" being Christina, queen of Sweden. His next play *Sir Martin Mar all*, or *the Feign'd Innocence*, an adaptation in prose of the duke of Newcastle's translation of Molière's *L'Etourdi*, was produced at the Duke's theatre, without the author's name, in 1667. It was about this time that Dryden became a retained writer under contract for the King's theatre, receiving from it £300 or £400 a year, till it was burned down in 1672, and about £200 for six years more till the beginning of 1678. His co-operation with Davenant in a new version (1667) of Shakespeare's *Tempest* (for his share in which Dryden can hardly be pardoned on the ground that the chief alterations were happy thoughts of Davenant's, seeing that he affirms he never worked at anything with more delight) must also be supposed to be anterior to the completion of his contract with the Theatre Royal. He was engaged to write three plays a year, and he contributed only 10 plays during the 10 years of his engagement, finally exhausting the patience of his partners by joining in the composition of a play for the rival house. Comedies produced by him in this period are *An Evening's Love*, or *the Mock Astrologer*, an adaptation from *Le Fent Astrologue* of the younger Corneille, produced at the King's theatre in 1668, *Ladies à la Mode* (1668), *Marriage à la Mode* (1671), *The Assignment*, or *Love in a Nunnery* (1673), *The Kind Keeper*, or *Mr Limberham* (1678), but only *Marriage à la Mode* was really successful.

While Dryden met with such indifferent success in his wiling efforts to supply the demand of the age for low comedy, he struck upon a really popular and profitable vein in heroic tragedy. *Tyrannic Love*, or *the Royal Martyr*, a Roman play dealing with the persecution of the Christians by Maximian, was produced in 1669. It is in rhymed couplets, but the author again did not trust solely for success to them; for, besides the magic incantations, the singing angels, and the view of Paradise, he made Nell Gwyn, who had stabbed herself as Valena, start to life again as she was being carried off the stage, and speak a notorious epilogue, in violent contrast to the serious character of the play. *Almanzor and Almahide*, or *the Conquest of Granada*, a tragedy in two parts, was written in 1669 to 1670. This piece seems to have given the crowning touch of provocation to the wits, who ridiculed the popular taste for these extravagant heroic plays. *The Rehearsal* (1671) written by the duke of Buckingham, with the assistance, it was said, of Samuel Butler, Martin Clifford, Thomas Sprat and others, was a severe and just punishment for Dryden's boast in the epilogue to the second part of *The Conquest of Granada* of the superiority of Restoration comedy over that of the Elizabethan age. Davenant was originally the hero, but on his death in 1668 the satire was turned upon Dryden, who is ridiculed under the name of Bayes, the name being justified by his appointment in 1670 as poet laureate and historiographer to the king (with a pension of £300 a year and a butt of canny wine). It is said that *The Rehearsal*

was begun in 1663, but this probably only means that Buckingham and his friends had resolved to burlesque the extravagant heroics of *The Indian Queen*. Later Dryden fully avenged himself on Buckingham by his portrait of Zimri in *Absalom and Achitophel*. His immediate reply is contained in the preface "Of Heroic Plays" and the "Defence of the Epilogue," printed in the first edition (1672) of his *Conquest of Granada*.

His next tragedy *Ambonyne* (1673), put on the stage to inflame the public mind in view of the Dutch war, was written, with the exception of a few passages, in prose, and those passages in blank verse. An opera which he wrote in rhymed couplets, called *The State of Innocence*, and *Fall of Man*, an attempt to turn part of *Paradise Lost* into rhyme, as a proof of its superiority to blank verse, prefaced by an "Apology for Heroique Poetry and Poetique Licence," was entered at Stationers' hall in 1674, and printed in 1677, but never acted. Dryden praises his original as "undoubtedly one of the greatest, most noble and most sublime poems which either this age or nation has produced." He is said to have had the elder poet's leave "to tag his verses." In *Aurengzebe*, which was Dryden's last, and also his best rhymed tragedy, he borrowed from contemporary history, for the Great Mogul was still living. In the prologue he confessed that he had grown weary of his long loved mistress rhyme and retracted, with characteristic frankness, his disparaging contrast of the Elizabethan with his own age. But the stings of *The Rehearsal* had stimulated him to do his utmost to justify his devotion to his mistress, and he claims that *Aurengzebe* is "the most correct" of his plays. It was entered at Stationers' hall and probably acted in 1675, and published in the following year.

After the production of *Aurengzebe* Dryden seems to have reconsidered the principles of dramatic composition, and to have made a particular study of the works of Shakespeare. The fruits of this appeared in *All for Love*, or *the World Well Lost*, a version of the story of Antony and Cleopatra, produced in 1678, which must be regarded as a very remarkable departure for a man of his age, and a wonderful proof of undiminished openness and plasticity of mind. In his previous writings on dramatic theory, Dryden, while admiring the rhyme of the French dramatists as an advance in art, did not give unqualified praise to the regularity of their plots, he was disposed to allow the irregular structure of the Elizabethan dramatists, as being more favourable to variety both of action and of character. But now, in frank imitation of Shakespeare, he abandoned rhyme, and, if we might judge from *All for Love*, and the precepts laid down in his "Grounds of Criticism in Tragedy," prefixed to *Troilus and Cressida* (1679), the chief point in which he aimed at excelling the Elizabethans was in giving greater unity to his plot. He upheld still the superiority of Shakespeare to the French dramatists in the delineation of character, but he thought that the scope of the action might be restricted, and the parts bound more closely together with advantage. *All for Love* and *Antony and Cleopatra* are two excellent plays for the comparison of the two methods. Dryden gave all his strength to *All for Love*, writing the play for himself, as he said, and not for the public. The action of his play takes place wholly in Alexandria, within the compass of a few days, it does not, like Shakespeare's, extend over several years, and present incessant changes of scene. Dryden chooses, as it were, a fragment of a historical action, a single moment during which motives play within a narrow circle, the culminating point in the relations between his two personages. He elevates his whole play, also, to those relations, only what bears upon them is admitted. In Shakespeare's play we get a certain historical perspective, in which the love of Antony and Cleopatra appears in its true proportions beneath the firmament that overhangs human affairs. In Dryden's play this love is our universe, all the other concerns of the world retire into a shadowy, indistinct background. If we rise from a comparison of the plays with an impression that the Elizabethan drama is a higher type of drama, taking Dryden's own definition of the word as "a just and lively image of human nature," we rise also with an impression of Dryden's power such as we get from nothing else that he had written since his *Heroic Stanzas* 20 years before.

It was 12 years before Dryden produced another tragedy worthy of the power shown in *All for Love*. *Don Sebastian* was acted and published in 1690. In the interval he wrote *Oedipus* (1679) and *The Duke of Guse* (1683) in conjunction with Nathaniel Lee, *Troilus and Cressida* (1670), *The Spanish Friar* (1681), *Albion and Albanius*, an opera (1685), *Amphitruon* (1690). In *Troilus and Cressida* he follows Shakespeare closely in the plot, but the dialogue is rewritten throughout, and not for the better. The versification and language of the first and the third acts of *Oedipus*, which with the general plan of the play were Dryden's contribution to the joint work, bear marked evidence of his recent study of Shakespeare. *The Duke of Guse*, in which he used one scene from his earliest dramatic attempt, provided an obvious parallel with contemporary English politics. Henry III was identified with Charles II, and Monmouth with the duke. The lord chamberlain refused to license it until the political situation was less disturbed. The plot of *Don Sebastian* is more intricate than that of *All for Love*. It has also more of the characteristics of his heroic dramas, the extravagance of sentiment and the suddenness of impulse remind us occasionally of *The Indian Emperor*, but the characters are much more elaborately studied than in Dryden's earlier plays, and the verse is stately and powerful. It would be difficult to say whether *Don Sebastian* or *All for Love* is his best play; they share the palm between them. Dryden's subsequent plays are not remarkable. Their titles and dates are *King Arthur*, an opera (1691), for which Purcell wrote the music, *Cleomenes* (1692), *Love Triumphant* (1691).

Soon after Dryden's abandonment of heroic couplets in tragedy, he found new and more congenial work for his favourite instrument in satire. As usual the idea was not original to Dryden, though he struck in with his majestic style and energy divine, and immediately took the lead. The pioneer was Mulgrave in his *Essay on Satire*, an attack on Rochester and the court, which was circulated in ms. in 1679. Dryden himself was suspected of the authorship, and he may have given some help in reviving it, but it is not likely that he attacked the king on whom he was dependent for the greater part of his income, and Mulgrave in a note to his *Art of Poetry* (1717) expressly asserts Dryden's ignorance. Dryden, however, was attacked in Rose street, Covent Garden, and severely cudgelled by a company of ruffians who were generally supposed to have been hired by Rochester. Toward the close of 1681 Dryden took the field as a satirist on the side of the court, at the moment when Shaftesbury, baffled in his efforts to exclude the duke of York from the throne as a Papist, and to secure the succession of the duke of Monmouth, was waiting his trial for high treason. *Absalom and Achitophel* produced a great stir. Nine editions were sold in rapid succession in the course of a year. There was no compunction in Dryden's ridicule and invective. Delicate wit was not one of Dryden's gifts, the motions of his weapon were sweeping, and the blows hard and trenchant. The advantage he had gained by his recent studies of character was fully used in his portraits of Shaftesbury and Buckingham, Achitophel and Zimri. In a play produced in 1681 (*The Spanish Friar*) he had written on the other side, gratifying the popular feeling by attacking the Roman Catholic priesthood.

Three other satires followed *Absalom and Achitophel* one of them hardly inferior in point of literary power. *The Medal*, a *Satire against Sedition* (March 1682) was written in ridicule of the medal struck to commemorate Shaftesbury's acquittal. Then Dryden had to take vengeance on the literary champions of the Whig party who had opened upon him with all their artillery. Their leader, Shadwell, had attacked him in *The Medal of John Bayes*, which Dryden answered in Oct. 1682 by *Much Ado About Nothing*, or *A Satire upon the True-Blow Protestant Poet, T. S.* This satire, in which Shadwell filled the title role, served as the model of the *Duncado*. To the second part of *Absalom and Achitophel* (Nov. 1682), written chiefly by Nahum Tate, he contributed a long passage of invective against Robert Ferguson, one of Monmouth's chief advisers, Elkannah Settle, Shadwell and others. *Rehearsal Two*, which appeared in the same month, though nominally an exposition of a layman's creed, and deservedly admired as such, was not without a political purpose. It attacked the Papists but declared

the "fanatics" to be still more dangerous.

Dryden's next poem in heroic couplets was in a different strain. On the accession of James II in 1685, he became a Roman Catholic. There has been much discussion as to whether this conversion was or was not sincere, but it is worth while to notice that in his earlier defense of the English Church he exhibits a desire for the definite guidance of a presumably infallible creed, and the case for the Roman Church brought forward at the time may have appeared convincing to a mind singularly open to new impressions. At the same time nothing can be clearer than that Dryden always regarded his literary powers as a means of subsistence, and had little scruple about accepting a brief on any side. *The Hind and the Panther*, published in 1687, is an ingenious argument for Roman Catholicism, put into the mouth of "a milk white hind, immortal and unchanged." Prior and Montagu, the future earl of Halifax, ridiculed it in *The Hind and the Panther transversed to the story of the Country Mouse and the City Mouse*. Dryden's other literary services to James were a savage reply to Stillingfleet (who had attacked two papers published by the king) and a translation of a life of Xavier in prose. He had written also a panegyric of Charles II in *Threnodia Augustalis* (1685), and a poem in honour of the birth of James II's heir, under the title of "Britannia redi viva" (1688).

Dryden did not abjure his new faith on the Revolution, and so lost his office and pension as laureate and historiographer royal. His rival Shadwell reigned in his stead. Dryden was once more thrown mainly upon his pen for support. He turned again to the stage and wrote the plays already enumerated. In the last decade of his life his translations from the classics occupied much of his attention. *Ovid's Epistles translated* appeared in 1680, and numerous translations from Virgil, Horace, Ovid, Lucretius and Theocritus appeared in the four volumes of *Miscellaneous Poems—Miscellany Poems* (1684), *Sylvarum* (1685), *Examen poetarum* (1693), *The Annual Miscellany* (1694) by the "most eminent hands"; in 1693 was published the verse translation of the *Satires* of Juvenal and of Persius by "Mr. Dryden and several other eminent hands," which contained his "Discourse concerning the Origin and Progress of Satire," and in 1697 Jacob Tonson published his most important translation, *The Works of Virgil*. The book, which was the result of three years' labour, was a vigorous, rather than a close, rendering of Virgil into the style of Dryden. Among other notable poems of this period are the two "Songs for St Cecilia's Day," written for a London musical society for 1687 and 1697, and published separately. The second of these is the famous ode on "Alexander's Feast." The well known paraphrase of *Veni, Creator Spiritus* was printed in the *Examen Poeticum*, and his "Ode to the memory of Anne Killigrew," called by Dr Johnson the noblest ode in the language, was written in 1686.

His next work was to render some of Chaucer's and Boccaccio's tales and Ovid's *Metamorphoses* into his own verse. These translations appeared in 1700, a few months before his death, and are known by the title of *Fables, Ancient and Modern*. The preface, which is an admirable example of Dryden's prose, contains an excellent appreciation of Chaucer, and, incidentally, an answer to Jeremy Collier's attack on the stage. Thus a large portion of the closing years of Dryden's life was spent in translating for bread. Besides, his three sons held various posts in the service of the pope at Rome, and he could not well be on good terms with both courts. However, he was not molested by the government and in private he was treated with the respect due to his age and his admitted position as the greatest of living English poets. He held a small court at Will's coffeehouse, where he spent his evenings, here he had a chair by the fire in winter and by the window in summer, Congreve, Vanbrugh and Addison were among his admirers, and here Pope saw the old poet of whom he was to be the most brilliant disciple. He died at his house in Gerard street, London, on May 1, 1700 and was buried on the 13th of the month in Westminster Abbey. Dryden's portrait, by Sir G. Kneller, is in the National Portrait gallery.

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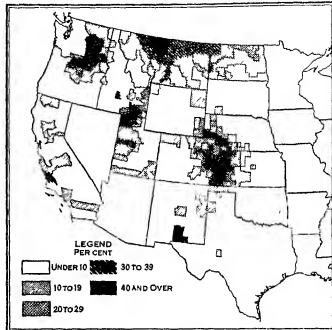
the poet's *Dramatic Works* (1717), edited by Congreve. *Poems on Various Occasions and Translations from Several Authors* (1701), also published by Tonson, was very incomplete, and although other editions followed there was no satisfactory collection until the edition of the *Works* (1858, and ed. 1881) by Sir Walter Scott, who supplied historical and critical notes with a life of the author. This is revised and corrected by G. Saintsbury (1881-93), still is regarded as the standard edition, but John Sargeant issued an edition with introduction and textual notes in 1910. His *Critical and Miscellaneous Prose Works* (1866) were edited by Edmund Malone, who collected industriously the materials for a life of Dryden. Convenient partial modern editions are the *Poetical Works* (1870), edited by W. D. Christie with an excellent "life," *The Best Plays of John Dryden* ("Mermaid Series") edited by G. Saintsbury, and *Essays of John Dryden* (1900), edited by W. P. Ker. Besides the critical and biographical matter in these editions see Johnson's *Lives of the Poets*, G. Saintsbury, *Dryden in the "English Men of Letters Series"* (1881), A. B. J. J. Le Public et les hommes de lettres en Angleterre 1600-1742 (1897), A. W. Ward, *History of English Dramatic Literature* (now in 1899), J. Churton Collins, *Essays and Studies* (1895), L. N. Chute, *The English Heroic Play* (1909), M. Van Doren, *The Poetry of John Dryden* (1920), and Sir W. Raleigh, in *Some Authors* (1923). (See also ENGLISH LITERATURE.)

DRY DOCK see DOCKs

DRY FARMING Dry farming is farming without irrigation in areas where the moisture supply is the chief limitation to crop production. Such farming practices have existed approximately as long as man has been an agriculturist, particularly as subsistence farming on desert margins and in areas having dry

are given more space. Primitive races in many lands have made use of wide plant spacings to help avoid failure of maize and sorghums.

Dry farming of the commercial sort, whether of the family farm or bonanza size, illustrates the most modern large scale, highly capitalized and mechanized agriculture. Special implements have been developed, not only adapted to extensive farming, but designed to keep the surface weed free, water absorbent and yet resistant to wind erosion. Net agricultural incomes per hour of labour in good years are



BY COURTESY OF U. S. DEPARTMENT OF COMMERCE
CULTIVATED SUMMER FALLOW AS A PERCENT OF TOTAL U. S. CROPLAND
1949 DATA FOR 17 WESTERN STATES

particularly of wheat, barley and grain sorghums.

Efficient dry farming consists of making the best use of a limited water supply by storing in the soil as much of the rainfall as is possible and by growing adapted crop plants by the methods that make the best use of this moisture. Storing water is accomplished by main-

among the highest, yet fixed costs are high and the risk is such as to emphasize the desirability of such adaptation to income uncertainty as is possible, whether by insurance and credit improvements or diversification involving livestock and some irrigation agriculture where possible.

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DRY ICE is the trade name for solid carbon dioxide, a dense, snowlike substance having a temperature of -78.5°C or lower. Carbon dioxide gas is changed to a liquid when subjected to a pressure more than five times that of the ordinary atmosphere and at -57°C . When this liquid is allowed to expand rapidly from the high pressure to atmospheric pressure, carbon dioxide snow results. This snow is compressed into cakes. Instead of melting, it evaporates to a dry gas that has no corrosive action if moisture free. It makes possible the shipping of perishable products (mexis ice cream) long distances. One pound of dry ice will absorb a little less than twice as much heat as one pound of water ice. A block of dry ice 10 in. x 10 in. x 10 in. weighs about 45 lb.

DRYNESS, CHEMICAL There are many instances recorded in chemical literature where it appeared that a trace of water must be present in order for a reaction to proceed with measurable velocity. Usually the experiments were not conducted with sufficient care so that quantitative statements could be made as to the amount of water present, and any conclusion that in the absence of small quantities of water a reaction would not take place at all, should not be accepted without further investigation. However, it is well established that water is a catalyst for many reactions, and as is commonly the case with reactions which are subject to catalysis, the reaction proceeds so slowly in the absence of the catalyst that it is difficult to say

and destruction of weeds. The ideal surface, to absorb water and prevent wind and water erosion, is one that is free from live weeds but has enough clods or dead vegetable matter to hinder runoff and prevent erosion. Cultivation that controls weeds is generally sufficient to maintain such a surface condition, but loosening a packed surface is sometimes necessary. The depth of plowing has little to do with

heat and drought conditions are not severe. They may either be crops that are planted in fall or early spring and mature in time to miss much of the hot part of summer or those that are planted late and make much of their growth after the period of greatest summer heat has passed. Crops adapted to dry farming are usually smaller in stature and quicker in maturing than those grown under more humid conditions. Planting rates are also generally lower and the individual plants

whether it is taking place at all. Thus, it had been reported that the combination of gaseous hydrogen chloride and ammonia would not take place in the absence of water. W. H. Rodenbush and J. C. Michalek (1929) found that when the gases are intensively dried, there is a considerable lag in reaching equilibrium. On the other hand, there is no evidence that equilibrium was not reached or that when reached, proportions of the various constituents present were different from what they would have been in the presence of water vapour.

Hence it may be concluded that water plays an important role as a catalyst in many reactions, and when powerful drying agents such as phosphorus pentoxide are employed, the amount of water present may be reduced to a point where the reaction does not appear to take place. The explanation for the activity of the water molecule as a catalyst is to be found in its polar character and its tendency to form addition compounds through hydrogen bonding with other molecules including those of water itself. The action of moisture in promoting the corrosion of iron is familiar to everyone.

On the other hand there is no confirmation for the conclusion that the properties of pure substances such as liquid benzene are profoundly affected by the intensive drying. It is true that the total vapour pressure of liquid benzene will be markedly increased by the solution of small amounts of water, but the increase will be strictly proportional to the quantity of water added.

By far the most important action of small quantities of water is in the form of surface films. If a solid material contains polar atoms such as oxygen, then water molecules will be attached to these atoms by hydrogen bonds, and other water molecules will be attached to these first molecules until a continuous film is formed, one or more molecules thick. In the case of glass the water molecules not only form surface films but penetrate some distance below the surface. Glass fibres when first drawn have a hard, smooth surface and great tensile strength, but after being exposed to the atmosphere, moisture penetrates the surface and weakens the fibre. Likewise, when it is desired to produce a high vacuum in a glass vessel, a prolonged heating and baking out is required to drive the moisture out of the walls.

The insulating power of dielectrics is adversely affected by adsorbed films of moisture. Fused quartz is an excellent insulator so far as electrical conduction through the body of the material is concerned, but the adsorbed layer of moisture on the surface dissolves carbon dioxide and other gases from the air to give a conducting surface layer. To be effective at high relative humidity, insulators must be made of materials which do not contain polar atoms which would attract a surface layer of moisture.

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DRYOPITHECUS, the type and European representative of a group of fossil apes, the Dryopithecinae, ranging from early Miocene to Late Pliocene in Europe, North Africa and India, and including at least seven other genera. The Dryopithecinae represent the ancestry of the living anthropoid apes and some students claim that they include the common ancestors of man and the recent apes.

See W. K. Gregory, M. Hellman and G. E. Lewis, *Fossil Anthropoids of the Yale Cambridge India Expedition of 1935* (1938). (G. G. St.)

DRY POINT. Though generally classed as a variety of etching, and in practice often combined with that process, dry point is, strictly speaking, a kind of engraving.

In etching the needle scratches only through the etching ground and exposes the surface of the plate, the latter is then placed in a bath of acid, and it is the chemical action of the acid that eats out in the copper a line of sufficient depth to hold printing ink. In dry point, on the contrary, as in line engraving, the lines are hollowed out by the tool itself in direct contact with the copper, as directed by the engraver's hand, without the intervention of any chemical action. Zinc can be used instead of copper, but work on this metal wears out quickly under the pressure of the

printing press. Celluloid plates have been used but no heat can be applied during the inking and printing of the plates.

Methods—The "dry" point, so called because no bath of acid supplements its use, is a tapering pointed instrument of steel, of stronger build than the point or needle used by the etcher and sometimes sharpened at both ends, but many modern engravers have substituted for steel a diamond point, or more rarely a ruby. With one of these instruments the engraver works directly upon a plate of hard and polished copper, either shiny or blackened, or merely dimmed with grease, plowing up a line shallow or deep, according to the amount of pressure used. Along one edge of this line if the point is slanting, or along both edges if it is held upright, a raised edge of copper is turned up by the tool, and this ridge is termed the "burr." The burr, when the plate is inked for printing, becomes clothed with ink and produces in the impression the rich, soft and velvety effect which constitutes the peculiar charm of a dry-point proof. If the burr is removed (as it easily can be, should the engraver desire it with a scraper) the somewhat thin line thus produced is less easily distinguished, except by a practised eye, from the characteristic lines produced by the burin or the etching point. The burr is delicate and is easily worn out, either by too vigorous wiping with rag or muslin when the plate is inked or by too great pressure in the printing press. In any case the burr does not last long and the "bloom" of the early proofs of a dry point soon wears off. The first two or three proofs, though they may be rough and uneven, often have a charm which can never be replaced by the more even printing of the bulk of the edition, and at some stage, it may be after a dozen proofs, or 20 or 50, according to the manipulation of the plate and the depth to which the lines have been sunk, deterioration inevitably becomes noticeable, unless the plate has been protected from wear by steel facing. Some engravers assert that this precaution in no way affects the beauty of the proofs, and of some dry-point plates this may be true. But most engravers and most collectors are of the opinion that there is an appreciable difference and that, according to H. W. Singer, "a trained eye can distinguish between the good, warm impressions taken from the copper and the hard, cold ones, taken from the plate after it has been steelled."

There can be no doubt that dry points printed from the steel-faced plate for book illustration, such as Andre Dunoyer de Segonzac's illustrations to *Les Croix de bois* by R. Dorgeles (1921), can all sustain comparison with the few artist's proofs taken before the steel facing. In fact the process is thoroughly unsuitable for any purpose that requires the production of a large edition printed with mechanical regularity, and the dry point yields its essential charm only in the hands of a sensitive and conscientious printer—none is better than the artist himself, if he understands the art of printing also—who knows when to stop at the moment when the plate begins to show signs of wear, and does not feel bound to fulfil a contract by delivering a certain number of proofs, whether the plate will bear it or not. The dry point, more than any other process of engraving, needs to be under the direct control, at every stage, of the artist who has invented the design to which he feels this process, rather than another, to be appropriate.

Corrections—Two advantages which the dry-point process offers to the original etcher are the power which he possesses when using it of seeing exactly what he is doing with his tool upon the plate, and the comparative ease with which he can make alterations if he changes his mind or requires to correct a fault. Lines already made can be almost entirely obliterated with the burnisher or worked over with other lines, whereas in etching such alterations can be effected only by the much more difficult operation of laying a new ground. To quote E. S. Lumsden, "Corrections are very easily made in dry point, because so little metal is removed from the surface, the strength depending principally upon the upturned ridges. This means that the sides of the lines are comparatively easily closed up by pushing them together with the burnisher. If the passage is to be reworked with heavy strokes, there is no difficulty at all, but if the original surface has to be recovered in order to print a clean

tone from it, considerable labour is often needed to erase the scratches altogether as under heavy pressure the faintest indications of a line will show up in the proof. With care and patience anything can be done, and the freshness of the surface kept intact."

The comparative ease with which changes can be made results, in the case of some modern original artists whose work is done in dry point, in a multiplicity of states. Of a celebrated dry point by Sir Murrhead Bone, "A Spanish Good Friday," there are no less than 39 states, the engraver having repeatedly changed his mind about some detail, or thought of a fresh improvement that he could introduce, after he had begun to take proofs.

Dry Point and Etching.—Dry point has sometimes been used by line engravers, instead of etching to which they far more frequently resort, in the first preparatory stage (outline) of plates which are subsequently to be finished with the burr. The French line engravers of the 18th century made a regular practice of producing first states in pure etching. Much more usual is the combination of dry point with etching. Such a combination may be made either for the general enrichment of an etched plate, in a second or subsequent state by the addition of the dry point burr, or for the sake of introducing small corrections. Corrections to an etched plate can be made far more easily (though less permanently) by a few touches with the dry point than by an additional biting of the plate, involving as this does the stopping out or laying of a fresh ground. Dry point additions to an etching can be readily distinguished by a trained eye in early impressions, but they can wear away gradually in the course of the printing till almost every trace of them is lost. It is the presence of the clearly visible dry-point work, lending richness where it was intended, that confers value on such an etching as the second state of Rembrandt's "Hundred Guilder" print, or the only state of his "Christ Healing the Sick." Yet these rich early impressions and the bare looking late ones after the worn plate has lost its dry point burr have, it should be remembered, to be described as impressions of the same state.

HISTORY

In a retrospect of the use of pure dry point during the centuries which have elapsed since the invention of engraving, it will appear that its popularity has been intermittent, and that there have been prolonged periods during which, in one country or another, if not in all countries, it has quite fallen out of favour.

Earliest Work.—Its first appearance is earlier than that of etching, for there can be no doubt that the scarce and valuable prints of the "Master of the Hausbuch," a painter-engraver who worked in western Germany (probably on the middle Rhine) about 1480, were produced with the dry point or possibly with the burr used in the same way, so as to scratch the surface of the copper and throw up a burr, which was not scraped away. This engraver is also called the "Master of the Amsterdam Cabinet" from the fact that the largest collection of his prints, numbering about 80 in all, is in that collection, but the name is to be deprecated, since it suggests that he was a Dutchman. He was a very original artist and a keen observer of nature, with a technique quite unlike that of any other 15th century engraver.

Dürer.—The next engraver whom we find employing dry point is Albrecht Dürer, who resorted to this process only in or about the year 1512, and probably abandoned the experiment when he discovered how few good proofs a plate engraved in this manner could yield. There are only three dry points by Dürer, "The Man of Sorrows," 1512 (Bartsch 21, Dodgson 65), "St. Jerome Seated Near a Pollard Willow," 1512 (Bartsch 59, Dodgson 66), and its companion print, the undated "Holy Family" of similar dimensions (Bartsch 43, Dodgson 67). Of the two latter dry points very few good impressions are extant, for the burr wore off rapidly, and the majority of extant specimens were taken from the worn-out plates. Of Dürer's first work in this technique, "St. Jerome," two proofs only exist of a first state before the monogram (in the British Museum, and the Albertina, Vienna). These are of superb quality, the Albertina impression of the second state is also very fine indeed. A fourth dry point, "St. Veronica"

(Bartsch 64), dated 1510, which figures in the older catalogues as one of the great rarities in Dürer's work, for only two impressions are known, is discredited, for it was proved to be a copy of an unsigned woodcut published at Nuremberg in a *Salus Animæ* of 1503. Hans Sebald Beham alone of the followers of Dürer used dry point, and that but sparingly. It is hardly found again in the history of German engraving until a much later date.

Italy.—In Italy also the process was used in early times, chiefly by Andrea Schiavone, or Meldola (1527-82), an engraver who worked at Venice, and perhaps also by the monogrammist H.E., for early impressions of his prints show signs of burr which in the usual later prints would not be suspected.

Rembrandt.—In the Netherlands dry point was hardly used if at all, before the 17th century. Its varied uses, as described above, for the enrichment of the etched plate by the addition of burr to the etched line as well as for the production of pure dry points were first discovered and exploited by the greatest of all painter etchers, Rembrandt, who in his middle period, from about 1639 onward, used this technique increasingly, in a thoroughly personal manner for the sake of substituting "colour" and warmth for the drier effect of the pure etchings of his earlier period. From 1640-50 Rembrandt used dry point extensively for retouching his etched plates—"The Death of the Virgin" and the "Hundred Guilder" print are examples taken from the beginning and close of this period—while in his last period (1650-61), plates wrought wholly in dry point became more and more frequent. Among the finest of these must be reckoned "The Goldweaver's Field" (1651), "The Vista" (1652), the two large plates, "The Three Crosses" and "Christ Presented to the People," of 1653 and 1655, respectively and the "Portrait of Arnold Tholinx," 1656. An impression of the exceedingly rare first state of this portrait, in the Rudge collection, sold at auction in Dec. 1924, realized the large sum of 3,600 guineas, the highest price hitherto paid at an auction for an etching, if not for a print of any kind.

The 18th Century.—After Rembrandt, no very considerable use of the dry point was made by any of the great engravers for a lengthy period. The 17th century was in all countries an age of line engraving and etching, while in the Low Countries, Germany and England, the invention and development of mezzotint were claiming attention. In the 18th century dry point was used here and there by a number of painter etchers, amateurs in their technique as compared with the professional engravers, who found the medium congenial and probably took hints in their use of it from their study of Rembrandt. A beautiful example of such an 18th century dry point is the portrait of himself, dated 1739, by Arthur Pond (reproduced, *Print Collector's Quarterly*, 1922, ix, 324). One of the little subjects illustrating the destruction by fire of the Foire de Saint Germain in 1762, by Gabriel de St. Aubin, is a dry point which seems in its modernity a precursor of the 19th century. In the period which preceded what is known as "the revival of etching," that is to say, during the first half of the 19th century, several English and Scottish etchers produced dry points of remarkable merit. Among these were D. C. Read, of Salisbury (1790-1821), E. T. Daniell, of Norwich (1804-42) and especially the two Scottish painter-etchers Andrew Geddes (1783-1844) and Sir David Wilkie (1785-1841). Of the last two, catalogues describing all the states of their plates with reproductions of five specimens will be found in the 5th and 11th publications of the Walpole Society, 1917 and 1923, while a revised and improved catalogue of both artists, by C. Dodgson, forms the 15th publication (1936) of the Print Collectors' Club. Geddes' "Portrait of the Artist's Mother," his "Peckham Rye" and some other landscapes, and Wilkie's one pure dry point, "The Lost Receipt" are of conspicuous merit if compared with the dry points of any period. The French etcher, Charles Jacque, also produced, long before 1850 a number of dry-point landscapes, with figures or horses, of great beauty.

Modern Work.—The etchers of the "revival," both in France and England, soon brought the dry point, as well as etching, into renewed favour. In the hands of Sir Francis Seymour Haden it yielded masterpieces like "Windmill Hill" and "Sunset in Ire-



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DRY POINTS BY ENGRAVERS AND ETCHERS FROM THE 16TH TO THE 19TH CENTURY

- 1 St. Jerome Seated Near a Pollard Willow (1512) by Albrecht Dürer the first of three dry points From the Impression of the second state in the Albertina museum Vienna
- 2 Holy Family by Albrecht Dürer Undated, but about 1512
- 3 The Man of Sorrows (1512) by Albrecht Dürer This plate and the two preceding were the only dry points made by Dürer
- 4 Portrait of Himself (1735) by Arthur Pond one of the English painter etchers of the 18th century who used the dry point technique with success
- 5 Spectacle des Tuilleries (1760) by Gabriel de St Aubin Touched up in dry point in 1763
- 6 L'Orange (1840) by Charles Jacques a French etcher who produced a number of dry point landscapes with figures or horses
- 7 Portrait of the Artist's Mother (1822) by Andrew Geddes
- 8 Title proof (Oct 7, 1877) of Windmill Hill dry point by Sir Francis Seymour Haden one of the leading English etchers of the 19th century
- 9 Sunset in Ireland (from a very rich Impression) by Sir Francis Seymour Haden, 1863

like cutting of the fourth—there is no ring comparable to this in any other system of making prints and new triumphs of individual method in dry point may yet have to be recorded (See ETCHING, LINGRAVING)

BIBLIOGRAPHY.—W. P. Robins, *Etching Craft* pp. 163 et seq. (1923)
E. S. Lumsden, *The Art of Etching*, pp. 18, 46, 257 et seq. (1915)
(Mv B)

DRY QUENCHING is a process of cooling a hot solid substance without using a liquid in direct contact with the substance to be quenched. The sensible heat in most of the cases can thereby economically be converted into useful energy and the quality of the product improved. This process has been applied and developed primarily for the quenching of coke as it is discharged from coke ovens at temperatures of 1,800° to 2,000° F. It was for a long time common practice to sprinkle this hot coke with water or to submerge it in water to reduce its temperature sufficiently to prevent it from re-igniting and to facilitate handling and transportation. This method, however, has several disadvantages. The coke takes up water thereby considerably reducing its heating value. The wet quenching vapours are corrosive and affect steel and concrete construction, thereby largely increasing maintenance costs. They also carry coke dust high into the air and scatter it widely over the plant and the community.

Methods.—In the Sulzer system, the process of dry quenching of the hot coke is accomplished by circulating an inert mixture of gases in a closed cycle, first through the hot coke mass where the gases extract the sensible heat, thence through a steam boiler where the hot gases transfer the heat to the water in the boiler and convert it into steam. The cooled gases leaving the boiler are conducted back to the fan and again forced through the coke.

The hot coke is conveyed to the dry quencher in more or less regular intervals depending upon the schedule of discharge of the coke ovens. It is introduced through the top door of the coke container which holds a number of loads. Before a new load of coke is charged an equal amount of cooled coke is withdrawn from the bottom of the apparatus. The coke, therefore, is allowed to remain in the container for several hours gradually reaching lower cooling zones. The cooling gas is circulated by means of a fan continuously operating and flows through the coke mass in an upward direction thereby performing the cooling in accordance with the counterflow principle.

The inert mixture of gas is formed when starting up the plant. A small portion of coke is converted into a mixture of carbon monoxide and carbon dioxide whereby the oxygen of the air within the system is completely consumed. The cooling gas therefore consists mainly of these products of combustion and nitrogen. Care must be taken that two doors are never open at the same time in order to prevent air entering the system causing combustion of coke. As long as only one door is open at a time, the pressure in the system adjusts itself to atmospheric pressure at that point, but no gas is pushed out nor air sucked in. However, on discharging cooled coke an equal volume of air enters the system.

Advantages.—The principal benefit in dry quenching is the production of 400 to 500 lb of steam per 1,000 lb of coke quenched, this representing a saving that equals 25 to 40% of the fuel required to carbonize the coal. The steam may be used in the by-product plant or for generating of power which may either cover the needs of the plant or be fed into the lines of a power company.

blast furnaces, foundry cupolas and domestic furnaces is the benefit resulting from the use of dry quenched coke. From this coke can still be considered as a high quality fuel, while wet quenched coke breeze due to high moisture is very likely to cause trouble in furnace operation. The dry quenching process may also be adapted for the purpose of cooling other hot products of the chemical industry such as calcium carbide, lime, cement clinker, etc., saving the sensible heat and improving the quality of the product. (H. D. S.)

DRY ROT, a term applied to the decay of wood caused by various kinds of fungi. Frequently the term is applied solely to such decay as takes place in timber that has been worked or is in actual use. The present article deals solely with dry rot in this restricted sense. The fungi fed upon the wood and thus cause it to become lighter in weight, weaker, more brittle and less elastic, so that when struck the wood emits a muffled sound and readily snaps. In more advanced stages, rot the wood is apt to warp and may show cracks ("cross shakes") at right angles to the grain and can greedily absorb liquids, e.g., water, and, comparatively early, the wood may show discolourations and lose any characteristic scent.

The fungi causing dry rot belong to the great class that includes the familiar toadstools and mushrooms. They are composed of very slender, hollow, jointed, closed tubes (*hyphae*) which grow in length and emit branches. These tubes permeate the wood, and outside this may also produce loose mould like coatings, or by interweaving can give rise to denser shreds, nets, strings or more massive fruit-bodies shaped like cakes, brackets or mushroom rooms.

The fruit bodies, which are easily visible to the naked eye, eject myriads of microscopic infectious germs, termed spores. But spores are likewise produced by certain species of these fungi quite apart from the fruit-bodies.

Infection of wood may also take place by means other than by spores. Certain species of fungi, including the most malignant causal agent of dry rot in houses in Europe, *Merulius lacrymans* (*domesticus*), not only grow inside the wood but can more rapidly spread over its surface, and advance over non-wooden surfaces, and, in the form of strings penetrate or perforate brick walls, attacking wood that they reach. Contrasting with such *contagious* species are other merely *infectious* species that usually live only in the interior of the wood until they thrust their fruit bodies outside it, such internal decay is often difficult to detect, as the superficial wood may be quite sound and normal in appearance.

Wood may be protected against dry rot by one or both of two methods: (1) sanitation, (2) antiseptic (fungicidal) treatment.

Sanitation.—Sanitation is the cheapest method of preventing, and sometimes of arresting, dry rot. One essential condition for activity is a sufficient supply of air, as these fungi absorb oxygen and give out carbonic acid and water. Although they can grow in the absence of oxygen, they are readily killed by an accumulation of carbon dioxide. During respiration certain species of fungi can produce water so vigorously that dry wood is thoroughly moistened and drops of water appear on the fungus itself (hence the specific name of *Merulius lacrymans*).

An adequate supply of water is required by the fungus which owes the main part of its weight to water and cannot take in food unless this be dissolved in water. So far as dry rot in temperate regions is concerned, in the dry air of deep coal pits and of warmed rooms wood may last for decades or centuries, whereas dry rot is common in moist, shallower coal pits, in moist cellars and damp ground-floors, especially can it appear near escapes of water from water pipes or steam pipes, and in stuffy, feebly ventilated places, for instance under floors covered with linoleum. In a house fungus causing dry rot may be luxuriant on the hidden faces of floor boards, panels and skirting boards, but be entirely lacking on the visible faces of these in contact with drier air of rooms, so that dry rot may be widespread through a building although no fungus be visible until the wood work is disturbed.

Fungi causing dry rot cannot attack wood that is either too wet or too dry. Some species demand much moisture, among such

are *Conophora cerebella* (whose slender black threads are common on the surface of damp wood in houses) and a number of fungi that do not grow over the surface of the wood. These species are probably largely responsible for "wet rot," a popular term apparently applied to discoloured wood showing to the naked eye no fungus inside or outside the wood, no external cross-shakes, but giving evidence of weakness and possibly former or present wetness (which caused the decay and disappearance of any fungus formerly outside the wood).

Other fungi, including *Merulius lacrymans*, produce considerable amounts of water and, transporting this, can thus moisten distant wood, thus they can feed on drier wood.

Where dry rot in a building is caused by fungi demanding much moisture, it may be arrested by merely cutting off the excessive supply of water, this will not suffice when *Merulius lacrymans* is the causal agent. Moreover cutting off the excess of moisture does not necessarily cause death of the fungus inside the wood when wood attacked by *Merulius* or when certain internal feeders have been thoroughly dried for months, the fungus inside the wood may awaken into activity if the wood be remoistened.

Arrangements to secure a house against excess of dampness include erection on a light pervious soil, provision of efficient dampcourses, care against absorption or condensation of water by and on the walls, under the ground floor, adequate ventilation and provision of a water tight coating over the concrete, obviating of leakage or overflow from rain water pipes and gutters outside the house, and water pipes and steam pipes indoors, proper construction of window casements to allow water to flow properly away from them, renewal of put on external wood work, and adequate maintenance of the roofing.

Fungi causing dry rot are active only within certain ranges of temperature, but inasmuch as the temperatures prevailing in all parts of a building, from cellar to roof, in temperate regions at times enable these fungi to be active, temperature from the practical point of view intervenes only as a means of eradication. Low temperatures (for instance the freezing point of water) at least in the case of *Merulius lacrymans* do not suffice to kill fungus or spores. Higher temperatures (over 50° C) are much more effective so that infected wood can be sterilized by heat, especially by steam, at temperatures below the boiling point of water. A painter's lamp suffices to sterilize infected surfaces, but an oxy-acetylene flame, or some equivalent, is required for rapid sterilization of walls permeated with fungi causing dry rot.

Antiseptic (Fungicidal) Treatment—The decay of wood can be combated by the application of disinfectants and especially by substances that are powerful fungicides.

Among organic wood-preservatives the most familiar is so called creosote oil, "creosote oil," which is very widely used out of doors to preserve railway sleepers, paving blocks, telegraph poles, etc. Its scent is too powerful and persistent to permit of its use indoors, so that in houses, etc., "creosote" is often replaced by some what similar preservatives from which the more volatile and strong scented oils have been removed. Extremely powerful organic fungicides suitable for use on wood are dinitrophenol and sodium dinitrophenate, to which are added other substances, such as sodium fluoride, designed to render the mixture non-explosive. On the other hand carbolic acid and formalin are too evanescent, and many other disinfectants used to destroy bacteria causing disease are too weak in action on fungi to act as timber preservatives.

Among aqueous solutions of inorganic salts used to preserve wood are copper sulphate (which attacks iron), zinc chloride (which easily washes out and when too warm or strong destroys wood), corrosive sublimate (very poisonous), sodium fluoride, and acid (commercial) magnesium silico fluoride (which attacks metals and glass). Of these inorganic salts the last two may be generally regarded as the best for use in houses.

It is generally true that with increasing depth of penetration of the preservative into the wood the greater is the durability conferred, but the more costly is the process of treatment. Out doors the preservative (usually "creosote") is driven deep

into thick pieces of timber (such as sleepers, poles or paving-blocks) by pneumatic pressure or by immersion in hot tanks. Whereas wood work in buildings is usually merely coated with the preservative, reliance being more economically based upon sanitation including proper methods of construction. (P. G. M.)

DRY TORTUGAS, a group of 10 coral islets or keys 65 m west of Key West, Florida. The largest are East Key, Bird Key and Loggerhead. Fort Jefferson, the site of a military prison during the Civil War, is a quarantine station. Loggerhead has a Carnegie laboratory of marine biology. The group forms a Federal bird reservation.

DUAL IGNITION *see* INTERNAL COMBUSTION ENGINES

DUALISM In metaphysics, dualism postulates the eternal coexistence of mind and matter, as opposed to monism both idealistic and materialistic. Two forms of this dualism are held. It is said that (1) mind and matter are absolutely heterogeneous, thus making any causal relation between them *ex hypothesi* impossible, (2) there is a hypothetical dualism, so that mind cannot bridge over the chasm so far as to know matter *in itself*, though it is compelled by its own laws of cause and effect to postulate matter as the origin, if not the cause, of its sensations. It follows that, for the thinking mind, matter is a necessary hypothesis. Hence the theory is a kind of monism, inasmuch as it confessedly does not assert the existence of matter save as an intellectual postulate for the thinking mind. Matter, in other words, must be assumed to exist, though mind cannot know it *in itself*. From this question there emerges a second and more difficult problem. Consciousness, it is held, is of two main kinds, sensation and reason. Sensation alone is insufficient to explain all our intellectual phenomena, all sensation is momentary and individual (*cf.* EMPIRICISM). How then are we to account for memory and the principles of necessity, similarity, universality? It is argued that there must be in the mind an enduring, primary faculty whereby we retain, compare and group the presentations of sense. This faculty is *a priori*, transcendental, and entirely separate from all the data of experience and sense-perception. Here then we have a dualism within experience. The mind is not to be regarded as a sensitized film which automatically records the impressions of the senses. It contains within itself this co-ordinating power which reacts upon and arranges the sense-given presentations.

In Ethics and Theology—In the domain of morals, dualism postulates the separate existence of Good and Evil, as principles of existence. In theology the appearance of dualism is sporadic and has not the fundamental, determining importance which it has in metaphysics. It is a result rather than a starting point. The old Zoroastrianism, and those Christian sects (*e.g.*, Manichaeism) which were influenced by it, postulate two contending deities Ormuzd and Ahriman (Good and Evil), which war against one another in influencing the conduct of men. So, in Christianity, the existence of Satan as an evil influence, antagonistic to God, involves a kind of dualism. But generally speaking this dualism is permissive, inasmuch as it is always held that God will triumph over Satan in His own time. So, in Zoroastrianism, the dualism is not ultimate, for Ahriman and Ormuzd are represented as the twin sons of Zervana Akarana, *i.e.*, limitless time, wherein both will be finally absorbed. The postulate of an Evil Being arises from the difficulty, at all times acutely felt by a certain type of mind, of reconciling the existence of evil with the divine attributes of perfect goodness, full knowledge and infinite power. John Stuart Mill (*Essay on Religion*) preferred to disbelieve in the omnipotence of God rather than forgo the belief in His goodness. It follows from such a view that Satan is not the creation of God but rather a power coeval in origin, over whose activity God has no absolute control.

In Christology—Dualism is also used in a special theological sense to describe a doctrine of the Nestorian heresy. According to this doctrine the personality of Christ is twofold, the Divine Logos dwells as a distinct personality in the man Jesus Christ, the union of the two natures being analogous to the relation between the believer and the indwelling Holy Spirit.

History of Metaphysical Dualism—The earliest European thinkers (*see* IONIAN SCHOOL or PHILOSOPHY) endeavoured to

reduce all the facts of the universe to a single material origin, such as Fire, Water, Air. It is only gradually that there appears any recognition of a spiritual principle exercising a modifying or causal influence over inert matter. Anaxagoras was the first to postulate the existence of Reason (*νοῦς*) as the source of change and progress. Yet even he did not conceive this Reason as incorporeal, it was in reality only the most highly rarefied form of matter in existence. In Plato for the first time we find a truly dualistic conception of the universe. Asserting that Ideas alone really exist, he yet found it necessary to postulate a second principle of not being, the groundwork of sensuous existence and of imperfection and evil. Herein he identified metaphysics and ethics combining the good with the truly existent and evil with the non-existent. Aristotle rebels against this conception and substitutes the idea of *πρῶτη ὕλη* and development. Nevertheless he does not escape from the dualism of Form and Matter, *νοῦς* and *ὕλη*. The scholastic philosophers naturally held dualistic views resulting from their extreme devotion to formalism. This blind dualism found its natural consequence in the revolt of the Renaissance thinkers, Bruno and Paracelsus, who asserted the unity of mind and matter in all existence and were the precursors of the more intelligent monism of Leibniz and the scientific metaphysics of his successors. The birth of modern physical science on the other hand in the investigations of Bacon and Descartes obscured the metaphysical issue by the predominance of the mechanical principles of natural philosophy. They attempted to explain the fundamental problems of existence by the unaided evidence of the new natural science. Thus Descartes maintained the absolute dualism of the *res cogitans* and the *res extensa*. Spinoza realized the flaw in the division and preferred to postulate a single substance (*unica substantia*) of which mind and matter are ultimate attributes, while Leibniz explained the universe as a harmony of spiritual or semispiritual principles. Kant practically abandons the problem. He never really establishes a relation between pure reason and things in themselves (*Dinge an sich*), but rather seeks refuge in a dualism within consciousness, the transcendental and the empirical. Since Kant there are, therefore, two streams of dualism, dealing, one with the radical problem of the relation between mind and matter, the other with the relation between the purely rational and the empirical elements within consciousness. To the first problem one answer commonly given is that matter in itself is inherently unthinkable and comes within the vision of the mind only as an intellectual presentation, so that philosophy is in a sense both dualist and monist, it is a cosmic dualism inasmuch as it admits the possible existence of matter as a hypothesis, though it denies the possibility of any true knowledge of it, and is hence with regard to the only possible knowledge an idealistic monism. It is a self-destructive dualism, a confessedly one-sided monism, agnostic as to the fundamental problem. To the second problem there are two main answers, that of Associationism which denies to the mind any *a priori* powers and asserts that sensation is the only source of knowledge, and that which admits the existence of both transcendental and empirical knowledge.

DUALITY. A statement capable of two different meanings, both of them true, one obtained from the other, by simply interchanging two words, is an illustration of the principle of duality. An important application of the principle is found in projective geometry. In the plane this is accomplished by interchanging the words "point" and "line"; it is well illustrated by the theorem of Pappus, which may be stated as follows:

Given any two straight lines u, u' in the plane, choose any three points A, B, C on u , and any three points A', B', C' on u' . The three points of intersection $AB', A'B, AC', A'C, BC', B'C$ lie on a straight line u'' . The dual theorem is:

Given any two points U, U' , draw any three lines a, b, c through U and a', b', c' through U' . The three lines joining the points $ab', a'b; ac', a'c; bc', b'c$ all pass through a point U'' . If the first

proof has been established, the second follows by duality, since the determining elements of lines in terms of points are identical with those of points in terms of lines. The principle was first recognized by Poncelet in the *Journal für Mathematik* (1829) and by Gergonne in the *Annales de Mathématiques pures et appliquées* (1825-27), and first generally applied by Steiner in his *Systematische Entwicklungen*, (1832).

In geometry of three dimensions there is a corresponding duality between points and planes. In this case the line is self dual, as it is determined by any two distinct points on it or by any two distinct planes through it.

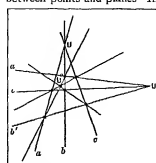


FIG. 2

through A, B, O . After this has been done for every line, think of the point O being removed from the plane. The resulting system of incomplete circles furnishes a non-euclidean interpretation of plane geometry. The line sphere transformation of Lie is an illustration of a complete duality between lines and spheres in space. Much of higher geometry is concerned with the principle of duality, every new application practically doubles the extent of existing knowledge. (See PROJECTIVE GEOMETRY.)

DUALIA, one of the principal negro peoples of Cameroon estuary, west Africa. (See CAMEROONS.)

DUAL ORGANIZATION. A distinctive feature in the social structure of certain simple communities is their division into two complementary sections which have important functions in the social and ceremonial life of the people. This system of dual organization occurs most typically in many parts of Australia, Melanesia and N. America, and has been recorded from India and Assam, its existence elsewhere has not been definitely established. The two sections, usually termed moieties or phratries, are unilateral in character, membership being determined by descent through either the father or the mother. In Melanesia matrilineal descent predominates, elsewhere both matrilineal and patrilineal descent are common. An exceptional case is found among the Fox and Kuckpoo of N. America, where the father usually, but not always, determines which moiety his child shall enter, so that often the first-born child will belong to one moiety and the next child to the other. The structure of the moieties also varies in some communities they are simple undivided groups, in others they are each composed of a number of smaller sub-divisions or clans, e.g., among the Winnebago of N. America, where the one moiety consists of 28 clans and the other of 26.

Functions.—The dual organization is very frequently connected with the regulation of marriage. In most communities the moieties are exogamous, and consequently a man belonging to one moiety must always marry a woman belonging to the other. This feature is sometimes regarded as the distinctive characteristic of the dual organization, but although it is of most frequent occurrence there are several exceptions. Among certain N. American tribes, e.g., the Hidatsa, Yuchi, Western Mono and Iroquois, marriage between members of the same moiety is not prohibited. When the moieties are exogamous a man is never permitted to marry any woman he chooses in the opposite moiety. The form of marriage is always dependent upon other factors, such as age, status and kinship, where certain relatives are prescribed as eligible mates while marriage between others is not permitted. Thus the form of marriage most frequently found with the dual organization is that between cross-cousins, and, where the moieties are exogamous, it follows (whether descent be patrilineal or matrilineal) that cross-cousins belong to different moieties, while parallel cousins from whom marriage is not permitted, become mem-

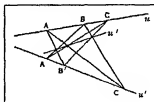


FIG. 1

bers of the same moiety. The dual organization in such cases does not determine but merely systematizes the form of marriage. Only under exceptional circumstances can cross cousin marriage result from the division of the community into moieties (see Cousin Marriage).

Other functions of the dual organization vary according to the community in which it is found. In the daily life of the people, the members of the two moieties are very commonly separated at games, feasts, contests, etc., and may even inhabit different parts of the settlement. Often there is also a striking development of reciprocal services between the two moieties, so that they assist each other, e.g., at the initiation and burial of their members, at the building of houses and in various other economic enterprises, while communal ceremonies are usually so arranged that one moiety is conceived as giving them to the other. The symmetry of structure characteristic of the dual organization here serves as the indispensable basis of reciprocal obligations (cf. B. Malinowski, *Crime and Custom in Savage Society*, chap. IV). Thus among the Iroquois of N. America the two moieties are always represented at the great annual festivals and at the ceremonial meetings of the medicine or religious societies, and in the ceremonial Long House they are spatially separated, the speakers on each side addressing the other in the course of the ceremony, games such as ball and lacrosse, are also played between the two moieties, they have the obligation of burying each other's members, and they also exercise political functions, each moiety e.g., having the right of veto over the choice of the other in the election of chiefs (cf. L. H. Morgan, *The League of the Iroquois*).

Again, there is sometimes to be found a theoretical dichotomy of the universe whereby all natural phenomena are divided between the two moieties, and, especially where the moieties are subdivided into clans, this system of classification is frequently accompanied by totemism (q.v.). Thus the Wotjobaluk of S.E. Australia have two moieties called Krokitich and Gamutich, each of which is subdivided into a number of clans. Associated with each moiety in rather arbitrary fashion is a long list of animals, plants, etc., in fact, the native concept is that everything in the world is either Krokitich or Gamutich. This classification is carried still further, so that objects regarded as belonging say to Krokitich are subdivided among the clans composing that moiety. Moreover, suppose a man is a member of a certain clan in the Krokitich moiety to which the white cockatoo also belongs then the white cockatoo is his totem, and he has a series of special observances to fulfil towards it while he also has a general ritual relation towards all the other objects belonging to his moiety (cf. A. W. Howitt, *Native Tribes of S.E. Australia*).

Frequently also the dual division of the community seems to stimulate a tendency to emphasize contrasts between the two moieties. One moiety, e.g., is believed to be of local origin, the other to have come from elsewhere, or they are supposed to have different physical and mental characters, or their mythologies and traditions differ, or the one is regarded as superior to the other, or their names are antithetical, e.g. the widespread Australian names "Eaglehawk" (white) and "Crow" (black).

Sometimes, as in Melanesia, the moieties are apparently even hostile, and each regards the other with dislike and suspicion. All such distinctions bring out the fundamental significance of the dual organization in the structure of the community.

Theories of Origin.—The dual organization is ascribed sometimes to a process of fission whereby a single group came to be divided into two moieties. On the other hand Rivers (*The History of Melanesian Society*, chap. xxxviii), emphasizing the idea of contrast between the two moieties as found in Melanesia, believed that the dual organization there developed as the result of the intermarriage of two distinct peoples, one of which migrated into the region and set up a social system in co-operation with the communities it found there. This idea is carried still further, by not restricting the term "dual organization" to the moiety system, to which alone it applies, but extending it to dualism of every form—economic, political, religious, mythological, etc.—regarded as having originated in Egypt as the result of a process whereby a duality of ruling groups became completely superseded on a duality of a

territorial nature (Upper and Lower Egypt), and is having spread with these characteristics to all parts of the world where it is now found (cf. W. J. Perry, *The Children of the Sun*). This theory however suffers from defects which render it unacceptable.

All theories which attempt to find a single origin for the dual organization are inadequate. This mode of social structure cannot be regarded either as the invention of one people or as the result of one particular social process. It is a recurring institution that has arisen many times in different places—now by the reduction of clans, now by the fusion of two intermarrying groups, and again by other processes. No one theory of origin can be laid down as conclusive: each occurrence must receive special investigation. (I.S.)

BIBLIOGRAPHY.—The following general works on primitive society should be consulted: Sir J. G. Fraser, *Totemism and Exogamy* (1910), useful as a collection of data, R. H. Lowie, *Primitive Society* (1911), A. A. Goldenweiser, *Early Civilization* (1922), W. H. R. Rivers, *Social Organization* (1924).

DUARS, a tract of country in north east India consisting of the Western and the Eastern Duars, both of which belonged to Bhutan prior to the Bhutan War of 1864-65, as a result of this they passed into possession of the British, when the Eastern Duars were assigned to Assam and the Western to Bengal. The Eastern Duars, 1,570 sq. m., are in the Gopalganj district of Assam forming a strip of flat country lying beneath the Bhutan mountains. It is but slightly developed and sparsely populated. The Western Duars, 1,862 sq. m., lie at the foot of the Himalayas in the north east of the Jalpaiguri district of Bengal. They are traversed by the Bengal Duars railway and are an important centre of the tea-planting industry.

DU BARRY, MARIE JEANNE BECU, COMTESSE (1746-1793), French adventurer, mistress of Louis XV. was born at Vauxoulers on Aug. 19, 1746, the illegitimate daughter of a tax collector. She lived as a courtesan in Paris under the name of Middle Linge, and Jean, comte du Barry, took her into his house to make it more attractive to the dupes whose money he won by gambling. Through Lebel, valet de chambre of Louis XV., and the duc de Richelieu, he succeeded in installing her, in 1769, as official mistress of the king, after a nominal marriage with Guillaume du Barry. The duc de Choiseul, who refused to acknowledge her, was disgraced in 1771, and the duc d'Angoulême, who had the reputation of being her lover, took his place, and in concert with her governed the monarch. Louis XV. built for her the mansion of Luciennes. At his death in 1774 an order of his successor banished her for a brief period to the abbey of Pont aux Dames, near Meaux. She led a retired life at Luciennes with the comte de Cossé-Brissac. Having gone to England in 1792 to endeavour to raise money on her jewels, she was on her return accused before the Revolutionary Tribunal of having conspired against the republic. She was condemned to death on Dec. 7, 1793, and guillotined the same evening. Her contemporaries, scorning her low birth rather than her vices, attributed to her a malicious political role of which she was heart incapable, and have done scant justice to her quick wit, her frank but gracious manners and her seductive beauty. The volume of *Lettres et anecdotes* (1779) which bears her name was not written by her.

See E. and J. de Goncourt, *La du Barry* (Paris, 1880), C. Vatel, *Histoire de Madame du Barry* (1882-83), based on sources, R. Doughty, *The Life and Times of Madame du Barry* (1896), Saint-André, *Madame du Barry* (1908).

DU BARTAS, GUILLAUME DE SALLUSTE, SEIGNEUR (1544-1590), French poet, was born near Auch. He was employed by Henry IV. of France in England, Denmark and Scotland, and he commanded a troop of horse in Gascony, under the marshal de Martignan. He was a convinced Huguenot, and cherished the idea of writing a great religious epic in which biblical characters and Christian sentiment were to supplant the pagan *mise en scène* then in fashion. His first epic, *Judith*, appeared in a volume entitled *La Muse chrétienne* (Bordeaux, 1573). This was followed five years later by his principal work, *La Sepmaine*, a poem on the creation of the world. This work was held by admirers of du Bartas to put him on a level with Ronsard, and

30 editions of it were printed within six years after its appearance. Its religious tone and fanciful style made it a great favourite in England where the author was called the divine du Bartas, and placed on an equality with Anost. Spenser, Hall and Ben Jonson all speak of it in the highest terms. King James VI of Scotland tried his 'pensive hand' at the translation of du Bartas's poem *L'Uranie*, and the compliment was returned by the French writer who translated, as *La Iéphanthe*, James's poem on the battle of Lepanto. Du Bartas began the publication of the *Secondes Sepmaines* in 1584. He aimed at a great epic, never completed, which should stretch from the story of the creation to the coming of the Messiah. Du Bartas died in July 1590 in Paris from wounds received at the battle of Ivry.

Joshua Sylvester translated the *Sepmaines* in 1598, other English translations from du Bartas are *The Historie of Iudith* (1584), by Thomas Hudson, of portions of the 'Weeks' (1623) by William Lisle (1569-1637), the Anglo-Saxon scholar, *Uranie* (1589), by Robert Ashley (1565-1641), and Sir Philip Sidney (see Florio's dedication of the second book of his translation of Montaigne to Lady Rich) wrote a translation of the first 'Week' which is lost. *The Œuvres complètes* of du Bartas were printed at Paris (1579), Paris and Bordeaux (1611), a selection, *Choix de poésies*, was edited by Benric and de Gourcuff in 1890. See also G. Pellissier, *La vie et les œuvres de du Bartas* (1883), H. Ashton, *Du Bartas en Angleterre* (1908).

DUBAWNT or **DOOBAUNT** (Indian *Toobaung*, i.e., turbid), a river of Mackenzie and Keewatin districts, Canada. It rises in Wholadai (or Daly) Lake, in 104° 20' W and 66° 15' N, and flows northward to its confluence with the Thelon river, and thence eastward to Chesterfield Inlet, an arm of Hudson Bay.

DUBBO, a town about 180 mi N.W. of Sydney, New South Wales, Australia, on the Macquarie river, a manufacturing town in a wheat and sheep district with coal and copper in the neighbourhood. It has perhaps the most uniform rainfall in Australia, being on the line separating summer and winter rainfall types. Pop. (1933) 8,344.

DU BELLAY, GUILLAUME, *SIEUR DE LANGEY* (1491-1543), French soldier and diplomat, was born at the château of Glatigny, near Montmirail in 1491, of the Angevin family which gave many soldiers to France. Guillaume, the eldest of six brothers, was a soldier, humanist, historian, and the most able diplomat at the command of Francis I. He was taken prisoner at Pavie (1525) and shared the captivity of Francis I. He was sent three times to England in 1529-1530, was occupied with the execution of the treaty of Cambrai and also with the question of Henry VIII's divorce. With the help of his brother Jean, then bishop of Paris, he obtained a decision favourable to Henry VIII from the Sorbonne (July 2, 1530). From 1532 to 1536, though he went three times to England, he was principally employed in uniting the German princes against Charles V., in May 1537 he signed the treaty of Schyern with the dukes of Bavaria, the landgrave of Hesse, and the elector of Saxony, and in Jan. 1544 the treaty of Augsburg. During the war of 1537 Francis I. sent him on missions to Piedmont, he was governor of Turin from Dec. 1537 till the end of 1539, and subsequently replacing Marshal d'Annebaut as governor of the whole of Piedmont, he displayed great capacity in organization. But at the end of 1542, overwhelmed by work, he was compelled to return to France, and died near Lyons on Jan. 9, 1543. Rabelais, an eye witness, has left a moving story of his death (*Pantagruel*, iii ch. 21, and iv ch. 27). Charles V. is said to have remarked that Langey, by his own unaided efforts, did more mischief and thwarted more schemes than all the French together.

Without actually joining the reformers Guillaume du Bellay defended the innovators against their fanatical opponents. In 1534-35 he even tried, unsuccessfully, to bring about a meeting between Francis I. and Melancthon. and in 1541 he intervened in favour of the Vaudois. Rabelais was the most famous of his clients, and followed him to Piedmont from 1540 to 1542. Guillaume was himself a clear and precise writer. He imitated Livy in his *Oxydoles* a history of the rivalry between Francis I. and the emperor from 1521, of which fragments were inserted by his brother Martin du Bellay (d. 1559) in his *Mémoires* (1569). The celebrated *Instructions*, reprinted as *Traité de la discipline militaire* in 1554 and 1592 and translated into Italian, Spanish and

German, are not his (see Bayle *Dict. Hist.*, i. 502, and Jahns, *Geschichte der Kriegswissenschaften* i. 498 seq.).

See also the edition of Martin du Bellay's *Mémoires* by Michaud and Poujoult (1836), and Bourrill's *Fragment de la première Oxydoles* (Paris, 1905). There is an excellent study of Guillaume du Bellay by V. L. Bourrill (Paris, 1905).

DU BELLAY, JEAN (c. 1495-1560), French cardinal and diplomat, younger brother of Guillaume du Bellay, appears as bishop of Bayonne in 1526, member of the privy council in 1530, and bishop of Paris in 1531. He carried out several missions in England (1527-34) and Rome (1534-36). In 1535 he received his cardinal's hat, in 1536-37 he was nominated 'lieutenant general' to the king at Paris and in the Ile de France, and was entrusted with the organization of the defence against the imperialists. When Guillaume du Bellay went to Piedmont, Jean was put in charge of the negotiations with the German Protestants, principally through the humanist Johann Sturm and the historian Johann Sleidan. In the last years of the reign of Francis I., Cardinal du Bellay was in favour with the duchesse d'Étampes and received many benefices. Under Henry II, being involved in the disgrace of all the servants of Francis I. he was sent to Rome (1547), and he obtained eight votes in the conclave which followed the death of Pope Paul III. After three quiet years passed in retirement in France (1550-53), he was charged with a new mission to Pope Julius III and took with him to Rome his young cousin the poet Joachim du Bellay (q.v.). In 1555 he was nominated bishop of Ostia and dean of the Sacred College. He died at Rome on Feb. 10, 1560. The cardinal had brilliant qualities, was on the side of toleration and protected the reformers. Budaevs was his friend, Rabelais his faithful secretary and doctor, men of letters, like Étienne Dolet, and the poet Simon Maugin, were indebted to him for assistance. He left three books of graceful Latin poems (printed with Salmon Maugin's *Odes*, 1546, by R. Estienne), and some other compositions, including *Franciscus Francorum regis epistola apologetica* (1542).

BIBLIOGRAPHY—The Bibliothèque Nationale at Paris has numerous unpublished letters of Jean du Bellay. See also Ribier, *Lettres et mémoires d'éclat* (Paris, 1666), V. L. Bourrill and P. de Vaissière, *Ambassade de Jean du Bellay en Angleterre* vol. 1 (Paris, 1905), marquis de la Jonquière, *Le Cardinal du Bellay* (Alençon, 1887), Heulhard, *Rabelais, ses voyages en Italie* (Paris, 1891), Chamard, *Joachim du Bellay* (Ile, 1900), V. L. Bourrill, *Guillaume du Bellay* (Paris, 1905), 'Jean du Bellay, les protestants et la Sorbonne' in the *Bulletin du protestantisme français* (1903, 1904), and 'Jean Sleidan et le Cardinal du Bellay' in the *Bulletin*, etc. (1901, 1905).

DU BELLAY, JOACHIM (c. 1521-1560), French poet and critic, member of the Pleiade, was born at the château of La Turmelière, not far from Lire near Angers, being the son of Jean du Bellay, seigneur de Gonnor, cousin german of the cardinal Jean du Bellay and of Guillaume du Bellay. Both his parents died while he was still a child, and he was left to the guardianship of his elder brother, René du Bellay, who neglected his education, leaving him to run wild at La Turmelière. When he was 23, however, he went to Poitiers to study law, no doubt with a view to obtaining preferment through his kinsman the cardinal. At Poitiers he came in contact with the humanist Marc Antoine Muret and with Jean Salmon Maugin (1490-1557), a Latin poet famous in his day. There too he probably met Jacques Peletier, who had published a translation of the *Ars poetica* of Horace, with a preface in which much of the programme advocated later by the Pleiade is to be found in outline.

It was probably in 1548 that du Bellay met Ronsard in an inn on the way to Poitiers, an event which may justly be regarded as the starting-point of the French school of Renaissance poetry. The two immediately became fast friends. Du Bellay returned with Ronsard to Paris to join the circle of students of the humanist attached to Jean Daurat (1494) at the Collège de Coqueret. While Ronsard and Antoine de Brif were most influenced by Greek models, du Bellay was more especially a Latinist, and perhaps his preference for a language so nearly connected with his own had some part in determining the more national and familiar note of his poetry. In 1548 appeared the *Art poétique* of Thomas Sibilet, who championed the cause of Clément Marot and his disciples, and poured scorn on the sonnet and on new fangled ideas

subsidence in the ground affords a nucleus for the formation of bog with which about 2,000 ac are covered. There are also a few small tracts of bog in the northern part of the county. The mountain district is well adapted for timber. The northern coast of the county from Balbriggan to Howth has generally a sandy shore, and affords only the small harbours of Balbriggan and Skerries. In the promontory of Howth, the coast suddenly assumes a bolder aspect, and between the town of Howth and the rocky islet of Ireland's Eye an unsuccessful artificial harbour was constructed. Kingstown harbour on the south side of Dublin bay superseded this, and is by far the best in the county. The chief river is the Liffey, which rises in the Wicklow mountains about 12 m S.W. of Dublin, and empties itself into Dublin bay. The course of the river is so tortuous that 40 m may be traversed and only ten gained in direction.

Dublin is among the counties generally considered to have been formed by King John, and comprised the chief portion of country within the English pale. The limits of the county, however, were uncertain and underwent many changes before they were fixed. As late as the 17th century the mountainous country south of Dublin offered a retreat to the lawless, and it was not until 1606 that the boundaries of the county received definition in this direction, along with the formation of county Wicklow. Although so near the seat of government much land was forfeited in the Rebellion of 1641 and in the Revolution of 1688. In 1867 the most formidable of the Famine risings took place near the village of Tallaght, about 7 m from the city. Raids or encampments are frequent, and there are also dolmens and round towers.

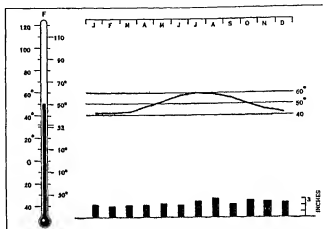
The extension of Dublin city and its suburbs has no doubt had its influence on the decrease of acreage under both tillage and pasture. Oats and potatoes are the principal crops, but live stock, especially cattle, receives greater attention. A large proportion of the land holdings are smaller than one acre. The manufactures of the county are mainly confined to the city and suburbs, but there is manufacture of cotton hosiery at Balbriggan. Fisheries, both deep sea and coastal, are important, and Kingstown is the headquarters of the fishery district. The salmon fishery district of Dublin also affords considerable employment. The communications of the county are good, several important railways and two canals converging upon the city of Dublin, under the head of which they are considered. Co. Dublin returns five members to Dail Eireann.

DUBLIN, county borough and seaport, and the metropolis of Eire. It lies at the head of a bay of the Irish Sea, to which it gives name, about midway on the eastern coast of the island and 70 mi W. of Holyhead. The Gaelic name, Baile Atha Cliath, "Town of the Ford of the Hurdles," is now used by the Post Office. Pop. (1936) 468,203.

History—The name of Dublin signifies the "Black pool." It is recorded that the inhabitants of Leinster were defeated by the people of Dublin in the year 291. Christianity was introduced by St. Patrick about 450. In the 9th century the Danes took Dublin. The first Norse king was Thorkel I. (832), though the Danes had appeared in the country as early as the close of the previous century. Thorkel established himself strongly at Armagh. In 1014 Brian Boru, king of Munster, fought the battle of Clontarf against the Danes, and he and his son and 11,000 of his followers fell. The Irish, however, won the battle, but the Danes reoccupied the city. Constant struggles with the Irish resulted in intermissions of the Danish supremacy from 1052 to 1072, at various intervals between 1075 and 1118 and from 1124 to 1136. The Danes were finally ousted by the Anglo-Normans in 1171. In 1172 Henry II. came to Dublin and held his court there. Previous to his departure for England, Henry bestowed the government on Hugh de Lacy, having granted by charter "to his subjects of Bristol his city of Dublin to inhabit, and to hold of him and his heirs for ever, with all the liberties and free customs which his subjects of Bristol then enjoyed at Bristol and through all England." In 1176 Strongbow, earl of Pembroke, died in Dublin and was buried in Christ Church cathedral. A fresh charter was granted in 1207 by King John to the inhabitants of Dublin, who were at constant feud with the native Irish. In 1216 Magna

Carta was granted to the Irish by Henry III. In 1217 the fee farm of the city was granted to the citizens at a rent of 200 marks per annum, and about this period many monastic buildings were founded. In 1227 the same monarch confirmed the charter of John fixing the city boundaries and the jurisdiction of its magistrates.

During the invasion of Ireland by Edward Bruce in 1315 some of the suburbs of Dublin were burnt to prevent their falling into



GRAPH OF THE AVERAGE TEMPERATURE IN DUBLIN THROUGH THE YEAR. The mercury in the thermometer stands at the normal annual mean temperature. The curve shows the normal monthly mean temperature through the year. The columns below indicate the normal precipitation for each month.

his hands. The mood of Bruce had been countenanced by native Irish ecclesiastics, whose sentiments were recorded in a state ment to Pope John XXII.

Richard II. erected Dublin into a marquessate in favour of Robert de Vere, whom he also created duke of Ireland. The same monarch entered Dublin in 1394, and after holding a parliament and making much courtly display before the native chieftains, returned to England. Five years later Richard returned to Ireland and visited Dublin, where he remained a fortnight.

In 1534 Lord Thomas Fitzgerald, son of the Lord Deputy Kildare, organized a rebellion against the English Government and attacked the city of Dublin itself, but raised the siege on certain conditions. After many vicissitudes, Lord Thomas and others were executed at Tyburn in 1536.

At the outbreak of civil war in 1641, a conspiracy to seize Dublin Castle was disclosed, and the city was thus preserved for the king's party, but the Irish outside began an indiscriminate extermination of the Protestant population. In 1646 Dublin was besieged unsuccessfully by the Irish. The city had been put in an efficient state of defence by the marquess of Ormonde, then lord-lieutenant, but in the following year, to prevent its falling into the hands of the Irish, he surrendered it on conditions to Colonel Jones, commander of the Parliamentary forces. In 1649 Ormonde was totally defeated at the battle of Baginbally, near Old Rathfriland, in an attempt to recover possession. The same year Cromwell landed in Dublin, as commander-in-chief under the parliament.

When James II. landed in Ireland in 1689 to assert his right to the British throne, he held a parliament in Dublin, which passed acts of attainer against upwards of 3,000 Protestants. The governor of the city, Colonel Luttrell, at the same time issued a proclamation ordering all Protestants not housekeepers, excepting those following some trade, to depart from the city within 24 hours, under pain of death or imprisonment, and in various ways restricting those who were allowed to remain. In the hope of relieving his financial difficulties, the king decreed the coinage. After his defeat at the battle of the Boyne, James returned to Dublin for a few hours. William III. on the following day proceeded in state to St. Patrick's cathedral to return thanks for his victory.

In 1783 a convention of delegates from all the volunteer corps in Ireland assembled in Dublin for the purpose of procuring a

reform in parliament, but the House of Commons refused to entertain the proposition. In May 1798 a conspiracy planned by the United Irishmen to seize the city was frustrated. In 1803 an insurrection broke out, but was immediately quelled, with the loss of some lives in the tumult, and the death of its leaders on the scaffold. In 1848 the lower classes in Dublin were greatly agitated, but the city was saved from much bloodshed. In 1867 the most serious of modern conspiracies, that known as the Fenian organization, came to light. The Habeas Corpus Act was suspended at one sitting by both Houses of Parliament and about 960 arrests were made in Dublin in a few hours. Dublin Castle was fortified, and the citizens lived in a state of terror for several weeks together. For later history, see IRELAND.

GROWTH OF THE CITY

Buildings.—The expansion of Dublin from a castle nucleus is of great interest to the student of town planning. The castle was built on a ridge overlooking the river and the low ground to the east. Within the limits of the old walls are found Christ Church cathedral, the city hall, municipal offices, and several business premises. Speed's map of 1610 gives a good idea of this settlement and shows also some buildings to the north of the river. With the exception of some of the churches, however, the buildings now found in the old centre of the city are themselves later than the 17th century. The castle was originally built in the first two decades of the 13th century, and there are portions of this period, but nearly the whole is of the 16th century and later.

The cathedral of Christ Church, or Holy Trinity, was founded by Sigtryg, a Christianized king of the Danes of Dublin, in 1038 but dates its elevation to a deanery and chapter from 1541. It was restored in 1870-77 by G. E. Street, who rebuilt the choir and south side of the nave, but the model of the ancient building was followed with great care. The crypt embodies remains of the founder's work, the rest is Transitional Norman and Early English in style. Among the monuments is that of Strongbow, the invader of Ireland, to whom the earlier part of the superstructure (1170) is due. Here the tenants of the church lands were accustomed to pay their rents. Synods were occasionally held in this church, and parliaments also, before the Commons' Hall was destroyed in 1566. Here also the pretender Lambert Simnel was crowned.

The portions of the city immediately around the castle nucleus represent the development up to the first half of the 19th century. There was considerable growth to the north of the river where Sackville (O'Connell) street is one of the principal thoroughfares, although it was badly damaged in 1922. In it is the Nelson pillar, 134 ft. in height with a statue of the admiral on the top. Farther to the east are the docks. The customs house was destroyed in 1922 but was rebuilt. The most interesting buildings, however, are to the south of the river.

A short distance south from Christ Church through the squallid quarter of Nicholas and Patrick streets, stand the cathedral dedicated to St. Patrick, the foundation of which was an attempt to supersede the older foundation of Christ Church, owing to jealousies, both ecclesiastical and political, arising out of the Anglo-Norman invasion. It was founded about 1100 by John Comyn, archbishop of Dublin, but there was a church dedicated to the same saint before. It was burnt about 200 years later but was rebuilt. At the Reformation it was deprived of its status as a cathedral, and the building was used for some of the purposes of the courts of justice. Edward VI contemplated its change into a university, but the project was defeated. In the succeeding reign of Mary, St. Patrick's was restored to its original purpose. The installations of the knights of St. Patrick were originally held here. This cathedral contains the monument of Dean Swift. Attached to the cathedral is Marsh's library, incorporated in 1707, by a request of Primate Marsh, archbishop of Armagh.

Westmoreland street is a continuation to the south of Sackville street and where it meets Dame street, which leads up to the castle, re-enters the Bank of Ireland and Trinity college. The Bank of Ireland was formerly the House of Parliament. There are three fronts, the principal, towards College Green, is a

colonnade of the Ionic order, with façade and two protecting wings, it connects with the western portico by a colonnade of the same order, forming the quadrant of a circle. The eastern front which was the entrance of the House of Lords, is of the Corinthian order. The House of Lords contains tapestry dating from 1733 and remains in its original condition, but the octagonal House of Commons was demolished by the bank directors. The building was begun in 1729 but the fronts date from the end of the century, the remodelling took place in 1803.

Trinity College.—Trinity college, or the University of Dublin founded in 1591, has a Palladian façade (1759), with two statues by Foley, of Goldsmith and Burke. Above the gateway is a hall called the Regent House. The first quadrangle, Parliament square contains the chapel (1798), with a Corinthian portico, the public theatre or examination hall (1787), containing portraits of Queen Elizabeth, Molyneux, Burke, Bishop Berkeley and other celebrated men, and the wainscoted dining hall, also containing portraits. A beautiful cimpanie (1853) occupies the centre of the square. The library is one of those scheduled in the Copyright Act as entitled to receive a copy of every volume published in the United Kingdom. There is a notable collection of early Irish manuscripts including the ornamented Book of Kells, containing the gospels. The building was begun in 1712. In this square are the oldest buildings of the foundation dating in part from the close of the 17th century, and the modern Graduates' Memorial building (1904). These contain a theatre, library and reading room, the rooms of the college societies and others. The schools form a fine modern pile (1856), and other buildings are the provost's house (1760), printing house (1760), museum (1857) and the medical school buildings in three blocks, one of the best schools in the kingdom. Other buildings of the 20th century include chemical laboratories. The college (recreation) park and fellows' garden are of considerable beauty. The college observatory is at Dunsink about 5 m. N.W. of Dublin. It was erected in 1785, and in 1799 was placed by statute under the management of the royal astronomer of Ireland, whose official residence is here. The magnet observatory of Dublin was erected in the years 1837-38 in the gardens attached to Trinity college, at the expense of the university. A normal climatological station was established in the fellows' garden in 1904. The botanic garden is at Ball's Bridge 1 m. S.E. of the college.

The outer portions of the city extending as far as the circular road which skirts the periphery date from the second half of the 19th century whilst beyond this boundary has been some more recent development. The congestion in the tenements of the older quarter has to some extent been relieved although much remains to be done. Near St. Stephen's Green is University college, which occupies the site of the International Exhibition of 1865. University college is one of the constituent colleges, with Cork and Galway, of the National University of Ireland.

COMMERCE AND TRANSPORTATION

Trade.—Dublin was for long stigmatized as lacking, for so large a city, in the proper signs of commercial enterprise. About the time of the Revolution, the woollen trade flourished in Dublin and the produce attained great celebrity. The cheapness of labour attracted capitalists, who started extensive factories in that quarter of the town known even now as the Liberties. This quarter was inhabited altogether by workers in wool. About 1700 the English legislature prevailed on William III to assent to laws which directly crushed the Irish trade. All exportation except to England was forbidden, and the woollen manufacture soon decayed. But at the close of the 18th century there were 5,000 persons at work in the looms of the Liberties. About 1715 parliament favoured the manufacture of linen, and the Linen Hall was built. The cotton trade was soon afterwards introduced, and silk manufacture was begun by the Huguenots, who had settled in Dublin in considerable numbers after the revocation of the edict of Nantes. Acts favourable to these enterprises were passed, and they flourished apace. But the old jealousy arose in the reign of George I and in the reign of George III an Act was passed which tended directly to the ruin of the manufacture. The line shared the same fate. Dublin poplins, however, keep their reputa-

tion. However adverse influences may have been combated, Dublin yet produces little for export save whisky and porter, but a considerable export trade, principally in agricultural produce, passes through Dublin from the country. To the manufacturing industries of the city there should be added mineral water works, biscuit-making, glass making, cigarette-making, foundries and ship building.

By continual dredging a great depth of water is kept available in the harbour. The Dublin Port and Docks Board, which was created in 1893, undertook considerable works of improvement at the beginning of the 20th century. These improvements, *inter alia*, enabled vessels drawing up to 23 ft to lie alongside the extensive quays which border the Liffey at low tide. The extensive Alexandra tidal basin, on the north side of the Liffey, admits vessels of similar capacity. The Custom House Works on the north side have about 17 ft of water. With docks named after them are connected the Royal and Grand canals, passing respectively to north and south of the city, the one penetrating the great central plain of Ireland on the north, the other following the course of the Liffey, doing the same on the south and both joining the river Shannon. The docks attached to the canals, and certain other smaller docks, are owned by companies. Vessels entering these piers toll, but not those entering docks under the Board.

The direct route to Dublin from London and other parts of England is by the Holyhead route, controlled by the LMSR with steamers to the port of Dublin itself, while the company also works in conjunction with the mail steamers of the City of Dublin Steam Packet Company to the outlying port of Kingstown, 7 mi S.E. Passenger steamers, however, also serve Liverpool, Heysham, Bristol, the south coast ports of England and London, Edinburgh and Glasgow, and other ports of Great Britain. The rail ways leaving Dublin are the following: the Great Northern, with suburban lines and a main line running north to Drogheda, Dundalk and Belfast, with ramifications through the northern counties, the Great Southern to Kilkenny, Athlone and Cork, the Midland Great Western to Cavan, Sligo and Galway, and there is the North Wall station of the LMSR, with the line known as the North Wall extension, connecting with the other main lines. The internal communications of the city are excellent, electric tram ways which connect all the principal suburbs. The county borough of Dublin is divided into four constituencies—Dublin North East returning three members, Dublin North West returning five, Dublin South returning seven and Dublin Townships three to Dail Eireann. Dublin is governed by an elected council and a manager. The council's powers are restricted to imposing rates, raising loans and making by-laws. Other functions are performed by the manager, a paid official who has power over all municipal officers and whose own removal is subject to central authority.

See W. Harris, *History and Antiquities of the City of Dublin* (1766), Sir J. T. Gilbert, *History of the City of Dublin* (1859), L. J. Voss, *Dublin som Norsk* By (Christiania, 1896), *The Dublin Civic Survey*, vol. II of the publications of the Civic Institute of Ireland (1925).

DUBLIN, a city of Georgia, U.S.A., on the Oconee river, 125 mi S.E. of Atlanta, the county seat of Laurens county. It is on federal highway 80, and is served by the Macon, Dublin and Savannah and the Wrightsville and Tonnelle rail ways. The population was 10,212 in 1950 and 7,814 in 1940 by federal census. It is a shipping point for various agricultural products, lumber and naval stores, produces peanuts, and has cottonseed oil mills, fertilizer plants and wood-working industries. A veterans' hospital is located there. The city was incorporated in 1812.

DUBNER, JOHANN FRIEDRICH (1802-1867), German classical scholar (naturalized a Frenchman) was born in Heselager, near Gotha. In 1813 he was invited by the brothers Didot to Paris, to co-operate in a new edition of H. Etienne's Greek *Thesaurus*, and dictated many volumes. In Didot's *Bibliotheca Graeca* He received the Legion of Honour for his edition of Caesar, undertaken by command of Napoleon III. His editions did much to raise the standard of classical scholarship in France. He violently attacked Burnouf's method of teaching Greek, but without result. Dubner may have gone too far in his zeal for reform, but time has shown him to be right. The old text books

have been discarded, and a great improvement in classical teaching has taken place.

See F. Godefroy, *Notice sur J. J. Dubner* (1867), Sainte Beuve, *Discours a la memoire de Dubner* (1868), article in *Allgemeine deutsche Biographie*.

DUBOC, JULIUS (1829-1903), German author and philosopher, was born on Oct. 10, 1829, at Hamburg, and died on June 11, 1903, at Dresden. He studied at both Leipzig and Berlin and became a disciple of Feuerbach. Evolutionary monism, atheism, and the doctrine that pleasure is the end of all human activity had expression in his works, which include *Soziale Briefe* (3rd ed. 1875), *Die Psychologie der Liebe* (1874), *Das Leben ohne Gott* (1875), *Hundert Jahre Zeitgeist in Deutschland* (1889), and *Die Lust als sozialtheistisches Entwicklungsprinzip* (1900).

DUBOIS, FRANÇOIS CLEMENT THEODORE (1837-1924), French musical composer, was born at Romey (Marne) on Aug. 24, 1837. He studied at the Conservatoire under Ambrose Thomas, and won the Grand Prix de Rome in 1861 with his cantata *Atala*. On his return to Paris he was appointed 'maître de Chapelle' at the church of Ste. Clotilde where Cesar Franck was organist. Here he produced *Les Sept Paroles du Christ* (1867), a work which has become well known in France. In 1868 he became 'maître de Chapelle' at the Madeleine, and nine years later succeeded Camille Saint-Saëns there as organist. He became professor of harmony at the Conservatoire in 1871, and was appointed professor of composition in succession to Leo Delibes in 1891. At the death of Ambrose Thomas in 1896 he became director of the Conservatoire, he retired in 1905. Dubois was an extremely prolific composer and wrote in a variety of forms. His sacred works include four masses, a requiem, a large number of motets and pieces for organ. For the theatre he composed a light opera, *La Cigale de l'Émir* (Athènes, April 30, 1873), a one act piece, *Le Pape bu* (Opera Comique, Feb. 30, 1879), a ballet, *La Farandole* (Grand Opera, Dec. 14, 1883), *Don Hamet*, a four act opera (Théâtre Italien, Dec. 10, 1884), *Xavère*, a dramatic idyll in three acts (Opera Comique, Nov. 26, 1895). His orchestral works include two concert overtures, the overture to *Frisco* (1880), several suites, *Marche héroïque de Jeanne d'Arc* (1888), etc. He was also the author of various sacred works and in addition he composed much for the piano and voice. Dubois died in Paris on June 11, 1924.

DUBOIS, GUILLAUME (1656-1723), French cardinal and statesman, was born at Brive, Corrèze, on Sept. 6, 1656. He received the tonsure at the age of 13, was educated at the college of St. Michel at Paris, and became tutor to the young duke of Chartres, afterwards duke of Orleans. When his pupil became regent (1715) Dubois, who had for some years acted as his secretary, was made councillor of state and the chief power passed into his hands.

His policy was steadily directed towards maintaining the peace of Utrecht. To counteract Alberoni's intrigues for the aggrandisement of Spain, he suggested an alliance with England, and succeeded in negotiating the Triple Alliance (1717). In 1719 he sent an army into Spain, and forced Philip V. to dismiss Alberoni. Other wise his policy remained that of peace. Dubois's success strengthened him against the bitter opposition of a large section of the court. In spite of his dissolute life he asked the regent to give him the archbishopric of Cambrai. His demand was supported by George I. and the regent yielded. In one day all the usual orders were conferred on him, and even Massillon consented to take part in the ceremonies. After long and most profitable negotiations on the part of Pope Clement XI. the red hat was given to him by Innocent XIII. (1721), whose election was largely due to the bribes of Dubois. This cardinalate cost France about 8,000,000 francs. In the following year he was named first minister of France (August).

When Louis XV. attained his majority in 1723, Dubois remained chief minister. He had accumulated an immense private fortune, possessing in addition to his see the revenues of seven abbeys. He died at Versailles on Aug. 10, 1723. His portrait was thus

drawn by the duc de St. Simon—"He was a little, pitiful, wizened, herring gutted man, in a flaxen wig, with a weasel's face, brightened by some intellect. All the vices—peridy, avarice, debauchery, ambition, flattery—fought within him for the mastery. He was so consummate a liar that, when taken in the fact, he could brazenly deny it." This famous picture is certainly biased Dubois, in spite of his vices, gave France peace after the disastrous wars of Louis XIV.

In 1789 appeared *Vie privée du Cardinal Dubois*, attributed to one of his secretaries, Mongez, and in 1815 his *Mémoires secrets et correspondance inédite*, edited by L. de Sevelinges. See also A. Cheruel, *Saint-Simon et l'épiscopat Dubois*, L. Wiesner, *Le Régent, l'abbé Dubois et les Anglais* (1891), and memoirs of the time.

DUBOIS, JEAN ANTOINE (1705-1848), French Catholic missionary in India, was ordained in the diocese of Viviers in 1792, and sailed for India in the same year under the *Missions Étrangères*. He at first worked in the southern districts of the present Madras presidency. On the fall of Serenapatam in 1799 he went to Mysore to reorganize the Christian community shattered by Tipu Sultan. He benefited his impoverished flock by founding agricultural colonies and introducing vaccination as a preventive of smallpox. By his fervent desire to understand Hindu life, he gained an extraordinary welcome amongst all castes, and is still spoken of in many parts of south India with affection and esteem as "the prince's son, the noblest of Europeans." His great work, *Hindu Manners, Customs and Ceremonies* (3rd ed., Oxford, 1900) gives a shrewd, clear sighted, candid account of the manners and customs of the Hindus. Dubois left India in Jan. 1823, and on reaching Paris was appointed director of the *Missions Étrangères*, of which he afterward became superior (1836-39). He translated into French the famous book of Hindu fables called *Panchatantra*, and also a work called *The Exploits of the Gurm Paramarta*. He died on Feb. 17, 1848.

DUBOIS, LOUIS ERNEST (1850-1929), French ecclesiastic, was born at Saint Calais, France, Sept. 1, 1856. In 1901 he became bishop of Verdun, in 1909 Archbishop of Bourges, and in 1916 of Rouen. He was made cardinal of Santa Maria in Aquino, Rome, by Pope Benedict XV. In Dec. 1916 On the death of Cardinal Amette in 1910, Cardinal Dubois was made Cardinal Archbishop of Paris. He died at Paris on Sept. 23, 1929.

See his *Mémoires* published in 1929.

DUBOIS, PAUL (1830-1905), French sculptor and painter, was born at Nogent-sur Seine on July 18, 1830, and died on March 22, 1905. After studying at the Ecole des Beaux-Arts, Dubois went to Rome. His first contributions to the Paris Salon (1860) were busts of "The Countess de B" and "A Child." "A Florentine Singer of the Fifteenth Century" was shown in 1865, "The Virgin and Child" appeared in the Paris Universal Exhibition in 1867, from 1873 onwards date the busts of Henner, Dr. Parrot, Paul Baudry, Pasteur, Gounod and Bonnat, remarkable alike for vivacity, likeness, refinement and subtle handling. The chief work of Paul Dubois was "The Tomb of General Lamourette" in the cathedral of Nantes, a brilliant masterpiece conceived in the Renaissance spirit, with allegorical figures and groups representing Warlike Courage, Charity, Faith and Modesty, with bas-reliefs and enrichments. The statue of the "Constable Anne de Montmorency" was executed for Chantilly, and that of "Joan of Arc" (1889) for the town of Reims. In 1873 Dubois was appointed keeper of the Luxembourg museum. He succeeded Guillaume as director of the Ecole des Beaux-Arts, 1878, and Permaud as member of the Académie des Beaux-Arts.

DUBOIS, PIERRE (c. 1250-c. 1312), French publicist in the reign of Philip the Fair, was educated at the university of Paris. In 1300, he wrote his anonymous *Summa*, a *compendiosa doctrina fidei explicationis et abbreviationis guerrarum et litium regni Francorum*, which is extant in a unique ms., but is analysed by N. de Wailly in the *Bibliothèque de l'Ecole des Chartes* (2nd series, vol. vi). In the contest between Philip the Fair and Boniface VIII Dubois identified himself with the secularizing policy of Philip. His *Supplication du pape de France au roi contre le pape Boniface le VIII*, printed in 1614 in *Acta inter Bonifacium VIII et Philippum Patrum*, dates from 1304, and is a heated indictment of the temporal power. He represented

Coutances in the states general of 1302, but in 1306 he was serving Edward I as an advocate in Guenne, without apparently abandoning his Norman practice by which he had become a rich man. His treatise *De recuperatione terrarum sanctae*, outlining the conditions for a successful crusade, was written in 1306, and dedicated in its extant form to Edward I, though it is certainly addressed to Philip. Dubois's ideas on education, on the clergy of the clergy, and his schemes for the codification of French law, were far in advance of his time. He was an early and violent "Galicant," and the first of the great French lawyers who occupied themselves with high politics. In 1308 he attended the states-general at Tours. He is generally credited with *Quoddam proposita papae a rege super facto Templariorum*, a draft epistle supposed to be addressed to Clement by Philip.

See an article by E. Renan in *Hist. litt. de la France*, vol. xxvi pp. 471-536, P. Dupuy *Hist. de la condamnation des Templiers* (Brussels, 1713), and *Hist. du différend entre le pape Boniface VIII et Philippe le Bel* (Paris, 1655), and *Notices et extraits de manuscrits*, vol. xx. E. Zeck, *Pierre Dubois*, etc. (1912).

DU BOIS, a city of Clearfield county, Pa., U.S., on Sandy Luck creek, 85 mi. N.E. of Pittsburgh. It is on federal highways 119, 219 and 322, and is served by the Baltimore and Ohio and the Pennsylvania railroads and by All American air line. Pop. (1950) 11,466. The city is built on a small plateau surrounded by hills, on the western slope of the Allegheny mountains, nearly 1,400 ft. above sea level. Industrial production includes a gas meter and regulator plant, brewery, electronics and resistor factory, soot blowery factory, electric battery works, luggage plant, rubber fabricating plant, automobile spring works, foundry and machine shop and numerous bituminous coal operations in the immediate vicinity. The city was founded in 1872 by John Du Bois, and was incorporated in 1881.

DUBOIS-CRANCE, EDMOND LOUIS ALEXIS (1747-1814), French revolutionary, born at Charleville, was elected deputy to the states general in 1789 by the third estate of Vitry le François. At the Constituent Assembly, of which he was named secretary in Nov. 1789, he worked for the replacement of the old military system, with its caste distinctions and its mercenaries, by national guards open to all citizens. In his report on Dec. 12, 1789, he adumbrated the idea of conscription. He secured the Assembly's vote that any slave who touched French soil should become free. Elected to the Convention by the department of the Ardennes, he sat among the *Montagnards*. In the trial of Louis XVI he voted for death without delay or appeal. On Feb. 21, 1793, he was named president of the Convention. He composed a remarkable report on the army, recommending the rapid advancement of the lower officers, and the fusion of the volunteers with the veteran troops. In Aug. 1793 Dubois-Crancé was designated "representative on mission" to the army of the Alps, to direct the siege of Lyons. Accused of lack of energy, he was replaced by G. Couthon (q.v.). On his return he was excluded from the Jacobin club at the instance of Robespierre. He took part in the revolution of 9th Thermidor of the year II, directed against Robespierre. He was one of the committee of five which had to oppose the Royalist insurrection of Vendémiaire (see FRENCH REVOLUTION), and was named a member of the committee of public safety, then much reduced in importance. After the Convention, under the Directory, Dubois-Crancé was a member of the council of the Five Hundred, and was appointed inspector general of infantry, then, in 1799, minister of war. Opposed to the *coup d'état* of the 18th Brumaire, he lived in retirement during the consulate and the empire. He died at Rethel on June 29, 1814.

Among the numerous writings of Dubois Crancé may be noticed his *Observations sur la constitution militaire, ou bases du travail proposé au comité militaire*. See H. F. T. Jung, *Dubois de Crancé Larmée et la Révolution, 1789-1794* (2 vols. 1884).

DU BOIS-REYMOND, EMIL (1818-1896), German physiologist, was born in Berlin on Nov. 7, 1818. His father belonged to Neuchâtel, his mother was of Huguenot descent, and he spoke of himself as "being of pure Celtic blood." He studied geology at Bonn, then anatomy and physiology at Berlin under Johannes Müller. Du Bois Reymond's graduation thesis on "Electric Fishes," was the beginning of a long series of investigations

on animal electricity. The results of these inquiries were published in his *Untersuchungen über tierische Elektrizität* (2 vols 1848–84).

This great work may be regarded under two aspects. On the one hand, it is a record of the exact determination and approximate analysis of the electric phenomena presented by living beings. On the other hand it contains an exposition of a theory. Du Bois Reymond developed the view that a living tissue, such as muscle, might be regarded as composed of a number of electric molecules, of molecules having certain electric properties, and that the electric behaviour of the muscle as a whole in varying circumstances was the outcome of the behaviour of these native electric molecules. This theory has perhaps not stood the test of time so well as have Du Bois Reymond's more simple deductions from observed facts. It was early attacked by Ludimar Hermann, who maintained that a living untouched tissue is not the subject of electric currents so long as it is at rest, is isoelectric in substance, and therefore need not be supposed to be made up of electric molecules, all the electric phenomena which it manifests being due to internal molecular changes associated with activity or injury. Although most subsequent observers ranged themselves on Hermann's side, Du Bois Reymond's theory was of great value if only as a working hypothesis, and as such it greatly helped in the advance of science.

For many years, Du Bois Reymond exerted a great influence as a teacher. In 1858, upon the death of Johannes Müller, he was given the new chair of physiology at Berlin. In 1851 he was elected to the Academy of Sciences of Berlin, and in 1867 became its perpetual secretary. From 1857 to 1877, he was co-editor of the *Archiv für Anatomie*. His principal work other than the one on electricity, is *Gesammelte Abhandlungen zur allgemeinen Muskel- und Nervenphysik* (2 vols., 1875–77). He died Nov. 26, 1896. See J. Burdon Sanderson in *Nature* (vol. IV, 1897).

DUBROVNIK (Ital. *Ragusa*), a port of Dalmatia, Yugoslavia. Pop. 18,767. Dubrovnik was known as Ragusa from before the 10th century, but upon its incorporation in the newly-formed state of Yugoslavia in 1918, its name was officially changed to Dubrovnik. The name is commonly thought to be derived from the Slavonic *dubrava*, "woody," though this derivation has been questioned.

It is by far the most picturesque city on the Dalmatian coast occupying a promontory jutting out into the sea under the bare limestone mass of Mt. Sergio. The seaward fortifications rise directly from the water's edge, while a massive round tower dominates the city on the landward side. Beyond the walls, mostly a double line, which have always been the pride of Dubrovnik, are many villas, surrounded by gardens. The Stradone, or main street, runs along a narrow valley, which until the 13th century was a marshy channel, dividing the Latin island of Ragusa from the forest settlement of Dubrovnik.

Dubrovnik first became prominent during the 7th century. In 639 and 656 the flourishing Latin communities of Salona and Epidaurus were destroyed by the Avars, and the island rock of Ragusa was colonized by the survivors. A colony of Slavs soon joined the Latin settlers at Ragusa, and thus, from an early date, the city formed a link between two great civilizations (see VIACHES). During the 9th, 10th, 11th and 12th centuries, Ragusa defended itself against attacks by foreign powers, but from 1205 to 1358 it acknowledged Venetian suzerainty. Ragusan policy during this period was usually peaceful. To refugees of all nations the city afforded asylum, and by means of treaty and tribute it worked its way to a position of great mercantile power. It was conveniently situated at the seaward end of a great trade route, which bifurcated at Plevlje to Byzantium and the Danube. Ragusan trade flourished, both by land throughout the Balkans, and by sea in the Mediterranean region in northern Europe, and in the 16th century, even as far as America and India. From 1358 to 1526, Ragusa was a vassal state of Hungary, but the downfall of Hungary in 1526 left the city free. About this time a great development of art and literature began in the 15th century and continued into the 17th, earned for the city its title of the "South Slavonic Athens." After this period, however, the importance of

Ragusa declined. The conquest of the Balkans by the Turks and the misrule of Hungary in Dalmatia ruined its commerce, and the discovery of America reduced the importance of the Mediterranean ports. In 1667 an earthquake destroyed a considerable portion of the city and about one-fifth of the inhabitants. Only during the Napoleonic wars did the republic regain its prosperity. From 1800 to 1805 it was the sole Mediterranean state remaining neutral, and thus it secured a large share of the carrying trade. In 1805, however, it was seized by the French. Napoleon deprived it of independence and in 1814 it was annexed to Austria. In 1918 it became a part of Yugoslavia and in 1941 it was seized by Italy.

Despite the havoc wrought by the earthquake in 1667 the city is rich in antiquarian interest. One church of the Byzantine period, is mentioned in 13th century documents as being even then of great age. Two 14th century convents stand at the ends of the city, for the Franciscans were set to guard the western gate against the hostile Slavs while the Dominicans kept the eastern one. The Rector's palace is one of the masterpieces of Dalmatian architecture. It has a fine façade of six arches and the capitals of the supporting pillars are curiously carved. One of them bears the figure of Aesculapius, whose tradition it birthplace was nearby Epidaurus whence the Latins migrated in the 7th century to found Ragusa.

The harbour being too small for modern needs and also difficult of approach Gravosa (Gruz), a village to the N with a good natural harbour became the steamship station and was connected by rail with Dubrovnik. Dubrovnik's industries include the manufacture of liquors, cheeses, silk, leather, drawn thread work, metalwork and soap oil refining and slate mining. Dates, figs, olives, etc. are cultivated. Malmsey formerly its most famous wine, was not produced after the vine disease of 1852. There is a secondary school and a naval college. The Grotto of Aesculapius is famous for its stactites.

LACROMA (Serbo-Croatian Lokrum), an island $\frac{1}{2}$ mi. to the S is remarkable for the beauty of its vegetation. It was a favourite resort of the Austrian crown prince Rudolph (1857–89), and of the archduke Maximilian afterwards emperor of Mexico (1832–67), who restored the chateau and park in which are the ruins of an 11th century Benedictine monastery and a church, locally ascribed to Richard I (1188–99).

See *Lacroma*, by the crown princess Stephanie, afterwards Countess Lonyay (Vienna, 1892).

DUBS, JAKOB (1822–1879), Swiss statesman, was born on July 26, 1822, at Affoltern, and studied law at Heidelberg, Bern and Zurich. After holding various offices in his native canton, he was elected a member and, in 1857, president of the federal court. He was president of the Swiss confederation in 1864 and in 1868. He died at Lausanne on Jan. 13, 1879. He published *Die Schweizer Demokratie* (1866) and *Das öffentliche Recht der Schweizerischen Eidgenossenschaft* (1877).

DUBUQUE, a city of Iowa, U.S.A. on the Mississippi river, opposite the boundary line between Wisconsin and Illinois, a port of entry and the county seat of Dubuque county. It is served by the Burlington, the Chicago Great Western, the Chicago, Milwaukee, St. Paul and Pacific and the Illinois Central railways, and by river steamers and barges.

Pop. (1950) 49,528, (1940) 43,892.

The business section of the city lies on the lowlands along the river, but most of the residential sections are on the slopes and tops of bluffs, which command extensive and picturesque views. Dubuque has a large traffic by rail and by water, and is winter quarters for the boats operating on the upper Mississippi. It is the centre of the state's lead and zinc mines, which were, however, abandoned because of water in 1918. There is a variety of manufacturing industries.

A city-manager government was adopted in 1920. Dubuque is the see of a Roman Catholic archbishop, and is the seat of Loras college for men, formerly Columbia college (established in 1839) and Clarke college for women, formerly Mt. St. Joseph's college (established as an academy in 1843), both Roman Catholic institutions, the University of Dubuque (Presbyterian), the outgrowth

of a school started in 1852 by a Presbyterian minister. Known especially as a German theological seminary from 1864 to 1905, and organized as a university in 1920 and Wartburg seminary. (Lutheran). Twelve miles southwest of the city is a monastery of Trappist monks. Dubuque is the oldest town of Iowa, and until after the Civil War was the largest. In 1838 Julien Dubuque (1765-1820) settled there, attracted by the lead deposits, which were crudely worked by the Sac and Fox Indians, and which he mined until his death. In June 1819, miners from Galesburg attempted to make a settlement, in direct violation of treaties with the Indians, but were driven away by U.S. troops, under orders from Col Zachary Taylor. White settlers began to come in immediately after the Black Hawk War. A town was laid out under authority of an act of congress (approved July 2, 1836) and in 1841 it was incorporated.

DU CAMP, MAXIME (1822-1894), French writer, was born in Paris. Between 1841 and 1845, and again, in company with Gustave Flaubert, between 1849 and 1851, he traveled in Europe, and the East, and made excellent use of his experiences in books published after his return. In 1851 he was one of the founders of the *Revue de Paris* (suppressed in 1858), and he was a frequent contributor to the *Revue des deux mondes*. He served as a volunteer with Garibaldi in 1860, and gave a vivid account of his experiences in his *Expédition des deux Siciles* (1867). Du Camp's *Souvenirs littéraires* (2 vols., 1882-83) contain much information about contemporary writers, especially Gustave Flaubert, of whom he was an early and intimate friend. Du Camp was one of the earliest amateur photographers, and his many books of travel were among the first photographically illustrated.

DU CANGE, CHARLES DU FRESNE, SIEUX (1610-1688), one of the lay members of the great 17th century group of French critics and scholars who laid the foundations of modern historical criticism, was born at Amiens on Dec. 18, 1610. He was educated at the Jesuits' college at Amiens, studied law at Orleans, and afterwards went to Paris, where in 1651 he was received as an advocate before the *parlement*. He had no success at the bar, and soon returned to his native city, where he married and settled. In 1647 he purchased the office of treasurer from his father-in-law. Forced to leave Amiens in 1669 in consequence of a plague, he settled in Paris, where he died Oct. 23, 1688. Of his numerous works the most important are the *Glossarium ad scriptores mediae et infimae latinitatis* (Paris, 1678), and the *Glossarium ad scriptores mediae et infimae graecitatis* (Lyons, 1685), which are indispensable aids to the student of the history and literature of the middle ages.

Du Cange studied the history of the later Roman empire, and wrote *Historia Byzantina duplex commentario illustrata* (Paris 1680), and an introduction to his edition and translation into modern French of Geoffrey de Villehardouin's *Histoire de l'empire de Constantinople sous les empereurs français* (1657). He also brought out editions (1670 and 1686) of the Byzantine historians, John Cinnamus and John Zonaras. His autograph manuscripts in addition to his large and valuable library passed through the hands of many persons before the French Government secured the greater portion of the manuscripts, which were preserved in the imperial library in Paris. Some of these were subsequently published, and the manuscripts are now found in various libraries.

To the three original volumes of the Latin *Glossarium*, three supplementary volumes were added by the Benedictines of St. Maur (Paris, 1733-50), and a further addition of four volumes (1766) by the Benedictine, Pierre Carpentier (1697-1767). There were other editions, and an abridgment with some corrections was brought out by J. C. Adelung (Halle, 1772-84). The edition in seven volumes edited by G. A. Henrichs (Paris, 1840-50) includes these supplements and also further additions by the editor, and this has been improved and published in ten volumes by Léopold Favre (Nîort, 1893-87). An edition of the Greek *Glossarium* was published at Breslau in 1889.

See H. Hardouin, *Essai sur la vie et sur les ouvrages de Ducange* (Amiens, 1849), and L. J. Feugère, in the *Journal de l'instruction publique* (1855).

DUCANGE, VICTOR HENRI JOSEPH BRAHAIN (1783-1833), French novelist and dramatist, was born on Nov. 24, 1783, at The Hague, where his father was secretary to the French embassy. Dismissed from the civil service at the Restoration, Victor Ducange became one of the favorite authors of the

liberal party, and owed some part of his popularity to the fact that he was fined and imprisoned more than once for his outspokenness. He was twice imprisoned for seditious articles in his journal *Le Diable rose*, ou *le petit courrier de Lucifer* (1822), after the publication of *Thelene ou l'amour et la guerre* (1823), he took refuge in Belgium. Durange wrote numerous plays and melodramas including *Marco Loricé, ou le petit Chouan de 1830* (1832), and *Trente ans, ou la vie d'un joueur* (1837). Many of his books were prohibited, ostensibly for their coarseness, but perhaps rather for their political tendencies. He died in Paris on Oct. 15, 1833.

DUCAS, DUKAS, or DOUKAS, the name of a Byzantine family which supplied several rulers to the Eastern Empire. The family first came into prominence during the 9th century, and was ruled when Constantine Dukas, a son of the general Andronikos Dukas, lost his life in his effort to obtain the imperial crown in 913. Towards the end of the 10th century there appeared another family of Ducas, which was perhaps connected with the earlier family through the female line. A member of this family became emperor as Constantine X. in 1059, and Constantine's son Michael VII. ruled nominally in conjunction with his younger brothers, Andronikos and Constantine, from 1071 to 1078. Michael left a son, Constantine, who married into the family, which was also allied by marriage with other great Byzantine houses, and its members continued to take an active part in public affairs. In 1204 Alexius Dukas, called Mourzoule, deposed the emperor Isaac Angelus and his son Alexius, and vainly tried to defend Constantinople against the attacks of the Latin crusaders. Nearly a century and a half later one Michael Dukas took a leading part in the civil war between the emperors John V. Palaeologus and John VI. Cantacuzenus, and Michael's grandson was the historian Dukas (see below). Many of the petty sovereigns who arose after the destruction of the Eastern empire sought to gain prestige by adding the famous name of Ducas to their own.

DUCAS (15th cent.), Byzantine historian, flourished under Constantine XIII. (XI) Dragases, the last emperor of the East, about 1450. The dates of his birth and death are unknown. He was the grandson of Michael Dukas (see above). After the fall of Constantinople, he was employed in various diplomatic missions by Doro and Domenico Gattelus, princes of Lesbos, where he had taken refuge. He survived the annexation of Lesbos in 1462, but no more is known of him. He was the author of a history of the period 1341-1462. Although baroque in style, it is both judicious and trustworthy, and it is the most valuable source for the closing years of the Greek empire and the capture of Constantinople. Ducas was a strong supporter of the union of the Greek and Latin churches, and is very bitter against those who rejected even the idea of appealing to the West for assistance against the Turks.

The history, preserved (without a title) in a single Paris MS, was first edited by I. Bullialdus (Bulliaud) (Paris, 1649), later editions are in the *Bonn Corpus scriptorum Hist. Byz.*, by I. Bekker (1834) and Mugge, *Patriologia Graeca*, civil. The Bonn edition contains a 15th century Italian translation by an unknown author, found by L. Ranke in one of the libraries of Venice, and sent by him to Bekker.

DUCASSE, PIERRE EMMANUEL ALBERT, Baron (1813-1893), French historian, was born at Bourges on Nov. 16, 1813. In 1849 he became aide-de-camp to Prince Jerome Bonaparte, ex king of Westphalia, then governor of the Invalides. He was attached to Jerome's son, Prince Napoleon, during the Crimean War. He was employed by Prince Napoleon on the *Correspondance* of Napoleon I, and afterwards published certain letters, purposely omitted there, in the *Revue historique*. These documents, subsequently collected in *Les Rois frères de Napoléon* (1883), as well as the *Journal de la reine Catherine de Westphalie* (1893), were edited with little care and are not entirely trustworthy, but their publication threw much light on Napoleon I and his entourage. Ducasse was also employed by Jerome Bonaparte and his son in the compilation of historical accounts of the affairs in which they were concerned.

DUCAT (dōk'at), a coin, generally of gold, and of varying value, formerly in use in many European countries. It was first struck by Roger II. of Sicily as duke of Apulia, and bore an

inscription "Sit tibi, Christe, datus, quem tu regis, iste ducatus" (Lord, thou rub'st thus ducato to thee by it dedicated), hence, it is said, the name. Between 1280 and 1284 Venice also struck a gold coin, known first as the ducat, afterwards as the zecchino or sequin, the ducat becoming merely a money of account. The ducat was also current in Holland, Austria, the Netherlands, Spain and Denmark (cf. MONEY, MEDIEVAL). A gold coin termed a ducat was current in Hanover during the reigns of George I. and George III. A pattern gold coin was also struck by the English mint in 1287 for a proposed decimal coinage. On the reverse was the inscription 'one ducat' within an oak wreath, above "one hundred pence," and below the date between two small roses.

DUCCIO DI BUONINSEGNA (c. 1255-1319), Italian painter of the Sienese School. His father's name was Buoninsegna. We learn some facts regarding Duccio's work from the records of the exchequer of the city of Siena (*Livro d'entrata e uscita de la Biccherna*). In 1278 he was employed as a painter by the commune to decorate *cartoni* in which public documents were kept. From 1285 to 1295 he received five commissions to decorate book covers of the Biccherna. He seems therefore to have been a craftsman at the beginning of his career, and his work on book covers may have brought him in touch with Byzantine illuminations.

According to a document in the state archives at Florence (Milanesi, *Documenti* etc., vol. 1, pp. 158-160) he was asked in 1285 to paint a large Madonna for the church of Sta. Maria Novella at Florence. This picture has been identified with the celebrated Ruccellai Madonna, long regarded as the work of Cimabue. In 1295 Duccio was consulted as to the site of the Fonte Nova, a Gothic fountain outside the Porta Oile of Siena, showing that his knowledge was not confined to painting. In 1302 he was paid for a "Madonna enthroned" in the Palazzo Pubblico of Siena, a picture now lost. In 1308 he began work on the great altarpiece for the Siena cathedral, which he undertook to carry out with his own hand. When the work was completed on June 9, 1311, a public holiday was proclaimed, and amid the rejoicing crowds the picture was carried in procession to the cathedral, accompanied by the principal men of the city, and placed over the high altar underneath the cupola. This was the climax of Duccio's career. He died eight years later, on Aug. 3, 1319. His great masterpiece is now preserved in the Opera del Duomo (Cathedral Museum). It adorned a double altar and was painted on both sides. The front represents the "Majestas," the Virgin Enthroned surrounded by angels and saints. The back is made up of small panels representing the life of Christ. Below was a predella, also made up of small panels. Several of these small pictures have been found their way to England. Three are in the National Gallery, London. The four of the Benson Collection were acquired by Duveen, and one of these is now in the Frick Collection, New York. The altarpiece is the one fully authenticated work of the master extant, and represents his later style. The following works are attributed to Duccio for stylistic reasons. To his early period belong, besides the Ruccellai Madonna mentioned above, three smaller pictures: the little Madonna with three Ircinicans in the Siena Gallery; the Madonna from Count Stroganoff's Collection; and the triptych in the National Gallery representing the Madonna and two saints. These paintings adhere closely to the Byzantine type. In the National Gallery triptych, however, a new influence makes itself felt. Here the gesture of childlike love contrasting with the aid expression in the mother's face is an innovation in Byzantine as well as in Italian art, and marks the direction in which Duccio was to develop. A triptych representing "the Crucifixion" in Buckingham Palace is ascribed to the master's second period. A very fine example of the artist's later period is the Crucifixion in Lord Crawford's collection; this work is contemporary with the altarpiece in the Opera del Duomo. When comparing his later work with his early work, we find a marked advance in the expression of emotion. The figures are inspired with virile energy. Moreover, Gothic features are introduced in the architecture and in the rendering of drapery, trees and animals. Nevertheless the Byzantine formulae are closely adhered to as regards the composition of figures. The harmoniously coloured shapes are arranged in an ex-

pressive, two dimensioned design, contrasting with the plastic conception of form in the work of Giotto, his younger contemporary. We do not know where Duccio learned his art. Both Vasari and Ghiberti agree that he painted in the "Manneri greci," and it is thought that he may have derived his training directly from Byzantine sources. He may have aimed at a revival of Byzantine painting at a time when the art of Central Italy was hopelessly degenerated. Though his influence was felt in the general development of Sienese art, he had but one or two direct followers. Segna di Buonaventura and Ugolino da Siena. Meanwhile Giotto carried the whole of Italy with him. Duccio may therefore be called the last and greatest representative of the Byzantine tradition.

See A. Lami, "Notizie di Duccio Pittore" in the *Bullettino Senese di Storia Patria* (Siena, 1808); J. P. Richter, *Lectures on the National Gallery* (1898); T.ington Douglas, *History of Siena* (1902); J. A. Crowe and G. B. Cavalcaselle, *History of Painting in Italy*, ed. 1. Douglas (2nd ed., 1903-14); C. H. Weylitz, *Duccio di Buoninsegna* (1911). (I. A. R.)

DU CHAILL, PAUL BELLONI (1835-1903), traveller and anthropologist, was born, probably in Paris, on July 31, 1835. In his youth he accompanied his father, who was in the African trade, to the west coast of Africa. In 1855 he settled in America, and was commissioned by the Academy of Natural Sciences at Philadelphia to explore the delta of the Ogowe river and the country of the Gabon. During his travels he saw numbers of the anthropoid apes, then known to scientists only by a few skeletons. A subsequent expedition, from 1863 to 1866, enabled him to confirm the accounts given by the ancients of a pygmy people inhabiting the African forests. His *Explorations and Adventures in Equatorial Africa* (1861) and *A Journey to Ashango Land* (1867) excited much controversy. Du Chaillu's later works are concerned with travel in Sweden and Lapland. He died on April 20, 1903, at St. Petersburg (Leningrad).

DUCHCOV or **DUX**, a town of Bohemia situated in the fertile Eger valley near the centre of the Bruck Teplitz lignite field. It has flourishing glass and ceramic industries using local raw materials. Pop. (1930) 12,877. 50% German.

DUCHESNE, GUILLAUME BENJAMIN AMAND (1806-1875), French physician, was born on Sept. 17, 1806, at Boulogne, the son of a sea captain. He was educated at Douai and then studied medicine in Paris until 1831, when he returned to his native town to practise his profession. Two years later he first tried the effect of electro-puncture of the muscles on a patient under his care, and from this time on devoted himself to electro-physiology and neurology, thereby laying the foundation of the modern science of electrotherapeutics. In 1842 he removed to Paris where he worked until his death. His greatest work, *L'Électrisation localisée* (1855), passed through three editions during his lifetime, though by many his *Physiologie des mouvements* (1867) is considered his masterpiece. He published over 50 volumes containing his researches on muscular and nervous diseases, and on the applications of electricity both for diagnostic purposes and for treatment. His name is especially connected with the first description of locomotor ataxia, progressive muscular atrophy, pseudo-hypertrophic paralysis, glosso labio laryngeal paralysis, and other nervous troubles. He died in Paris on Sept. 17, 1875.

For a detailed life see *Archives générales de médecine* (Dec. 1875), and for a list of his works the 3rd ed. of *L'Électrisation localisée* (1872).

DUCHESE (Latinized DUCHYNUS, QUERNEUS, or QUEREFANUS), **ANDRÉ** (1584-1640), French geographer and historian, generally styled the father of French history. Through the influence of Richelieu, he was appointed historiographer and geographer to the king. He died in Paris on May 30, 1640. Duchesne left behind him more than 100 folio volumes of manuscript extracts now preserved in the Bibliothèque Nationale (L. Delisle, *Le Cabinet des manuscrits de la Bibliothèque impériale*, t. L., 333-334). Several of his larger works were continued by his only son François du Chesne (1616-93), who succeeded him in the office of his topographer to the king. The principal works of André Duchesne are *Historiae Normannorum scriptores antiqui* (1619, now the only source for some of the texts), and his *Historiae Francorum*

scriptores (5 vols 1636-49). This last was intended to comprise 24 volumes and to contain all the narrative sources for French history in the middle ages, only two volumes were published by the author, his son François published three more, and the work remained unfinished. Ducesne's other works include *Les antiquités des rois de France* (1609), *Les antiquités de toute la France* (1609), *Histoires des Papes jusqu'à Paul V* (1619).

DUCESNE, LOUIS MARIE OLIVIER (1843-1922), French scholar and ecclesiastic, was born at St Servan, Brittany, on Sept. 13, 1843. He was educated at the seminary of St Briac and at Rome and was ordained priest in 1867. In 1874 he went on a scientific expedition to Mt Athos and in 1876 to Asia Minor, but his interest in the history of the Western Church appeared in 1877 when he received the degree of *docteur ès lettres* with two remarkable theses, a dissertation *De Macario magne*, and an *Étude sur le Liber pontificalis*, an acute critical study of the origin and editions of that celebrated chronicle. Immediately afterwards he was appointed professor at the Catholic Institute in Paris, and for eight years presented the example, then rare in France, of a priest teaching church history according to the rules of scientific criticism. His course, bold even to the point of rashness in the eyes of the traditionalists, was at length suspended. In Nov. 1885 he was appointed lecturer at the École Pratique des Hautes Études. In 1886 he published vol. 1 of his learned edition of the *Liber pontificalis* (completed in 1892 by vol. II). In 1888 he was elected member of the Académie des Inscriptions et Belles Lettres, and was afterwards appointed director of the French school of archaeology at Rome. Much light is thrown upon the Christian origins, especially those of France, by his *Origines du culte chrétien, étude sur la liturgie latine avant Charlemagne* (1889, Eng. trans. by M. L. McClure, *Christian Worship its Origin and Evolution*, London, 5th ed. 1919), *Mémoire sur l'origine des diocèses épiscopaux dans l'ancienne Gaule* (1890), the preliminary sketch of a more detailed work, *Pastes épiscopaux dans l'ancienne Gaule* (1894-99), and *Catalogues épiscopaux de la province de Tours* (1895). His *Antonomies ecclésiastiques, églises séparées* (1897, Eng. trans. by H. H. Mather, 1907), in which he speaks of the origin of the Anglican Church, but treats especially of the origin of the Greek Churches of the East, was received with scant favour in certain narrow circles of the pontifical court. In the *Histoire ancienne de l'église*, 4th ed. (1908, Eng. trans. by C. Jenkins, 1909-24) Ducesne touches cleverly upon the most delicate problems, and without any elaborate display of erudition, presents notable conclusions. *L'Église au VI^e siècle* was published posthumously in 1925. His incisive style, his fearless and often ruthless criticism, and his wide and penetrating erudition, make him a redoubtable adversary in the field of polemic. The *Bulletin critique*, a review of history, philology and theology, founded by him in 1850, has contributed powerfully to spread the principles of the historical method among the French clergy.

Ducesne received an honorary Litt D from Cambridge and D Litt from Oxford, and in 1910 was elected to the French Academy. He died on April 21, 1922.

See C. D. Haploville, *Grandes Figures de l'Église contemporaine—M^{gr} Ducesne* (1925).

DUCIS, JEAN FRANÇOIS (1733-1816), French dramatist and adapter of Shakespeare, succeeded to the fustian of Voltaire at the Academy in 1779. His father, originally from Savoy, was a linen-draper at Versailles. In 1768 he produced his first tragedy, *Amélie*. The failure of this first attempt was compensated by the success of his Shakespearean adaptations *Hamlet* (1769), *Roméo et Juliette* (1772), *Le Roi Lear* (1783), *Macbeth* (1783), and *Othello* (1792), which last, supported by the acting of Talma, obtained immense applause. Though actuated by honest admiration of the great English dramatist, Ducis is not Shakespearean. His ignorance of the English language left him at the mercy of the translations of Pierre Letourneur (1762-88) and of Pierre du la Place (1707-93), and even this modified Shakespeare had still to undergo a process of purification and correction before he could be presented to the fastidious criticism of French taste. He did not pretend to reproduce, but to excerpt and re-

fashion, and consequently the French play sometimes differs from its English namesake in everything almost but the name. The plot is different, the characters are different, the motifs different, and the scenic arrangement different. To *Othello*, for instance, he wrote two endings. In one of them Othello was enlightened in time and Desdemona escaped her tragic fate. Of his original works the best were *Odyse chez Admète* (1778), and *Abufar* (1795).

An edition of his works in three volumes appeared in 1813, *Oeuvres posthumes* were edited by Campenon in 1826, and *Hamlet, Odyse chez Admète, Macbeth* and *Abufar* are reprinted in vol. II of Didot's *Œuvres tragiques*. See Omelette Lacroix, *Étude sur la personne et les écrits de Ducis* (1852) based on Ducis own memoirs preserved in the library at Versailles, *Saint-Buve Censures du lundi*, t. VI, and *Nouveaux lundis*, t. IV, Villenave *Tableau de la littérature au XVIII^e siècle*.

DUCK, the English name for birds forming six of the ten subfamilies of the family Anatidae. Technically, duck is restricted to the female, the male being called "drake," and, in one species, "mallard."

Ducks comprise (1) the Anatine or fresh water ducks, (2) the Nyrocanine or diving ducks or sea ducks (see EIDER, GOLDEN EYE, POCHARD, SCAUP, SCOTER), (3) the Oxyurine or spiny-tailed ducks, (4) the Merganetinae or torrent ducks, (5) the Merginae or merganser (q.v.), (6) the Dendrocygninae or long-legged tropical tree ducks.

The Anatinae are the typical group and the only ones here considered. The mallard (*Anas platyrhynchos*) is the most plentiful and best known species, and is the origin of the domestic breeds of Europe and the USA. It inhabits the northern hemisphere, reaching Panamá, Egypt and N.W. India in winter, and the Arctic circle in summer. The nest may be on the ground or in a hole in a tree, 9 to 11 pale green eggs are laid on a lining of down which the mother pulls from her breast. As soon as the young hatch out, the mother takes them to the nearest piece of water. The male may guard the nest before hatching, but takes no interest in the brood and, indeed, is incapable of rendering active assistance by reason of an additional moult that deprives him of power of flight until the autumn. In hard weather, the ducks resort to tidal waters. For the domestic breeds of duck see POULTRY AND POULTRY FARMING. It is an interesting point that, whereas the male wild duck is monogamous, the domesticated drake is polygamous.

About 75 species of Anatinae are distributed throughout the world, some confined to small oceanic islands. Males are usually colourful, females duller, but both are dull in some like the American black duck (*A. rubripes*). Close to mallards are the pintail and the garganey (q.v.) and related teals (q.v.). Allied genera include shovellers (q.v.), gadwall (q.v.), widgeons (q.v.), shelldrakes (q.v.), the gorgeous Asiatic Mandarin (*Dendrocygna galericulata*) and North American wood duck (*A. sponsa*) and musk duck (*Cairina*).

DUCK, a plain fabric, made originally from tow yarns. The cloth is lighter than canvas or sailcloth, and differs from these in that it is almost invariably single in both warp and weft. The term is also used to indicate the colour obtained at a certain stage in the bleaching of flax yarns, it is a colour between half-white and cream. Most of the flax ducks (low yarns) appear in this colour, although quantities are bleached or dyed. Some of the ducks are made from long flax, dyed black, and used for kitbags, while the dyed tow ducks may be used for inferior purposes. The fabric, in its various qualities and colours, is used for an enormous variety of purposes, including tents, wagon and motor hoods, light sails, clothing workmen's overalls, bicycle tubes, mail and other bags and pocketings. *Russian duck* is a fine white linen canvas. The term is probably derived from the Dutch *doek*, a coarse linen material.

DUCKING AND CUCKING STOOLS, chairs used for the punishment of scolds, witches and prostitutes in bygone days. The two have been confused, but are distinct. The earlier, the cucking stool or stool of repentance, is of very ancient date, and was used by the Saxons, who called it the *Scalding or Scolding Stool*. Seated on this stool the woman, her head and feet bare, was publicly exposed at her door or paraded through the streets amidst the jeers of the crowd. The cucking stool was used for

both sexes, and was specially the punishment for dishonest brewers and bakers. The earliest record of the use of the ducking stool is towards the beginning of the 17th century. It was a strongly made wooden armchair in which the culprit was seated, an iron band being placed around her so that she should not fall out during her immersion. The chair was fastened to a long wooden beam fixed as a sloop on the edge of a pond or river. Sometimes, however, the ducking stool was not a fixture, but was mounted on a pair of wooden wheels so that it could be wheeled through the streets. In sentencing a woman the magistrates ordered the number of duckings she should have. Yet another type of ducking stool was a chair on two wheels with two long shafts fixed to the axles. This was pushed into the pond and the shafts released thus tipping the chair up backwards. Ducking stools were used in England as late as the beginning of the 19th century.

See W. Andrews, *Old Time Punishments* (Hull, 1890), A. M. Earle, *Curious Punishments of Bygone Days* (Chicago, 1896), W. C. Hazlett, *Faiths and Folklore* (London, 1905), Llewellyn Jewitt in *The Reliquary*, vols. 1 and 2 (1860-62), *Gentleman's Magazine* for 1732.

DUCKWEED, the common botanical name for species of *Lemna* (family Lemnaceae) which water ponds and ditches. The plants are extremely simple in structure and are the smallest and least differentiated of flowering plants. They consist of a so-called "frond"—a flattened green more or less oval structure which emits branches similar to itself from lateral pockets at or near the base. From the under surface a root with a well developed sheath grows downwards into the water. The flowers which are rarely found in Britain, are developed in one of the lateral pockets. The inflorescence is very simple, consisting of one or two male flowers each comprising a single stamen, and a female flower comprising a flask-shaped pistil. The family to which they belong is regarded as representing a very reduced type perhaps allied to the Aroids.

Besides *Lemna*, other genera representative of the family are *Spirodela*, with several roots, and *Wolffia* and *Wolffiella*, with no roots. In Great Britain three species of *Lemna* occur, the lesser duckweed (*L. minor*), the gibbous duckweed (*L. gibba*), and the ivy leaved duckweed (*L. trisulcata*), the greater duckweed (*Spirodela polyrrhiza*) is also found. All the foregoing are distributed widely throughout the world. In Great Britain the family is further represented by *Wolffia arrhiza*, in which the rootless fronds are only $\frac{1}{16}$ in long, it is the smallest of British flowering plants. In North America eight duckweeds occur, including all those found in Great Britain, there are also three species each of *Wolffia* and *Wolffiella*. *Wolffia punctata*, with fronds only $\frac{1}{16}$ in to $\frac{1}{8}$ in long, is one of the most minute of all flowering plants.

DUCKWORTH, SIR JOHN THOMAS (1748-1817), British admiral, was born at Leatherhead, Surrey, on Feb. 28, 1748, and entered the navy in 1759. He served in the three days' naval engagement in which the British fleet was defeated (June 1, 1794), and received a gold medal and the thanks of parliament. In March 1801 he was the naval commander of the combined force which reduced the islands of St. Bartholomew and St. Martin, a service for which he was rewarded with the Order

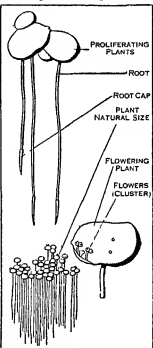
of the Bath and a pension of £1,000 a year. Promoted to be vice admiral of the blue, he was appointed in 1804 to the Jamaica station. Two years later, while cruising off Cadiz with Lord Collingwood, he was detached with his squadron to pursue a French fleet that had been sent to the relief of Santo Domingo. He came up with the enemy on Feb. 6, 1806, and, after two hours' fighting, inflicted a signal defeat, capturing three of their five vessels and stranding the other two. In 1807 he was again sent to the Mediterranean to watch the movements of the Turks. In command of the "Royal George" he forced the passage of the Dardanelles, but sustained considerable loss on his return. In 1815 he was appointed to the chief command at Plymouth, which he held until his death on April 14, 1817.

See *Naval Chronicle*, xviii, Ralle's *Naval Biography*, ii.
DUCLAUX, AGNES MARY FRANCES (1857-), English poet and critic (née Robinson), was born at Leamington on Feb. 27, 1857. In 1888 she married James Darmesteter (q.v.), and in 1901, after his death, Emily Duclaux, director of the Pasteur Institute. She published several volumes of poetry, including *A Handful of Honeysuckle* (1878), *The New Arcadia and other Poems* (1884), *An Italian Garden* (1886), *Collected Poems, Lyrica and Narrative* (1902), and *The Return to Nature, Songs and Symbols* (1904).

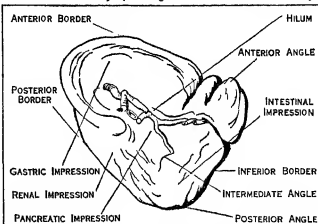
Mrs. Duclaux's best known prose works are a monograph on Emily Brontë (1893), *The Life of Ernest Renan* (1897), *The End of the Middle Ages* (1888), "Froussart" (1894) in the *Grands écrivains français*, *Le Duc de Nemours* (1907), *Midi de Sévigné* (1914), *La Princesse de Robert Browning* (1922) and *A Portrait of Pascal* (1927).

DUCOS, PIERRE ROGER (1747-1816), French politician, was born at Bay. Despite his lack of ability, he ascended the highest rungs of the political ladder from the day when he became member of the council of the Five Hundred, serving successively as a director, consul and vice president of the Senate. He abandoned Napoleon in 1814, but was himself exiled in 1816. He died at Ulm in March 1816.

DUCTLESS GLANDS, in anatomy, glands in the body having no ducts or canals for conveying away their products, which, known as internal secretions, pass directly into the veins or lymphatics. Among these structures are the *spleen*, *adrenals*, *thyroid gland*, *parathyroids*, *thymus* and the *carotid and occipital bodies*. In addition lymphatic glands are described under lymph.



DUCKWEED (*LEMNA MINOR*) OR DUCK MEAT SHOWING THE FLAT BLADE LIKE FROND AND FLOWER WHICH FLOAT ON THE WATER ALLOWING THE ROOTS TO HANG LOOSELY.



FROM CUNNINGHAM. TEXTBOOK OF ANATOMY. BY PERMISSION OF OXFORD MEDICAL PUBLICATIONS.

FIG. 1—THE SPLEEN. VISCERAL ASPECT.

phatic system (q.v.), and pineal and pituitary bodies under brain (q.v.).

THE SPLEEN

The human *spleen* is an oval, flattened gland, of a dull purple colour, and about 5 in. long by three broad, situated in the upper and back part of the left side of the abdominal cavity. The external surface is convex to adapt it to the concavity of the diaphragm, against the posterior part of which it lies, external to the diaphragm is the pleural cavity, and more externally still, the ninth, tenth and eleventh ribs. The internal surface is divided by

a prominent ridge into a gastric or anterior and a renal or posterior surface. Probably, the shape of the spleen varies somewhat from time to time. The gastric surface is concave to fit the fundus of the stomach, while just in front of the ridge separating the gastric and renal surface is the hilum, where the vessels enter and leave the organ. The renal surface is moulded on to the upper part of the outer border of the left kidney and just reaches the left adrenal body. The borders of the spleen usually show two or more notches. The whole spleen is surrounded by peritoneum, which is reflected off on to the stomach and the kidney. Small accessory spleens are fairly often found in the neighbourhood, though, possibly, some of these may be true lymph glands (see LYMPHATIC SYSTEM).

Microscopically the spleen has a fibro-elastic coat in which involuntary muscle is found (fig. 2). This coat sends fine trabeculae into the organ subdividing it into minute compartments, in which the red highly vascular, spleen pulp is contained. This pulp contains small spherical masses of adenoid tissue (Malpighian corpuscles), situated on the terminal branches of the splenic blood vessels, numerous red blood corpuscles, lymphocytes and endothelial cells, the last often containing pigment granules or fat. The arteries in large part open into spaces, which give origin to the veins.

Embryology—The spleen is developed in the dorsal mesogastrium (see CUTANEOUS AND SEROUS MEMBRANES) from the mesenchyme, or (most portion of the mesoderm) the cells of which lie scattered in a matrix. Large lymphoid cells are early seen among those of the mesenchyme, probably being derived from the coelomic epithelium. The network of the spleen seems certainly to be derived from cells of the mesenchyme which lose their nuclei.

Comparative Anatomy—The spleen is regarded as the remains of a mass of lymphoid tissue which, in a generalized type of vertebrate, stretched all along the alimentary canal. It is absent as a distinct gland in the Arthropoda and Cyclostomata. In the fishes it is closely applied to the U-shaped stomach, and in some of the Elasmobranchs, e.g., the basking and porbeagle sharks it is divided into small lobules. In Protostomes (Dipnoi) it is enclosed within the walls of the stomach. In frogs and toads (Amphibia) it is a spherical mass close to the rectum, and is derived from a different part of the original mass, already mentioned to that which persists in other vertebrates. In the Igurina (Reptilia) the organ has many notches, each corresponding to the point of entrance of a vessel. In mammals the notches when present also frequently correspond to the points of entrance of arteries at the hilum. The Monotremata and Marsupialia have curious Y-shaped spleens. As a rule flesh-eating animals have larger and more notched spleens than vegetable feeders, though among the Cetacea the spleen is relatively very small.

ADRENAL GLANDS

The adrenal glands or suprarenal capsules are two conical bodies, flattened from before backward, resting on the upper poles of the kidneys close to the sides of the vertebral column, each has a concave base which is in contact with the kidney. On the anterior surface is a transverse sulcus or hilum from which a large vein emerges. The arteries are less constant in their points of entry. The glands are entirely retroperitoneal. In a vertical transverse section each gland is seen to consist of two parts, cortical (yellow) and medullary (red). The cortical substance is composed of columns of cells, separated by a stroma. The medullary part consists of small islets of cells, which resemble columnar epithelium lying among venous sinuses, these cells are in close connection with the sympathetic nerve filaments from the great splanchnic plexus.

Embryology—The generally accepted view is that the cortical substance is derived from the coelomic epithelium covering the mesoderm of the upper (cephalic) portion of the Wolffian body and corresponds to the nephrostomes of mesonephridial tubules (see URINARY SYSTEM), while the medullary part grows out from the sympathetic ganglia and so is probably ectodermal in origin. In the early human embryo the adrenals are larger than the kidneys and at birth they are proportionately much larger than in the adult.

Comparative Anatomy—Adrenals are unknown in Amphioxus and the Dipnoi. In the Cyclostomata (hags and lampreys) they are said by some to arise in connection with the cephalic part of the pronephros, though other writers deny their presence altogether. In the Elasmobranchs and Holocephali the medullary and cortical parts are apparently distinct, the former being represented by a series of organs situated close to the intercostal arteries, while the latter may be either median or paired, and, be

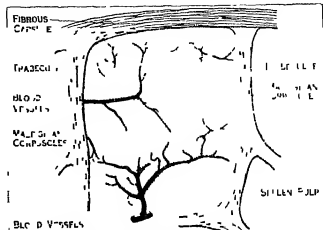


FIG. 2—SECTION OF SPLEEN UNDER LOW MAGNIFICATION SHOWING FIBRO-ELASTIC COVERING, BLOOD VESSELS AND VARIOUS CORPUSCLES.

ing placed between the kidneys, are often spoken of as interrenal. In the Amphibia the glands are sunk into the surface of the kidney. In reptiles and birds they are long lobulated bodies lying close to the testis or ovary. In the lower mammals they are not as closely connected with the kidney as they are in man, and their shape is usually oval or spherical.

THE THYROID GLAND

The thyroid body or gland is a deep red glandular mass consisting of two lobes which lie on each side of the upper part of the trachea and lower part of the larynx, these are joined across the middle line by the isthmus which lies in front of the second and third rings of the trachea. The gland is relatively larger in women and children than in men. It is enclosed in a capsule of cervical fascia and is supplied by the superior and inferior thyroid arteries. Microscopically, the gland consists of closed tubular alveoli filled with colloid material, and lined by cuboidal epithelial cells supported by a basement membrane. The lymphatic vessels are large and numerous, and contain the same colloid as the alveoli. Accessory thyroids close to the main gland, are often found.

Embryology—The median part of the gland is developed from the thyroglossal duct which grows down in the middle line from the junction of the buccal and pharyngeal parts of the tongue (q.v.), between the first and second branchial arches. The development of the hyoid bone obliterates the middle part of the duct, leaving its upper part as the foramen caecum of the tongue, while its lower part bifurcates. The lateral parts of the gland are developed from the endoderm of the fourth visceral clefts, and, joining the median part, lose their pharyngeal connection.

Comparative Anatomy—The undistyle, or hypobranchial groove of Tunicata and Acrania is regarded as the first appearance of the median thyroid, this is a median endodermal groove in the floor of the pharynx, secreting a glairy fluid in which food particles become entangled and so pass into the intestine. In the larval lamprey the connection with the pharynx is present, but in the adult as in all adult vertebrates, this connection is lost. In Elasmobranchs the single median thyroid lies close to the mandibular pharynx, but in Teleostei it is paired. In Dipnoi there is also an indication of a division into two lobes. In Amphibia the thyroid forms numerous vesicles close to the anterior end of the pericardium. In Reptilia it lies close to the trachea, and in Chelonians and Crocodilia is paired. In birds it is also paired and lies near the origin of the carotid arteries. In Mammalia the lateral

lobes make their first appearance. In the lower orders of this class the isthmus is often absent.

PARATHYROID GLANDS

These little ovoid bodies are, two on each side. The upper pair is embedded in the thyroid at the level of the lower border of the cricoid cartilage, while the lower pair may be embedded in the lateral lobes of the thyroid or be below in relation to the inferior thyroid veins. They are often very difficult to find in the adult. Microscopically they consist of solid masses of epithelioid cells with numerous blood vessels, while, embedded in their periphery, are often masses of thymic tissue including the concentric corpuscles of Hassall. They are developed from the endoderm of the third and fourth branchial grooves.

Parathyroids have been found in the orders of Primates, Chiroptera, Carnivora, Ungulata and Rodentia among the Mammalia, and also in birds. In the other classes of vertebrates little is known of them.

THE THYMUS GLAND

The thymus is a light pink gland, consisting of two unequal lobes, which lies in front of the pericardium and great vessels, it also extends up into the root of the neck to within a short distance of the thyroid gland. It continues to grow until the second year of life after which it remains stationary until puberty, when it usually atrophies and is represented by a mass of fat. Each lobe is divided up by areolar tissue, and, microscopically, the lobules consist of a cortical and medullary part. The cortex resembles in structure a lymphatic gland (*see LYMPHATIC SYSTEM*). In the medulla the lymphoid cells are fewer, and nests of epithelial cells are found (concentric corpuscles of Hassall). The vascular supply is derived from all the vessels in the neighbourhood, the lymphatics are very large and numerous, but the nerves, which come from the sympathetic and vagus, are few and small.

Embryology—The thymus is formed from a diverticulum, on each side, from the endoderm lining the third branchial groove, but the connection with the pharynx is soon lost. The lymphoid cells and concentric corpuscles are probably derived from the original cells lining the diverticulum.

Comparative Anatomy—

The thymus is always a paired gland. In most fishes it rises from the dorsal part of all five branchial clefts, in Lepidosteus (Dipnoi), from all except the first, in Urodela from third, fourth and fifth, and in Anura from the second only. In all fishes, including the Dipnoi, it is placed dorsally to the gill arches on each side. In Amphibia it is close to the articulation of the mandible. In Reptilia it lies along the carotid artery, but in young crocodiles it is lobulated and extends all along the neck, as it does in birds lying close to the side of the oesophagus. In mammals the Marsupials are remarkable for having a well developed cervical as well as thoracic thymus. In some of the lower mammals the gland does not disappear as early as it does in man.

CAROTID BODIES

These are two small bodies situated between the origins of the external and internal carotid arteries. Microscopically they are divided into nodules or cell balls by connective tissue, and these closely resemble the structure of the parathyroids, but are without any thymic tissue. The blood-vessels in their interior are large and numerous. It is believed that they are part of the sympathetic system.

COCCYGEAL BODY

This is a median body, the size of a pea, situated in front of the apex of the coccyx and between the insertions of the levatores ani muscles. It resembles the thyroid body in its microscopical structure, but is not so vascular. Concentric corpuscles, like those of the thymus have been recorded in it. Of its embryology and comparative anatomy little is known. Probably it is sympathetic in origin. (For further information *see ENDOCRINOLOGY*.)

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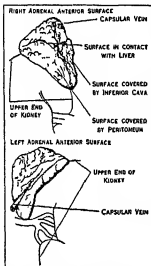
DUDDFLL, WILLIAM DU BOIS (1872–1917), British electrical engineer, was born in 1872. Because of his delicate health Duddell was educated at Cannes and as a child he showed signs of great mechanical ingenuity. He served his apprenticeship as an engineer at Colchester. In 1893, he went to the City and Guilds Institute, where he stayed for some years because of the facilities for experimental work. Later he had an office of his own in Victoria street, London. Duddell showed an extraordinary gift for designing and constructing apparatus. His first and probably his most notable instrument was the Duddell galvanometer or oscillograph (*see INSTRUMENTS, ELECTRICAL*). While carrying out observations on the resistance of the electric arc, the results of which were published in the *Proceedings of the Royal Society* (1901), he discovered the 'singing arc,' which led eventually to the development of the Poulsen arc. In connection with this work he designed and constructed a mechanical high frequency alternator giving 100,000 cycles per sec. Duddell also designed a thermo ammeter (*see INSTRUMENTS, ELECTRICAL*), which he used in his work on radio telegraphy. He was F.R.S. and held office in several learned societies. Duddell died on Nov. 4, 1917.

DUDERSTADT, town, Prussian province of Hanover, Germany, situated in a beautiful and fertile valley (formerly called *Goldene Mark*) watered by the Hahle and on the railway Wulfsen-Lünefelde. Population 6,950. Duderstadt was founded by Henry I. (the Fowler) in 929, passed later to the monastery of Quedlinburg, and then to Brunswick. It was a member of the Hanseatic League, and during the Thirty Years' War became a stronghold of the Imperialists. It was taken by Duke William of Weimar in 1632, in 1761 its walls were dismantled, and it passed finally in 1866 with Hanover to Prussia. It is an interesting mediaeval town with many ancient buildings. There are two beautiful Gothic churches of the 14th century. It makes gloves, hats, paper, cigars and bricks, it has also a trade in singing birds.

DUDEVANT, A. L. A. *see* SAND, GEORGE.

DUDLEY, BARONS AND EARLS OF The holders of these English titles are descended from John de Sutton (c. 1310–59) of Dudley Castle, Staffordshire, who was summoned to parliament as a baron in 1342. Sutton was the son of another John de Sutton, who had inherited Dudley Castle through his marriage with Margaret, sister and heiress of John de Soigny (d. 1321), he was called Lord Dudley, or Lord Sutton of Dudley, the latter being doubtless the correct form. However, his descendants, the Suttons, were often called by the name of Dudley, and from John Dudley of Atherington, Sussex, a younger son of John Sutton, the 5th baron, the earls of Warwick and the earl of Leicester of the Dudley family are descended.

John Sutton or Dudley (c. 1400–87), the 5th baron, was first summoned to parliament in 1440, having been viceroy of Ireland from 1428 to 1430. He died on Sept. 30, 1487. He was succeeded as 6th baron by his grandson Edward (c. 1459–1532), and one of his sons, William Dudley, was bishop of Durham from 1476 until his death in 1483. His descendant Edward Sutton or Dudley, the 9th baron (1567–1641), had several illegitimate sons. Among them was Dud Dudley (1599–1684), who in 1665 published *Metalum Martis*, describing a process of making iron with 'pot-coale, sea coale, etc.' which was put in operation at his father's ironworks at Pensnet, Worcestershire, of which he was manager. During the Civil War he was a colonel in the army of Charles I. Dying without lawful male issue in June 1643, the 9th baron was succeeded in the barony by his grand-daughter, Frances.



FROM CUMBERLAND "TEXTBOOK OF ANATOMY" (OXFORD UNIVERSITY PRESS).

FIG. 3.—RIGHT AND LEFT SUPRARENAL BODIES SHOWING THE ANTERIOR SURFACES.

(1611-97), she married Humble Ward (c. 1614-70), the son of a London goldsmith, who was created Baron Ward of Birmingham in 1644. Their son Edward (1641-1701) succeeded both to the barony of Dudley and to that of Ward but these were separated when his grandson William died unmarried in May 1740. The barony of Dudley passed to a nephew, Ferdinando Dudley Lea, falling into abeyance on his death in Oct. 1757, that of Ward passed to the heir male, John Ward (d. 1774), a descendant of Humble Ward. In 1761 Ward was created Viscount Dudley, and in April 1821 his grandson John William Ward (1781-1831), foreign minister in 1827-28, became the 4th viscount. He was created Viscount Edmunt and earl of Dudley in 1827, and when he died unmarried on March 6, 1835, these titles became extinct. His barony of Ward, however, passed to William Humble Ward (1781-1835), whose son, William (1817-85) was created Viscount Edmunt and earl of Dudley in 1860. The 2nd earl of Dudley in this creation was the latter's son William Humble (b. 1866), who was lord lieutenant of Ireland from 1902 to 1906, and governor general of Australia from 1908 to 1911. He died in 1932.

See H. S. Graebner in *The Herald and Genealogist*, vols. II, v and vi, in *Notes and Queries*, 2nd series, vol. vi, and in vol. ix of the publications of the Wilfrid Salt Society (1888).

DUDLEY, EDMUND (c. 1462-1510), minister of Henry VII of England, was a son of John Dudley of Atherington, Sussex, and a member of the great baronial family of Sutton or Dudley. After studying at Oxford and at Gray's Inn, Dudley came under the notice of Henry VII. He and his colleague Sir Richard Empson (q.v.) are called *faucaltes iudices* by Polydore Vergil, and their extortions made them bitterly hated. Dudley, who was speaker of the House of Commons in 1504, amassed a great amount of wealth for himself, and possessed large estates in Sussex, Dorset and Lincolnshire. When Henry VII died in April 1509, he was thrown into prison by order of Henry VIII and charged with the crime of constructive treason, being found guilty and attainted. He was executed on Aug. 17 or 18, 1510. Dudley's nominal crime was that during the last illness of Henry VII he had ordered his friends to assemble in arms in case the king died, but the real reason for his death was the unpopularity caused by his avarice. During his imprisonment he sought to gain the favour of Henry VIII by writing a treatise in support of absolute monarchy called *The Tree of Commonwealth* (printed privately, in Manchester 1859).

See Francis Bacon, *History of Henry VII* edit. J. R. Lumby (1881), and J. S. Brewer, *The Reign of Henry VIII*, edit. J. Gairdner (1884).

DUDLEY, SIR ROBERT (1573-1649), titular duke of Northumberland and earl of Warwick, English explorer, engineer and author, was the son of Robert Dudley, earl of Leicester (q.v.), the favourite of Queen Elizabeth. His mother was Lady Douglas Sheffield, daughter of Thomas, first Baron Howard of Effingham. Leicester, who deserted Lady Douglas Sheffield for Lettice Knollys, widow of the first earl of Essex, denied that they were married. Her son Robert was born in May 1573, was recognized by Leicester, and sent to Christ Church, Oxford, in 1587. He inherited all Leicester's property under the earl's will at his death in 1588, and in the following year the property of Ambrose Dudley, earl of Warwick. In 1594 he made a voyage to the West Indies, and in 1596 he took part in the expedition to Cadix and was knighted. After the death of Elizabeth he endeavoured to secure recognition of his legitimacy, and of his right to inherit the titles of his father and uncle. The proceedings were quashed by the Star Chamber. In 1605 he obtained leave to travel abroad, and went to Italy accompanied by the beautiful Miss Elizabeth Southwell, daughter of Sir Robert Southwell of Woodrising, in the dress of a page. When ordered to return home and to provide for his deserted wife and family, he refused, was outlawed, and his property was confiscated. On the continent he avowed himself a Roman Catholic, married Elizabeth Southwell at Lyons, and entered the service of Cosimo II, grand duke of Tuscany. He was employed in draining the marshes behind Leghorn, and in the construction of the port. In Italy Dudley was known as Duca di Nortombria and Conte di Warwick. He died near Florence on

Sept. 6, 1649. His deserted wife, Alicia, was created duchess of Dudley by Charles I. in 1644, and died in 1670, when the title became extinct. Dudley's chief claim to remembrance is the magnificent *Arcano del mare* (Florence, 3 vols. 1645-1646 reprinted 2 vols. 1661) a collection of all the naval knowledge of the age, remarkable for a scheme for the construction of a navy in five rates which Dudley designed and described.

See G. L. Craik *Romance of the Peasage* (London, 1848-1850), vol. II. Sir N. H. Nicolas *Report of Proceedings on the Claim to the Barony of Life* (London, 1829), and *The Italian Biography of Sir R. Dudley*, by Doctor Vaughan Thomas.

DUDLEY, THOMAS (1576-1653), British colonial governor of Massachusetts, was born in Northampton, England, in 1576, possibly a member of the elder branch of the family to which Robert Dudley earl of Leicester, belonged. He was the son of a country gentleman of some means and high standing was captain of an English company in the French expedition of 1597, serving under Henry of Navarre, and eventually became the steward of the earl of Lincoln's estates, which he managed with great success for many years. Having been converted to Puritanism, he became an advocate of its strictest tenets. About 1627 he associated himself with other Lincolnshire gentlemen who in 1629 entered into an agreement to settle in New England provided they were allowed to take the charter with them. This proposal the general court of the Plymouth Company agreed to, and in April 1630 Dudley sailed to America in the same ship with John Winthrop, the newly appointed governor. Dudley himself at the last moment being chosen deputy governor in place of John Humphrey (or Humfrey), the earl of Lincoln's son in law, whose departure was delayed. Dudley was for many years the most influential man in the Massachusetts Bay Colony, save Winthrop, with whose policy he was more often opposed than in agreement. He was deputy governor in 1629-34, in 1637-40, in 1646-50 and in 1651-53, and was governor four times, in 1634, 1640, 1645 and 1650. Soon after his arrival in the colony he settled at Newton (Cambridge), of which he was one of the founders, he was also one of the earliest promoters of the plan for the establishment of Harvard college. Winthrop's decision to make Boston the capital instead of Newton precipitated the first of the many quarrels between the two, Dudley's sterner and harsher Puritanism, being in strong contrast to Winthrop's more tolerant and liberal views. He was an earnest and persistent heresy hunter—not only the Antinomians, but even such good Puritan as John Cotton, against whom he brought charges, feeling the weight of his stern and remorseless hand. His position he himself best expressed in the following brief verse found among his papers—

Let men of God in courts and churches watch
O'er such as do a Toleration hatch,
Lest that ill egg bring forth a Cockatrice
To poison all with heresy and vice.

He died at Roxbury, Mass., on July 31, 1653.

See Augustine Jones, *Life and Work of Thomas Dudley, the Second Governor of Massachusetts* (1899), and *The Life of Sir Thomas Dudley, several times Governor of the Colony of Massachusetts*, written as it is supposed by Cotton Mather, edited by Charles Deane (1870). Dudley's interesting and valuable "Letter to the Countess of Lincoln," is reprinted in Alexander Young's *Chronicles of the Planters of the Colony of Massachusetts Bay* (1846), and in the New Hampshire Historical Society Collections, vol. IV (1834), G. K. Kouss, *Thomas Dudley, Governor of Massachusetts* (Boston, 1914).

His son JOSEPH DUDLEY (1647-1720), colonial governor of Massachusetts, was born in Roxbury, Mass., on Sept. 23, 1647. He graduated at Harvard college in 1665, became a member of the general court, and in 1682 was sent by Massachusetts to London to prevent the threatened revocation of her charter by Charles II. There, with an eye to his personal advancement, he secretly advised the king to annul the charter, this was done, and Dudley, by royal appointment, became president of the provisional council. With the advent of the new governor, Sir Edmund Andros, Dudley became a judge of the superior court and censor of the press. Upon the deposition of Andros, Dudley was imprisoned and sent with him to England, but was soon set free. In 1691-92 he was chief-justice of New York, presiding

over the court that condemned Leisler and Milbourn. Returning to England in 1695, he was lieutenant governor of the Isle of Wight and a member of parliament, and in 1700, after a long intrigue, secured from Queen Anne a commission as governor of Massachusetts serving until 1715. His administration was marked particularly in the earlier years, by ceaseless conflict with the general court, from which he demanded a regular fixed salary instead of an annual grant. He was active in raising volunteers for the so-called Queen Anne's War. He was accused by the Boston merchants, who petitioned for his removal, of being in league with smugglers and illicit traders, and in 1708 a bitter attack on his administration was published in London entitled *The Deplorable State of New England by reason of a Covetous and Treacherous Governor and Pusillanimous Counsellors*. His character may be best summed up in the words of one of his successors, Thomas Hutchinson, that 'he had as many virtues as can consist with so great a thirst for honour and power.' He died at Roxbury on April 2, 1720.

See Everett Kimball, *The Public Life of Joseph Dudley* (1911), J. G. Palfrey, *History of New England*, vol. iv (1895), and the *Massachusetts Historical Society, Collections*, series 5, vol. vi (1879).

Joseph Dudley's son, PAUL DUDLEY (1673-1751), graduated at Harvard in 1690, studied law at the Temple in London, and became attorney general of Massachusetts (1702-18). He was associate justice of the superior court of that province from 1718 to 1745, and chief justice from 1745 until his death. He was a member of the Royal Society (London), to whose *Transactions* he contributed several valuable papers on the natural history of New England, and was the founder of the Dudleyian lectures on religion at Harvard.

DUDLEY, market town, county and parliamentary borough, Worcestershire, England, in a portion of that county enclosed in Staffordshire, 8 mi. NW of Birmingham and 12½ mi. NW of London by the L.M.S. Ry., also served by the G.W. Ry. and on the Birmingham and Stourbridge canals. Pop. (1938) 61,600. Area 6 sq. mi. Dudley stands on a ridge in the Black Country, in which are ironworks and coal mines. The 'ten yard' coal, in the neighbourhood, is the thickest seam worked in England. Limestone, for burning, and dolomite, for road metal, are extensively quarried, while iron and brass foundries and engineering and brickworks are the chief industries. The principal buildings are the churches of the six parishes of the town, the council house (1935), the town hall (1928), county court, free libraries, grammar school, girls' school, technical school, teachers' training college, the Guest hospital (founded by Joseph Guest 1868) and a dispensary. The town is noted for the excellent Silurian fossils obtained from the limestone quarries of Dudley Castle and Wren's Nest. To the north of the town, on Dudley Castle hill, are extensive remains of an ancient castle, surrounded by beautiful grounds open to the public. The view from the castle is remarkable. The whole district is seen to be set with chimneys, pit-buildings and factories, and at night the glare of furnaces reveals the tireless activity of the Black Country. Dudley and its environs are connected by a bus system.

Brierley Hill, urban district and market town, 2½ mi. SW of Dudley, on the G.W. Ry., in Kingswinford parliamentary division, Staffordshire, and on the river Stour and the Stourbridge and Birmingham canals, is an important industrial centre, producing coal, fire clay and glass. Pop. (1938) 46,300. Between here and Dudley are the ironworks of Round Oak and Netherton, a suburb of Dudley. Three miles west of Dudley is Kingswinford (in Brierley Hill urban district), a mining township, with large brickworks, giving name to a parliamentary division of Staffordshire. The parliamentary borough of Dudley returns one member.

In mediaeval times, Dudley (*Duddeley*) depended on the castle, which is mentioned in the Domesday Survey. Before the Conquest Earl Eadwine held the manor, which in 1086 belonged to William FitzAnsculf, from whom it passed to Pulk Paynel, afterwards to the Somersys, Suttons and Wards, and their descendants, the present earls of Dudley. The first mention of Dudley as a borough occurs in an inquisition taken after the death of Roger de

Somery in 1272. In 1865 Dudley was incorporated. Before that time it was governed by a high and low bailiff, appointed every year at the court leet of the manor. Roger de Somery evidently held a market by prescription in Dudley before 1261, in which year he came to terms with the dean of Wolverhampton, who had set up a market in Wolverhampton. According to the terms of the agreement the dean might continue his market on condition that Roger and his tenants should be free from toll there. Two fairs, on Sept. 21 and April 21, were granted in 1684 to Edward Lord Ward, lord of the manor. Dudley was represented in the parliament of 1295, but not again until the Reform Act of 1832. Mines of set coal in Dudley are mentioned as early as the reign of Edward I., and by the beginning of the 17th century mining had become an important industry.

DUDO or **DUDON** (fl. c. 1000), Norman historian, was born of St. Quentin, where he was born about 965. Sent in 986 by Albert I. count of Vermandois, on an errand to Richard I., duke of Normandy, he spent some years in that country. During a second stay in Normandy Dudo wrote his history of the Normans, a task which Duke Richard I. had urged him to undertake. Very little else is known about his life, except that he died before 1043. Written between 1015 and 1030, his *Historia Normannorum*, or *Libri III de moribus et actis primorum Normanniae ducum*, was dedicated to Adalbero, bishop of Laon. Dudo appears to have obtained his information from oral tradition, much of it being supplied by Roul, count of Ivry, a half-brother of Duke Richard I. Consequently the *Historia* partakes of the nature of a romance, nevertheless, J. Lair and J. Steenstrup, while admitting the existence of a legendary element, regard the book as of considerable value for the history of the Normans. The *Historia*, which is written alternately in prose and in verse of several metres, is divided into four parts, and deals with the history of the Normans from 852 to the death of Duke Richard I. in 996. It was largely used by William of Jumièges, Wace, Robert of Torigni, William of Poitiers and Hugh of Fleury in compiling their chronicles, and was first published by A. Duchesne in his *Historiae Normannorum scriptores antiqui*, at Paris in 1619. Another edition is in the *Patrologia Latina*, tome cxi of J. P. Migne (Paris, 1844), but the best is perhaps the one edited by J. Lair (Caen, 1863).

See E. Dümmler, 'Zur Kritik Dudos von St. Quentin' in the *Forschungen zur deutschen Geschichte*, Bande vi and ix (Göttingen, 1866), G. Waitz, 'Über die Quellen zur Geschichte der Begründung der normannischen Herrschaft in Frankreich,' in the *Göttinger gel. Anzeigen* (Göttingen, 1866), J. C. H. R. Steenstrup, *Normannerne*, Band i (Copenhagen, 1896), J. Lair, *Étude critique et historique sur Dudo* (Caen, 1865), G. Kortum, *Über die Quellen des Roman de Rou* (Leipzig, 1867), W. Wattenbach, *Deutschlands Geschichtsquellen*, Band i (Berlin, 1904), and A. Molinier, *Les Sources de l'histoire de France*, tome ii (Paris, 1902).

DUDWEILER, a town of the Saar district of Germany, on the Sulzbach, 4 mi. by rail N.E. from Saarbrücken. It has extensive coal mines and ironworks and produces fireproof bricks. Pop. (1939) 25,061.

DUEL. A prearranged encounter between two persons, with deadly weapons, in accordance with conventional rules, with the object of voiding a personal quarrel or of deciding a point of honour. The first recorded instance of the word occurs in Coryate's *Cruddnet* (1611), but Shakespeare has *duello* in this sense, and uses 'duellist' of Tybalt in *Romeo and Juliet*. In its earlier meaning of a judicial combat we find the word latinized in the Statute of Wales (Edw. I., Act 12), '*Placita de terris in partibus istis non habent terminari per duellum*'. The word *duel* is from Ital. *duello*, Lat. *duellum*—old form of *bellum*—from *duo*, two.

Duels in the modern sense were unknown to the ancient world, and their origin must be sought in the feudal age of Europe. The single combats recorded in Greek and Roman history and legend, of Hector and Achilles, Aeneas and Turnus, the Horatii and Curiatii, were incidents in national wars and have nothing in common with the modern duel.

It is, however, noteworthy that in Tacitus (*Germania*, cap. x) we find the rudiments of the judicial duel. Domestic differences, he tells us, were settled by a legalized form of combat

between the disputants, and when a war was impending a captive from the hostile tribe was armed and pitted against a national champion, and the issue of the duel was accepted as an omen. The judicial combat was a Teutonic institution, and it was in fact an appeal from human justice to the God of battles partly a sanction of the current creed that might is right, that the brave not only will win but deserve to win. It was on these grounds that Gundobald justified against the complaints of a bishop, the famous edict passed at Lyons (A.D. 501) which established the wager of battle as a recognized form of trial. It is God, he argued, who directs the issue of national wars, and in private quarrels we may trust His providence to favour the juster cause. Thus, as Gibbon comments, the absurd and cruel practice of judicial duels, which had been peculiar to some tribes of Germany, was propagated and established in all the monarchies of Europe from Sicily to the Baltic. Yet in its defence it may be urged that it abolished a worse evil, the purgation by oath which put a premium on perjury, and the ordeal, or judgment of God, when the cause was decided by blind chance, or more often by priest-craft.

The Judicial Combat—Those who are curious to observe the formalities and legal rules of a judicial combat will find them described at length in the 28th book of Montesquieu's *Esprit des lois*. On these regulations he well remarks that, as there are in infinity of wise things conducted in a very foolish manner, so there are some foolish things conducted in a very wise manner. For our present purpose it is sufficient to observe the development of the idea of personal honour from which the modern duel directly sprang. In the ancient laws of the Swedes we find that if any man shall say to another, "You are not a man equal to other men," or "You have not the heart of a man," and the other shall reply "I am a man as good as you," they shall meet on the highway, and then follow the regulations for the combat. What is this but the modern challenge? By the law of the Lombards if one man call another *erga*, the insulted party might defy the other to mortal combat. What is *erga* but the *dimmer Junger* of the German student? Beaumanoir thus describes a legal process under Louis le Debonnaire. The appellant begins by a declaration before the judge that the appellee is guilty of a certain crime, if the appellee answers that his accuser lies, the judge then ordains the duel.

From Germany the judicial combat rapidly spread to France, where it flourished greatly from the 10th to the 12th century, the period of customary law. By French kings it was welcomed as a limitation of the judicial powers of their half-independent vassals. It was a form of trial open to all freemen and in certain cases, as under Louis VI, the privilege was extended to serfs. Even the Church resorted to it not unfrequently to settle disputes concerning church property. Abbots and priors as territorial lords and high justiciaries had their share in the confiscated goods of the defeated combatant, and Pope Nicholas was applied to in 858 pronounced it "a just and legitimate combat." Yet only three years before the council of Valence had condemned the practice, imposing the severest penance on the victor and refusing the last rites of the church to the vanquished as to a suicide.

Under Louis XII and Francis I we find the beginnings of tribunals of honour. The last instance of a duel authorized by the magistrates, and conducted according to the forms of law, was the famous one between François de Vivonne de la Châtaignerie and Guy Chabot de Jarnac. The duel was fought on July 10, 1547, in the courtyard of the château of St. Germain en Laye, in the presence of the king and a large assembly of courtiers. It was memorable in two ways. It enriched the French language with a new phrase, a sly and unforeseen blow, such as that by which de Jarnac worsted La Châtaignerie, has since been called a *coup de Jarnac*. And Henry, grieved at the death of his favourite, swore a solemn oath that he would never again permit a duel to be fought. This led to the first of the many royal edicts against duelling. By a decree of the council of Trent (1564) a ban was laid on "the detestable use of duels, an invention of the devil to compass the destruction of souls together with a bloody death

of the body."

Trial by Battle in England—In England, it is now generally agreed, the wager of battle did not exist before the time of the Norman Conquest. Some previous examples have been adduced, but on examination they will be seen to belong rather to the class of single combats between the champions of two opposing armies. By the laws of William the Conqueror the trial by battle was only compulsory when the opposite parties were both Normans, in other cases it was optional. As the two nations were gradually merged into one, this form of trial spread, and until the reign of Henry II it was the only mode for determining a suit for the recovery of land. The method of procedure is admirably described by Shakespeare in the opening scene in *Richard II*, where Henry of Bolingbroke, duke of Hereford, challenges Thomas, duke of Norfolk, in the mock-heroic battle between Horner the Armourer and his man Peter in *Henry VI*, and by Sir W. Scott in the *Fair Maid of Perth*, where Henry Gow appears before the king as the champion of Margaret Proudfoot.

The judicial duel never took root in England as it did in France. In civil suits it was superseded by the grand assize of Henry II, and in the cases of felony by indictment at the prosecution of the crown. One of the latest instances occurred in the reign of Elizabeth, 1571, when the lists were actually prepared and the justices of the common pleas appeared at Tottenham Fields as umpires of the combat. Fortunately the petitioners failed to put in an appearance, and was consequently non-suited (see *Selman Glossary*, s.v. "Campus"). As late as 1817 Lord Ellenborough, in the case of *Thornton v. Ashford*, pronounced that "the general law of the land is that there shall be a trial by battle in cases of appeal unless the party brings himself within some of the exceptions." Thornton was accused of murdering Mary Ashford, and claimed his right to challenge the appellant, the brother of the murdered girl, to a wager of battle. His suit was allowed, and the challenge being refused, the accused escaped. Next year the law was abolished (19 Geo. III., c. 46).

The Duel of Honour.—We are justified, then, in dating the commencement of duelling from the abolition of the wager of battle. The causes which made it indigenous to France are sufficiently explained by the condition of society and the national character. As Buckle has pointed out, duelling is a special development of chivalry, and chivalry is one of the phases of the protective spirit which was predominant in France up to the time of the Revolution. The third chapter of d'Audiguier's *Ancien usage des duels* is headed, "Pourquoi les seuls Français se battent en duel." English literature abounds with allusions to this characteristic of the French nation. Lord Herbert of Chesham, who was ambassador at the court of Louis XIII, says, "There is scarce a Frenchman worth looking on who has not killed his man in a duel."

Duels were not common before the 16th century. Hallam attributes their prevalence to the barbarous custom of wearing swords as a part of domestic dress, a fashion which was not introduced till the latter part of the 15th century. In 1500 the states general at Orleans supplicated Charles IX to put a stop to duelling. Hence the famous ordinance of 1566, drawn up by the chancellor de l'Hôpital, which served as the basis of the successive ordinances of the following kings. Under the frivolous and sanguinary reign of Henry III, "who was as eager for excitement as a woman," the rage for duels spread till it became almost an epidemic. In 1602 the combined remonstrances of the church and the magistrates extorted from the king an edict condemning to death whoever should give or accept a challenge or act as second. But public opinion was revolted by such rigour, and the statute was a dead letter. Fontenay-Mareuil says, in his *Mémoires*, that in the eight years between 1601 and 1609, 2,000 men of noble birth fell in duels. In 1609 a more effective measure was taken at the instance of Sully by the establishment of a court of honour. The edict decrees that all aggrieved persons shall address themselves to the king, either directly or through the medium of the constables, marshals, etc., that the king shall decide, whether, if an accommodation could not be effected, permission to fight should be given, and that anyone who kills

his adversary in an unauthorized duel shall suffer death without burial. Henri Martin has declared this "the wisest decree of the old monarchy on a matter which involves so many delicate and profound questions of morals, politics, and religion touching civil rights" (*Histoire de France*, x, 466).

"Who is to Fight to-day?"—In the succeeding reign the drama for duels revived. Rostand's *Cyrano* is a life like modern portraiture of French bloods in the first half of the 17th century. De Houssaye tells us that in Paris when friends met, the first question was, "Who fought yesterday? who is to fight today?" They fought by night and day, by moonlight and by torch light, in the public streets and squares. A hasty word, a misconceived gesture, a question about the colour of a ribbon or an embroidered letter, such were the commonest pretexts for a duel. The slighter and more frivolous the dispute, the less were they inclined to submit them to the king for adjudication. Often, like gladiators or prize fighters, they fought for the pure love of fighting. A misunderstanding is cleared up on the ground "N'importe," cry the principals, "puisque nous sommes ici, battons nous." Seconds, as Montaigne tells us, are no longer witnesses but must take part themselves unless they would be thought wanting in affection or courage, and he goes on to complain that men are no longer contented with a single second, "c'était anciennement des duels, ce sont à cette heure rencontres et batailles." There is no more striking instance of Richelieu's firmness and power as a statesman than his conduct in the matter of duelling. In his *Testament politique* he has assigned his reasons for disapproving it as a statesman and ecclesiastic. But this disapproval was turned to active detestation by a private cause. His elder brother, the head of the house, had fallen in a duel stabbed to the heart by an enemy of the cardinal. Already four edicts had been published under Louis XIII with little or no effect, when in 1626 there was published a new edict condemning to death any one who had killed his adversary in a duel, or had been found guilty of sending a challenge a second time. Banishment and partial confiscation of goods were awarded for lesser offences. But this edict differed from preceding ones not so much in its severity as in the fact that it was the first which was actually enforced. The cardinal began by imposing the penalties of banishment and fines, but, these proving ineffectual to stay the evil, he determined to make a terrible example. To quote his own words to the king, "Il s'agit de couper la gorge aux duels ou aux édit de votre Majesté." The count de Boutteville, a renegade who had already been engaged in 21 affairs of honour, determined out of pure bravado to fight a 22nd time. The duel took place at midday on the Place Royale. Boutteville was arrested with his second, the count de Chappelles, they were tried by the parlement of Paris, condemned and, in spite of all the influence of the powerful house of Montmorency, of which de Boutteville was a branch, they were both beheaded on June 27, 1627. For a short time the ardour of duellists was cooled.

Duels Under Louis XIV.—Under the long reign of Louis XIV many celebrated duels took place, of which the most remarkable were that between the duke of Guise and Count Coligny, the last fought on the Place Royale, and that between the dukes of Beaufort and Nemours, each attended by four friends. Of the ten combatants, Nemours and two others were killed on the spot, and none escaped without some wound. No less than 11 edicts against duelling were issued under le Grand Monarque. That of 1643 established a supreme court of honour composed of the marshals of France, but the most famous was that of 1679, which confirmed the enactments of his predecessors, Henry IV and Louis XIII.

The subsequent history of duelling in France may be more shortly treated. In the preamble to the edict of 1704 Louis XIV records his satisfaction at seeing under his reign an almost entire cessation of those fatal combats which by the myriads of force or custom had so long prevailed. Addison (*Spectator*, 99) notes it as one of the most glorious exploits of his reign to have banished the false point of honour. Under the regency of Louis XV there was a brief revival. The last legislative act for the suppression of duels was passed on April 12, 1723. Then came the Revolution

which in abolishing the *ancien régime* fondly trusted that with it would go the duel, one of the privileges and abuses of an aristocratic society. Duplex in his *Military Law concerning the Duel* (1611), premises that these have no application to lawyers, merchants, financiers or justices. This explains why in the legislation of the National Assembly there is no mention of duels. Camille Desmoulins when challenged shrugged his shoulders and replied to the charge of cowardice that he would prove his courage on other fields (than the Bois de Boulogne). The two great Frenchmen whose writings preluded the French Revolution both set their faces against it. Voltaire had indeed as a young man, in obedience to the dictates of society, once sought satisfaction from a noble man for a brutal insult, and had reflected on his temerity in the solitude of the Bastille. The story runs that Voltaire met the chevalier Rohan-Chabot at the house of the marquis of Sully. The chevalier, offended by Voltaire's free speech, insolently asked the marquis, "Who is that young man?" "One," replied Voltaire, "who if he does not parade a great name, honours that he bears." The chevalier said nothing at the time, but, seizing his opportunity, inveigled Voltaire into his coach, and had him beaten by six of his footmen. Voltaire set to work to learn fencing, and then sought the chevalier in the theatre, and publicly challenged him. A *bon mot* at the chevalier's expense was the only satisfaction that the philosopher could obtain. "Monsieur, si quelque affaire d'intérêt ne vous a point fait oublier l'outrage dont j'ai à me plaindre, j'espère que vous m'en rendrez raison." The chevalier was said to employ his capital in petty usury. After this incident and its consequences, Voltaire inveighed against duelling, not only for its absurdity, but also for its aristocratic exclusiveness. Rousseau had said of duelling, "It is not an institution of honour, but a horrible and barbarous custom, which a courageous man despises and a good man abhors." Napoleon was a sworn foe to it. "Bon duelliste mauvais savant" is one of his best known sayings, and, when the king of Sweden sent him a challenge, he replied that he would order a fencing-master to attend him as plenipotentiary. After the battle of Waterloo duels such as Lever loves to depict were frequent between disbanded French officers and those of the allies in occupation. The restoration of the Bourbons brought with it a fresh crop of duels. Since then duels have been frequent in France—more frequent, however, in novels than in real life—fought mainly between politicians and journalists, and with rare exceptions bloodless affairs. If fought with pistols, the distance and the weapons chosen render a hit improbable, and, if fought with rapiers, honour is generally satisfied with the first blood drawn. Among Frenchmen famous in politics or letters who have "gone out" may be mentioned Armand Carrel, who fell in an encounter with Emile Girardin. Thiers, who thus atoned for a youthful indiscretion, the elder Dumas, Lamartine, Ste Beuve, who to show at once his sangfroid and his sense of humour, fought under an umbrella, Ledru Rollin, Edmond About, Clément Thomas, Vuillot, the representative of the church militant, Rochefort, and Boulanger, the Bonapartist *fanaron*, whose discomfiture in a duel with Floquet resulted in a notable loss of popular respect.

Duels in England.—Duelling did not begin in England till some 100 years after it had arisen in France. There is no instance of a private duel fought in England before the 16th century, and they are rare before the reign of James I. A very fair notion of the comparative popularity of duelling, and of the feeling with which it was regarded at various periods, might be gathered by examining the part it plays in the novels and lighter literature of the times. The earliest duels we remember in fiction are that in the *Monastery* between Sir Pierce Shafton and Halbert Glen, dining, and that in *Kerithworth* between Tressilian and Varney (That in *Anne of Geierston* either is an anachronism or must reckon as a wager of battle.) Under James I we have the encounter between Nigel and Lord Dalgarno. The greater evil of war, as we observed in French history, expels the lesser, and the literature of the Commonwealth is in this respect a blank. With the Restoration there came a reaction against Puritan morality, and a return to the gallantry and loose manners of French society, which is best represented by the theatre of the day. The drama

of the Restoration abounds in duels. Passing on to the reign of Queen Anne, we find the subject frequently discussed in the *Tatler* and the *Spectator*, and Addison points in his happiest way the moral to a contemporary duel between Thornhill and Sir Cholmeley Dering. "I come not," says Spinoletto to King Pharamond, "I come not to implore your pardon, I come to relate my sorrow, a sorrow too great for human life to support. Know that this morning I have killed in a duel the man whom of all men living I love best." No reader of *Esmond* can forget Thackeray's description of the doubly fatal duel between the duke of Hamilton and Lord Mohun, which is historical, or the no less life like though fictitious duel between Lord Mohun and Lord Castlemore. The duel between the two brothers in Stevenson's *Master of Ballantrae* is one of the best conceived in fiction. Throughout the reigns of the Georges they are frequent. Richardson expresses his opinion on the subject in six voluminous letters to the *Literary Repostor*. Sheridan, like Farquhar in a previous generation, not only dramatized a duel, but fought two himself. Byron thus commemorates the bloodless duel between Tom Moore and Lord Jeffrey —

Can none remember that eventful day,
That ever glorious almost fatal fray,
When Little's leadless pistols met the eye,
And Bow Street myrmidons stood laughing by?

There are no duels in Miss Austen's novels, but in those of Miss Edgeworth, her contemporary, there are three or four. As we approach the 19th century they become rarer in fiction. Thackeray's novels, indeed, abound in duels. "His royal highness the late lamented commander-in-chief" had the greatest respect for Maj. Macmurdo, as a man who had conducted scores of affairs for his acquaintance with the greatest prudence and skill, and Rawdon Crawley's duelling pistols, "the same which I shot Captain Marker," have become a household word. Dickens, on the other hand, who depicts contemporary English life, and mostly in the middle classes, in all his numerous works has only three, and George Eliot never once refers to a duel. Tennyson, using a poet's privilege, laid the scene of a duel in the year of the Crimean War, but he echoes the spirit of the times when he stigmatizes "the Christless code that must have life for a blow." Browning, who delights in cases of conscience, has given admirably the double moral aspect of the duel in his two lyrics entitled "Before" and "After."

To pass from fiction to fact we will select the most memorable English duels of the last century and a half. Lord Byron killed Chaworth in 1705, Charles James Fox and Adams fought in 1779, duke of York and Colonel Lennox, 1789, William Pitt and George Tierney, 1796, George Canning and Lord Castlereagh, 1809, Christie killed John Scott, editor of the *London Magazine*, 1821, duke of Wellington and earl of Winchelsea, 1829, Roebuck and Black, editor of *Morning Chronicle*, 1835, Lord Alvanley and a son of Daniel O'Connell in the same year, Earl Cardigan wounded Captain Tuckett, was tried by his peers, and acquitted on a legal quibble, 1840.

The Killing of Captain Boyd — The year 1808 is memorable in the annals of duelling in England. Major Campbell was sentenced to death and executed for killing Capt. Boyd in a duel. In this case it is true that there was a suspicion of foul play, but in the case of Lieut. Blundell, who was killed in a duel in 1813, though all had been conducted with perfect fairness, the surviving principal and the seconds were all convicted of murder and sentenced to death, and although the royal pardon was obtained, they were all cashiered. The next important date is the year 1843, when public attention was painfully called to the subject by a duel in which Col. Fawcett was shot by his brother-in-law, Lieut. Monro. The survivor, whose career was thereby blasted, had, it was well known, gone out most reluctantly, in obedience to the then prevailing military code. A full account of the steps taken by the prince consort, and of the correspondence which passed between him and the duke of Wellington, will be found in the *Life of the Prince* by Sir T. Martin. Meanwhile there had been formed in London the association against duelling. It included leading members of both houses of parliament and distinguished

officers of both services. The first report, issued in 1844, gives a memorial of the association presented to Queen Victoria through Sir James Graham, and in a debate in the House of Commons (March 15, 1844) Sir H. Hardinge, the secretary of war, announced to the House that her majesty had expressed herself desirous of devising some expedient by which the barbarous practice of duelling should be as much as possible discouraged. In the same debate Turner reckoned the number of duels fought during the reign of George III. at 172, of which 91 had been attended with fatal results, yet in only two of these cases had the punishment of death been inflicted. But though the proposal of the prince consort to establish courts of honour met with no favour, yet it led to an important amendment of the articles of war (April, 1844). The 95th article ordains that "every person who shall fight or promote a duel, or take any steps thereto, or who shall not do his best to prevent duel, shall, if an officer, be cashiered, or suffer such other penalty as a general court martial may award." These articles, with a few verbal changes, were incorporated in the consolidated Army Act of 1879 (section 38), which is still in force.

Duels in Germany — Under the late imperial regime, German army duels were authorized by the military code as a last resort in grave cases. A German officer who was involved in a difficulty with another was bound to notify the circumstance to a council of honour at the latest as soon as he had either given or received a challenge. A council of honour consisted of three officers of different ranks and was instructed, if possible, to bring about a reconciliation. If unsuccessful the council had to see that the conditions of the duel were not out of proportion to the gravity of the quarrel.

Public opinion was greatly aroused by a tragic duel fought by two officers of the reserve in 1896, and the German emperor in a cabinet order of 1897, confirmed in 1907, enforced the regulation of the military court of honour, and gave warning that any infringement would be visited with full penalties of the law. It continued to be the fact that a German officer who was not prepared to accept a challenge and to fight, if the opinion of his regiment demanded it, was compelled to leave the service.

Under the Weimar republic prior to Hitler, the question was governed by articles 201 to 210 inclusive of the criminal code. The provisions referring to duelling may be summarized as follows:

1 (Article 201.) Any person challenging a second person to a duel or accepting such a challenge is liable to punishment by a term of imprisonment not exceeding six months.

2 (Article 205.) Persons taking part in a duel are liable to sentences ranging from three months to five years.

3 (Article 206.) Should anyone kill his opponent in a duel, he will be sentenced to imprisonment for not less than two years. Should it be shown, however, that the duel was entered into with mortal intent, the period of imprisonment shall not be less than three years.

4 (Article 210.) Should any person intentionally encourage another person to fight a duel, he will, in the event of the duel taking place, be punished by imprisonment for not less than three months.

The German Student Duels — The celebrated *Messuren*, or German students' duels, survived World War I. They continued to form a regular element in German student life. In Berlin fighting corps met once a week in secret.

These meetings continued from 8 o'clock in the morning onward, with some 20 fights taking place on each occasion. The police, as well as the university authorities, presumably knew all about them, but were only too willing to close their eyes. These fighting corps or *Verbundungen* existed in every German university.

The entry of a student into one of these clubs was held to be a considerable honour, and was only possible where a student had shown the necessary qualifications to permit of his admission. It moreover carried with it a number of advantages to the student in after life, and very often helped him to obtain a good position in a profession or industry. The primary qualification would seem to be having fought three "parties" or matches

'successfully' "

To fight a students' duel, it would seem that a considerable amount of previous practice was necessary. In each fighting *1er binding*, a *Fechtsaal* formed part of the equipment of the club house, and duly practice was provided for fighting students under the supervision of the training instructor—one of the senior students of the *Verbindung* and named the *Zweiter Charakter*.

There were two categories of fighting students. First, the *Fuchs* or novice, second, the *Bursch* (fellow or accepted member), besides these, the "inactive," which means a student who had finished his time in the *Verbindung*, but still retained his membership of the university.

The training practice consisted of a number of short bouts fought under rather similar conditions to the actual duel. The student, however, was provided with a steel mask to accustom him to the art of fencing without the possibility of damage. The body and arms were also protected. The sword, moreover, was not sharpened.

It is of interest in this connection to note that Roman Catholic members of the German universities were forbidden by their church to enter fighting *Verbindungen* on penalty of expulsion from the church.

Apparently the only point decided for or against a particular fighter was his bearing during the fight.

No points were given for skill in attack or defense and each fighter was judged by the witnessing *Korpsbruder* of his own fighting *Verbindung* only.

Modern Views of the Duel.—Any formal discussion of the morality of duelling is, in England at least, happily superfluous. No fashionable vice has been so unanimously condemned both by moralists and divines. Some, however, of the problems, moral and social, which it suggests may be noticed briefly. That duelling flourished so long in England the law is, perhaps, as much to blame as society. It was doubtless from the fact that duels were at first a form of legal procedure that English law has refused to take cognizance of private duels. A duel in the eye of the law differs nothing from an ordinary murder. The greatest English legal authorities, from the time of Elizabeth downwards, such as Coke, Bacon and Hale, have all distinctly affirmed this interpretation of the law. But here as elsewhere the severity of the penalty defeated its own object. The public conscience revolted against a Draconian code which made no distinction between wilful murder and a deadly combat wherein each party consented to his own death or submitted to the risk of it. No jury could be found to convict when conviction involved in the same penalty a Fox or a Pitt and a Turpin or a Brownrigg. Such, however, was the conservatism of English publicists that Bentham was the first to point out clearly this defect of the law, and propose a remedy. In his *Introduction to the Principles of Morals and Legislation*, published in 1789, Bentham discusses the subject with his usual boldness and logical precision. In his exposition of the absurdity of duelling considered as a branch of penal justice, and its inefficiency as a punishment, he only restates in a clearer form the arguments of Paley. So far there is nothing novel in his treatment of the subject. But he soon parts company with the Christian moralist, and proceeds to show that duelling does, however rudely and imperfectly, correct and repress a real social evil. "It entirely effaces a blot which an insult imprints upon the honour. Vulgar moralists, by condemning public opinion upon this point, only confirm the fact." He then points out the true remedy for the evil. It is to extend the same legal protection to offences against honour as to offences against the person. The legal satisfactions which he suggests are some of them extremely grotesque. Thus for an insult to a woman, the man is to be dressed in woman's clothes, and the retort to be inflicted by the hand of a woman. But the principle indicated is a sound one, that in offences against honour the punishment must be analogous to the injury. Doubtless, if Bentham were now alive, he would allow that the necessity for such a scheme of legislation had in a great measure passed away. That duels have since become extinct is no doubt principally

owing to social changes, but it may be in part ascribed to improvements in legal remedies in the sense which Bentham indicated. A notable instance is Lord Campbell's Act of 1843, by which, in the case of a newspaper libel, a public apology coupled with a pecuniary payment is allowed to bar a plea. In the Indian code there are special enactments concerning duelling, which is punishable not as murder but as homicide.

The duel, which in a barbarous age may be excused as "a sort of wild justice," was condemned by Bacon as "a direct affront of law and tending to the dissolution of magistracy." It survived in more civilized times as a class distinction and as an ultimate court of appeal to punish violations of the social code. In a democratic age and under a settled government it is doomed to extinction. The military duels of the European continent, and the so-called American duel, where the lot decides which of the two parties shall end his life, are singular survivals. For real offences against reputation law will provide a sufficient remedy. The learned professions will have each its own tribunal to which its members are amenable. Social stigma is it once a surer and juster defence against conduct unworthy of a gentleman.

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(F. S. X.)

DUENNA, specifically the chief lady-in-waiting upon the queen of Spain (Span *duenna*, a married lady or mistress, Lat. *domina*). The word is more widely applied, however, to an elderly lady in Spanish and Portuguese households (holding a position midway between a governess and companion) appointed to take charge of the young girls of the family, and "duenna" is thus used in English as a synonym for chaperon (q.v.).

DUEPPEL, a village of Germany, in the Prussian province of Schleswig-Holstein, opposite the town of Sonderburg (on the island of Alsén) (Pop. 600). The position of Düppel, forming as it does a bridge head for the defenders of the island of Alsén, played a conspicuous part in the wars between Denmark and the Germans. On May 28, 1848, the German federal troops were there defeated by the Danes under Gen. Hedemann, and a second battle was fought on June 6, 1848. On April 13, 1849, an indecisive battle was fought between the federal troops under Frittwitz and the Danes under Bulow. The most important event in the military history of Düppel was, however, the siege by the Prussians of the Danish positions in 1864. The flanks of the defenders' line rested upon the Alsén sund and the sea, and a second line of trenches was constructed behind the front attacked, and a small redoubt opposite Sonderburg to cover the bridges between Alsén and the mainland. The Prussian siege corps was commanded by Prince Frederick Charles and after three weeks' skirmishing a regular siege was begun, the batteries being opened on March 15. The siege was pushed rapidly from the first parallel, completed March 30, and the assault delivered on April 18. The whole line was carried after a brief but severe conflict, and the Prussians had penetrated to and captured the redoubt opposite Sonderburg by 2 P.M. The loss of the Danes, half of whose forces were not engaged, included 1,800 killed and wounded and 3,400 prisoners. This operation was followed by the daring passage of the Alsén sund, effected by the Prussians in boats almost under the guns of the Danish warships, and resulting in the capture of the whole island of Alsén (June 29, 1864).

See R. Neumann, *Über den Angriff der Doppelten Schenken in der Zeit vom 15. März bis 18. April 1863* (1863), and *Der deutschdeutsche Krieg 1864* published by the Prussian General Staff (1887)

DUET, a term in music for a composition for two performers, either vocal or instrumental, in which the two parts are of more or less equal importance. Thus a piece for a violin and piano in which the latter provides merely an accompaniment is not properly called a duet. Duo is a term having the same meaning though usually applied to instrumental duets only.

DUFAURE, JULES ARMAND STANISLAS (1798-1881), French statesman was born at Saujon (Charente Inferieure) on Dec. 4, 1798. He became an advocate at Bordeaux, and in 1834 was elected deputy. As minister of public works (1839) in the Soult ministry, he freed railway construction from the obstacles which till then had hampered it. In 1840 Dufaure became one of the leaders of the Opposition, and on the outbreak of the revolution of 1848 he frankly accepted the Republic. On Oct. 13 he became minister of the interior under G. Cavaignac but retired on the latter's defeat in the presidential election. During the Second Empire Dufaure practised at the Paris bar and was elected *batonnier* in 1862. In 1863 he succeeded to Pasquier's seat in the French Academy. In 1871 he became a member of the Assembly, and it was on his motion that Thiers was elected President of the Republic. Dufaure was minister of justice under Thiers and under L. J. Buffet, whom he succeeded (March 9, 1876) as president of the council. He resigned office on Dec. 12 but returned to power on Dec. 24, 1877. Early in 1879 Dufaure took part in compelling the resignation of Marshal MacMahon, but immediately afterwards (Feb. 1), worn out by opposition, he himself retired. He died in Paris on June 28, 1881.

See G. Picot, *M. Dufaure, sa vie et ses discours* (1883).

DUFF, ALEXANDER (1806-1878), Scottish missionary in India, was born at Auchnahyle, Moulou, Perthshire. At St. Andrews university he came under the influence of Dr. Chalmers, and was sent out by the foreign mission committee of the general assembly as their first missionary to India. He was ordained in Aug. 1829, and started at once for India, but was twice shipwrecked before he reached Calcutta in May 1830, and lost all his books and other property. Up to this time Protestant missions in India had been successful only in reaching low caste and out-caste peoples, particularly in Tinnevely and south Travancore. The Hindu and Mohammodan communities had been practically untouched. Duff therefore devised the policy of an educational mission. He first opened an English school in which the Bible was the centre of the school work, and along with it all kinds of secular knowledge were taught from the rudiments upwards to a university standard. The school soon began to expand into a missionary college, and a Government minute was adopted on March 7, 1835, to the effect that in higher education the object of the British Government should be the promotion of European science and literature among the natives of India.

After six years' furlough in England, Duff returned in 1840 to India. In 1839 the earl of Auckland, governor general, had yielded to the "Orientalists" who opposed Duff, and adopted a policy which was a compromise between the two. At the Disruption of 1843 Duff sided with the Free Church, gave up the college buildings with all their effects, and with unabated courage set to work to provide a new institution. He had the support of Sir James Outram and Sir Henry Lawrence, and the encouragement of seeing a new band of converts, including several young men of high caste. In 1844 Viscount Hardinge opened Government appointments to all who had studied in institutions similar to Duff's Foundation. In the same year Duff took part in founding the *Calcutta Review*, of which from 1845 to 1849 he was editor. In 1849 he returned home. He was moderator of the Free Church assembly in 1851.

In 1856 Duff returned to India. He gave much thought and time to the University of Calcutta, which owes its examination system and the prominence given to physical sciences to his influence. In 1863 Sir Charles Trevelyan offered him the post of vice-chancellor of the university, but his health compelled him to leave India. He continued his work for foreign missions in

different parts of the world, and was the first occupant of the chair of foreign missions at New College, Edinburgh, and at his death, on Feb. 12, 1878, left his personal property to found a lectureship on foreign missions on the model of the Bampton lectures.

See his *Life*, by George Smith (2 vols.)

DUFF, SIR EVELYN MOUNTSTUART GRANT (1803-1926), British diplomatist, second son of the Sir Mount Stuart Grant Duff, the administrator and diarist, was born on Oct. 9, 1803. From 1888 he was on Foreign Office service in Rome, Tehran, St. Petersburg (Leningrad), Stockholm and elsewhere. In 1913 he was made minister at Bern, a post which acquired great importance with the outbreak of war in 1914. Grant Duff had the responsibility of furthering friendly relations between the British and Swiss Governments and of mitigating the difficulties arising out of the blockade. He was the object of a violent news paper campaign instigated by the Germans, and was accused of taking observations of Friedrichshafen from the neutral Roman shore. This propaganda was officially contradicted by the Swiss Government. In 1900 he married Edith Florence, daughter of Sir George Bonham. Lady Grant Duff gave invaluable assistance in organizing the *Bureau de Secours aux prisonniers de Guerre* (British Section). Sir Evelyn resigned in August 1916. He died at Bath on Sept. 19, 1926.

DUFF, SIR MOUNTSTUART ELPHINSTONE GRANT (1829-1906), British politician and writer, was born at Eden, Scotland. He was educated at Edinburgh and Oxford, and in 1854 was called to the bar. He sat in parliament as the Liberal member for the Elgin Burghs from 1857 to 1881, being under secretary of state for India from 1868 to 1874 and for the colonies during 1880-81. He was governor of Madras from 1881 to 1886. His writings include *Miscellaneous, Political and Literary* (1878), *Studies in European Politics* (1886), *Memoirs of Henry Maine* (1892), *Reminiscences* (1893), and *Notes from a Diary for the years 1851-1901* (14 vols., 1897-1905).

DUFFERIN AND AVA, FREDERICK TEMPLE HAMILTON-TEMPLE-BLACKWOOD, 1ST MARQUESS OF (1826-1902), British diplomatist, son of Price Blackwood, 4th Baron Dufferin, was born at Florence, Italy, on June 21, 1826. The Irish Blackwoods were of old Scottish stock, tracing their descent back to the 14th century. Frederick went to Eton (1839-43) and Christ Church, Oxford (1845-47), where he took a pass school and was president of the Union. His father died in 1841, and the influence of his mother, Helena Selina Sheridan—one of three unusually accomplished sisters, the other two being the duchess of Somerset and Mrs. Norton (*q.v.*)—was very marked on his mental development, she lived till 1867 and is commemorated by the "Helen's Tower" erected by her son in her honour at Clondeboyne (the Irish seat of the Blackwoods) in 1861, and adorned with epigraphical verses written by Tennyson, Browning and others. Her son edited her *Poems and Verses* (1894). In 1846-48 Lord Dufferin was active in relieving the distress in Ireland due to the famine. He was a good landlord, in 1855 he already advocated compensation for disturbance and for improvements, but while supporting reasonable reform, he demanded justice for the land owners. When Gladstone adopted Home Rule, Lord Dufferin regarded the new policy as fatal both to Ireland and to the United Kingdom, though, being then an ambassador, he took no public part in opposing it. In 1849 Dufferin was made a lord in waiting. In 1855 Lord John Russell took him as attaché on his special mission to the Vienna Conference, and in 1860 sent him as British representative on a joint commission of the powers appointed to inquire into the affairs of the Lebanon (Syria), where the massacres of Christian Maronites by the Mussulman Druses had resulted in the landing of a French force and the possibility of a French occupation. Lord Dufferin was associated with French, Russian, Prussian and Turkish colleagues, and the diplomatic position was delicate. At last it was agreed to place a Christian governor, subordinate to the Porte, over the Lebanon district, and to set up local administrative councils. In May 1861 the French forces departed, and Lord Dufferin was thanked for his services by the government. In 1862 he married Harriet, daughter of Cap-

tain A. Rowan Hamilton, of Killyleagh Castle Down. He held successively the posts of under secretary for India (1864-66) and under secretary for war (1866) in Lord Palmerston's and Earl Russell's ministries, and he was chancellor of the duchy of Lancaster, outside the cabinet, under Gladstone (1868-72). In 1871 he was created earl of Dufferin.

In 1872 he was appointed governor general of Canada. He had already become known as a powerful and graceful orator, and a man of culture and political distinction, and his abilities were brilliantly displayed in dealing with the problems of the newly united province, of the Canadian Dominion. He admitted, strengthened and consolidated the imperial connection. Lord Dufferin left Canada in 1878, and in 1879 he was appointed by Lord Beaconsfield ambassador to Russia. In 1881 he was transferred to Constantinople, where he was concerned in the negotiations connected with the situation in Egypt caused by Arab revolt and the intervention of Great Britain. He was considerably helped by Turkish ineptitude, and by the accomplished fact of British military successes in Egypt, but his own diplomacy contributed to secure freedom of action for Great Britain. From Oct. 1882 to May 1883 he was in Egypt as British commissioner to report on a scheme of reorganization. In 1884 he was appointed viceroy of India, succeeding Lord Ripon. Lord Dufferin though agreeing in the main with Lord Ripon's native policy, gained the confidence of the Anglo-Indian community without producing any undesirable reaction. He initiated stable relations with Afghanistan, and settled the crisis with Russia arising out of the Panjdeh incident (1885), which led to the delimitation of the north-west frontier (1887). The annexation of Burma during his viceroyalty procured for him, on his resignation, the title of marquis of Dufferin and Ava (1888). His viceroyalty was also memorable for Lady Dufferin's work in providing better medical treatment for native women. In 1888 he was made ambassador at Rome, and in 1892 ambassador in Paris. He retired in 1896.

His last years, spent mainly at his Irish home, were clouded by the death of his eldest son, the earl of Ava, at Lydsmith in the Boer War (1900), and by business troubles due to his having accepted the chairmanship of the London and Globe Finance Corporation, of which Whitaker Wright was managing director. He died on Feb. 12, 1907, and was succeeded in the title by his second son Terence (1866-1918). His fourth son Frederick (b. 1875) succeeded in 1918 and was Speaker of the Senate, Northern Ireland, in 1921. Killed in an air crash, July 21, 1930, he was succeeded by his son Basil, Lord Ava (1909-1945).

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DUFF-GORDON, LUCIE (1821-1869), English woman of letters, daughter of John and Sarah Austin (q.v.), was born on June 24, 1821, and died in Egypt on July 14, 1869. Her chief playfellows as a child were her cousin, Henry Reeve, and John Stuart Mill, who lived next door in Queen Square, London. In 1834 the Austins went to Boulogne, and at table d'hôte Lucie found herself next to Heinrich Heine. The poet and the little girl became fast friends, and years afterwards she contributed to Lord Houghton's *Monographs Personal and Social* a touching account of a renewal of their friendship when Heine lay dying in Paris. Her parents went to Malta in 1836, and Lucie Austin was left in England at school. She married in 1840 Sir Alexander Duff Gordon (1811-1877). With her mother's beauty and had inherited her social gifts, and she gathered round her a brilliant circle of friends. George Meredith has analysed and described her extraordinary success as a hostess and the process by which she reduced too ardent admirers to 'happy crust-munching devotees'. 'In England in her day,' he says, 'while health was with her there was one house where men and women conversed when that house's power was closed a

light had gone out in our country.' She went in 1860 to the Cape of Good Hope, and later to Egypt, where she died. She had translated among other works *Ancient Grecian Mythology* (1830) from the German of Niebuhr, *Mary Schuadler, The Amber Witch* (1844) from the German of Wilhelm Meinhold, and *Stella and Vanessa* (1850) from the French of A. F. L. de Wailly. Her *Letters from the Cape* (1862-63) appeared in 1865, and were reprinted in 1927, and in 1865 her *Letters from Egypt* (1875) contained a memoir by her daughter, Janet Ross (q.v.). Lady Duff Gordon won the hearts of her Arab dependents and neighbours. She doctored their sick and taught their children.

The *Letters from Egypt* were not originally published in a complete form. A fuller edition, with an introduction by George Meredith, was edited in 1903 by Mrs. Janet Ross. See also Mrs. Ross's *Three Generations of Englishwomen* (1886).

DUFFTOWN, small burgh, Banffshire, Scotland, on the Fiddich, 64 m. WNW of Aberdeen by the LNER. Pop. (est. 1938) 1,429. It dates from 1817 and bears the name of its founder, James Duff, 4th earl of Fife. Although planned in the shape of a cross, with a square and tower in the middle, the arms of the cross are not straight, the constructor holding that, in order to prevent little towns from being taken in at a glance, their streets should be crooked. The leading factories are lime works and distilleries, the water being good for whisky making. The town is a health resort. Dufftown is in the parish of Mortlach. The Stone of Mortlach is traditionally believed to have been erected to commemorate the success of Malcolm II. over the Danes in 1010. There are also three large stones known as 'The King's Grave,' a hill fort and a castle. A portion of old Balvenie castle, a ruin, is considered to be of Pictish origin, but most of it is of the Scots Baronial period. Two miles south-east of Dufftown is the ruined castle of Auchindown, on a limestone crag, 200 ft. high, of which three sides are washed by the Fiddich and the fourth was protected by a moat. It dates from the 11th century, and once belonged to the Ogilvies, from whom it passed in 1535 to the Gordons. The Gothic hall with rows of fluted pillars is in fair preservation. About 4 m. to the NW is Cragellachie, on the confines of Elginshire. It is a growing place, with a large hotel, situated on the Spey amidst fine scenery. The slogan of the Grants is 'Stand fast Cragellachie!'

DUFFY, SIR CHARLES GAVAN (1816-1903), Irish and colonial politician, was born in Monaghan, Ireland, on April 12, 1816. He was one of the founders (1842) of the *Nation*, a Dublin weekly remarkable for the fire and spirit of its political poetry. In 1844 Duffy was included in the same indictment with O'Connell, and shared his conviction in Dublin and his acquittal by the House of Lords upon a point of law. His ideas, nevertheless, were too revolutionary for O'Connell, a schism took place in 1846, and Duffy united himself to the 'Young Ireland' party. He was tried for treason felony in 1848, but the jury were unable to agree. Duffy continued to agitate in the press and in parliament, to which he was elected in 1852, but his failure to bring about an alliance between Catholics and Protestants upon the land question determined him in 1856 to emigrate to Victoria. There he became in 1857 minister of public works, and after an active political career, in the course of which he was prime minister from 1871 to 1873, when he was knighted, he was elected speaker of the House of Assembly in 1877, being made K.C.M.G. in the same year. In 1880 he resigned and returned to Europe, residing mostly in the south of France. He published *The Ballad Poetry of Ireland* (1845), several works on Irish history, *Conversations with Carlyle* (1892), *Memoirs* (1898), etc. In 1897 he became first president of the Irish Literary Society. He died on Feb. 9, 1903.

DUFOUR, WILHELM HEINRICH (GUILLAUME HENRI) (1787-1875), Swiss general, was born at Constance, of Genevese parents temporarily in exile, on Sept. 15, 1787. He studied at the École Polytechnique in Paris, served in the French army, and returned to Switzerland after 1815. He became chief instructor at the military school at Thun, where he had Louis Napoleon (Napoleon III.) among his pupils. He carried out the trigonometrical survey of Switzerland, which was thirty-two years in the

making In 1847 Dufour was made general of the Federal Army, which was employed in reducing the revolted Catholic cantons a task in which he showed conspicuous skill and moderation. In politics he belonged to the moderate conservative party, and he consequently lost a good deal of his popularity in 1848. In 1856, in the conflict with Frederick-William IV of Prussia over the possession of Neuchâtel, Dufour was put at the head of the republican army and was sent to Paris to obtain the mediation of Napoleon III, and again in 1859 at the time of the French annexation of Savoy, he was in charge of the negotiations at Paris concerning the neutrality of northern Savoy (See SWITZERLAND History). In 1864 he presided over the international conference which framed the Geneva Convention as to the treatment of the wounded in time of war, etc. He died on July 14, 1875.

His works include *De la fortification permanente* (1850), *Mémoire sur l'artillerie des anciens et sur celle du moyen âge* (1840), *Manuel de tactique pour les officiers de toutes armes* (1842), and various other works in military science. His memoir, *La Campagne du Sonderbund* (Paris, 1876), is prefaced by a biographical notice.

See Sunn-Bardiene, *Das Buch des Generals Dufour* (6th ed, 1897).

DUGDALE, SIR WILLIAM (1605–1686), English antiquary, was born at Shustoke, near Coleshill, Warwickshire, on Sept. 12, 1605. He married at 17, and lived with his wife's family until his father's death in 1624, when he went to live at Tillingley, near Shustoke, an estate formerly acquired for him by his father. In 1625 he purchased the manor of Blythe, Shustoke, and removed thither in 1626. In 1635 he met Sir Symon Archer (1581–1662), himself a learned antiquary, who was then employed in collecting materials for a history of Warwickshire, and accompanied him to London. In 1638 Dugdale was created a pursuivant of arms extraordinary by the name of Blanch Lyon, and in 1639 rouge croix pursuivant in ordinary. He now had a lodging in the Herald's Office, and spent much of his time in London examining the records in the Tower and the Cottonian and other collections of MSS. In 1641 Sir Christopher Hatton, foreseeing the war and dreading the ruin and spoliation of the church, commissioned him to make exact drafts of all the monuments in Westminster Abbey and the principal churches in England, including Peterborough, Ely, Norwich, Lincoln, Newark, Beverley, Southwell, Kingston-upon-Hull, York, Selby, Chester, Lichfield, Tamworth and Warwick. In June 1642 he was summoned to attend the king at York. When war broke out Charles deputed him to summon to surrender the castles of Banbury and Warwick, and other strongholds which were being rapidly filled with ammunition and rebels. He went with Charles to Oxford, remaining there till his surrender in 1646. He witnessed the battle of Edgehill, where he afterwards made an exact survey of the field, noting how the armies were drawn up, and where and in what direction the various movements took place, and marking the graves of the slain. In Nov. 1642 he was admitted M.A. of Oxford university and in 1644 the king created him Chester herald. During his leisure at Oxford he collected material at the Bodleian and college libraries for his books. In 1646 Dugdale returned to London and compounded for his estates, which had been sequestrated, by a payment of £168. After a visit to France in 1648 he continued his antiquarian researches in London, collaborating with Roger Dodsworth (q.v.) in his *Monasticon Anglicanum*, which was published successively in single volumes in 1655, 1661 and 1673. At the Restoration he obtained the office of Norroy king-at-arms and in 1677 was created garter principal king-at-arms and was knighted. He died at Blythe hall on Feb. 10, 1686.

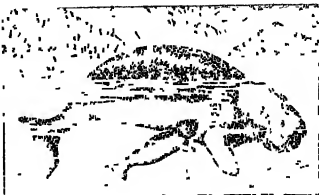
Dugdale's most important works are *Antiquities of Warwickshire* (1655, 1786), *Monasticon Anglicanum* (1655–73, 1840), *History of St. Paul's Cathedral* (1658), and *Baronage of England* (1675–76). His *Life*, written by himself up to 1678, with his diary and correspondence, and an index to his manuscript collections, was edited by William Hamper, and published in 1827.

DUGONG, one of the two existing genera of the Sirenia, or herbivorous aquatic mammals. Dugongs (*Dugong*) are distinguished from manatee by the presence in the upper jaw of the male of a pair of large tusks. There are never more than six molar teeth on each side of either jaw, and these are flat on

the grinding surface. The flippers are unprovided with nails, and the tail is broad and crescent-shaped, the bones are hard and firm.

Dugongs frequent the shallow waters of tropical seas where they may be seen basking on the surface of the water, or browsing on submarine pastures of seaweed, for which the thick lips and truncated snout pre-eminently fit them, they are gregarious. The female produces a single young one at a birth, and is remarkable for its great maternal affection.

One species, with possibly several races, is known as *Dugong dugong*. This is distributed in the Red sea, the Indian ocean and east in the Pacific as far as the Solomon and Marshall Islands, it ranges south along the coast of northern Queensland, Australia.



DUGONG (DUGONG DUGONG)

and north as far as the Lu Kiu Islands between Formosa and Japan. The islanders frequently hunt it with spears, for its flesh is an esteemed delicacy. The oil obtained from its blubber has been of commercial value and a full grown dugong may yield from 10 to 12 gallons. Adult animals are from 7 to 9 ft in length.

DUG-OUT, an underground chamber or passage dug out of a slope or bank or in a trench. The simplest form of dug-out is the small shelter for two or three men, protecting them rather against the elements than against the effects of enemy fire, larger and more elaborate dug outs will secure their occupants against bullets and splinters of shell, while the deep mined works, constructed by all belligerents on the Western front during the World War, were capable of housing whole units in complete immunity from even the heaviest bombardment, and were in many cases equipped with lighting, sleeping and living facilities. As against this security from shell fire, however, it was found that these large dug-outs often proved traps for the garrisons sheltering in them, who were unable to emerge in time to repel a hostile infantry attack, and during the later years of the war their construction was largely discontinued. The word also designates the Western plain dwellings of North American pioneers. (See also CANOE.)

DUGUAY-TROUIN, RENÉ (1673–1736), French sea captain, was born at St. Malo on June 10, 1673. On the outbreak of the war with England and Holland in 1689 he went to sea in a privateer owned by his family. As a volunteer in a vessel of 28 guns he was present in 1690 at a bloody combat with an English fleet of five merchant vessels. His family then gave him a corsair of 14 guns, and having been cast by a storm on the coast of Ireland, he burned two English ships in the River Limerick. In 1694 his vessel of 40 guns was captured by the English and he was confined in the castle of Plymouth. He escaped and obtained command of a vessel of 48 guns and captured some English vessels on the Irish coast. In 1696 he made a brilliant capture of Dutch vessels and was made *capitaine de frégate* (commander) in the royal navy. In 1704–5 he persistently raided the coasts of England. In 1706 he was raised to the rank of captain of a vessel of the line. In 1707 he captured off the Lizard the greater part of an English convoy of troops and munitions bound for Portugal. His most glorious action was the capture in 1711 of Rio Janeiro, on

which he imposed a heavy contribution. In 1715 he was made *chef d'escadre*, and in 1728 *lieutenant général des armées navales*. He died in Paris on Sept. 27, 1736.

See his own *Mémoires* (1740), and J. Poullan, *Duguay-Trouin* (1882).

DU GUESCLIN, BERTRAND (c. 1320–1380), constable of France, one of the ablest captains of the Hundred Years War, was born of the lower Breton gentry at the castle of La Motte Broons (Dinan). The name is spelled in various ways in contemporary records, e.g., Claquon, Klesquon, Guesquon, Glayaquin, etc. He first gained fame at the tournament held at Rennes in 1338 to celebrate the marriage of Charles of Blois with Joan of Penthièvre. In the war which followed between Charles of Blois and John of Montfort for the possession of the duchy of Brittany, he put himself at the head of a band of adventurers and fought on the side of Charles and of France. He fought a brilliant action at the siege of Vannes in 1342, after which he disappeared from history for a number of years.

In 1354 he was sent to England with the lords of Brittany to negotiate for the ransom of Charles of Blois, who had been defeated and captured by the English in 1347. When Rennes and Dinan were attacked by the duke of Lancaster in 1356, Du Guesclin fought against the English, and at this time he engaged in a celebrated duel with Sir Thomas Canterbury. He finally forced his way with provisions and reinforcements into Rennes, which he defended till June 1357, when the siege was raised in pursuance of the truce of Bordeaux. Shortly afterward he passed into the service of the king of France.

In 1359, 1360, 1361 and 1362 he was continually in the field though he was twice a prisoner of the English. In May 1364 he defeated the Navarrese at Cochelet and took Jean de Grailly, the famous captain of Buch, prisoner. He had previously been made lord of Pontorson (1357), of La Roche-Tesson (1361) and chamberlain (1364); he was now made count of Longueville and lieutenant of Normandy. Shortly afterward Du Guesclin was taken prisoner by Sir John Chandos at the battle of Auray, in which Charles of Blois was killed. Du Guesclin was ransomed for 100,000 crowns and was charged to lead the bands of discharged mercenaries, the famous *compagnies*, out of France. He marched with some of them into Spain, supported Henry of Trastámara against Peter the Cruel, helped to set the former upon the throne of Castile (1366) and was made constable of Castile and count of Trastámara.

He was defeated and captured by Peter's ally, the Black Prince, at Nájera in April 1367, but was soon released for a heavy ransom. Once more he fought for Henry, won the battle of Montiel (1369), reinstated him on the throne and was created duke of Molina.

In May 1370, at the command of Charles V, who appointed him constable of France, he returned to France. For nearly ten years he was engaged in fighting against the English in the south and the west of France, recovering from them the provinces of Poitou, Guenne and Auvergne.

In 1373, when the duke of Brittany sought English aid against a threatened invasion by Charles V, Du Guesclin seized the duchy, two years later he frustrated the attempt of the duke with an English army to recover it.

In 1380 he was sent into Languedoc to suppress disturbances and brigandage provoked by the harsh government of Louis I, duke of Anjou. His first act was to lay siege to the fortress of Châteauneuf-de-Randon, but on the eve of its surrender the constable died on July 13, 1380.

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DUHAMEL, GEORGES (b. 1884—), French poet, novelist and playwright, born in Paris on June 30, 1884. His early life was one of struggle and hardship. He studied medicine, and in the Quartier Latin made the acquaintance of Romans, Valdrac and Arcos, with whom he founded the group of the *Abbaye* (q.v.) at Creteil. He obtained his medical degree in 1909, and until World War I he divided his activity between scientific research and

literary work. He made his name with a series of volumes of verse. *Selon ma Loi* (1910), and *Compagnons* (1912). Several plays of his were produced about the same time. *La Lumière* (1911), *Dans l'Ombre des Statues* (1912) and *Le Combat* (1913). It was, however, his two war books, *Vie des Marijors* (1916) and *Civilisation* (1918) which brought him before the public. After that he published a number of essays mainly directed to the creation of a new religious thought independent of any denomination, and to the promotion of understanding between the peoples of different nationalities. He also wrote a number of novels, five of which formed the Salavin cycle, *Vie et aventures de Salavin*, 5 vol. (1920–32), in which the Russian influence is combined with typically French restraint and interest in everyday things of life. Also well known is the *Chronique des Pasquiers*, 10 vol., 1933–43. Later writings included (Eng. trans.) *Why France Fights* (1940) and *Suzanne and Joseph Pasquier* (1946).

DUHAMEL DU MONCEAU, HENRI LOUIS (1700–1782), French botanist and engineer, was born in Paris. His discovery of the fungus destroying the saffron plant in Gâtinais gained him admission to the Academy of Sciences in 1728. From then he devoted himself to vegetable physiology, and experimented on the growth and strength of wood, the growth of the mistletoe, on layer planting, on smut in corn, etc. He was probably the first, in 1736, to distinguish clearly between the alkalis, potash and soda. For many years he was inspector general of marine. He died in Paris on Aug. 13, 1782.

His principal works are *Tratado des arbores et arbustivos que se cultivam em France* (1755, 1768, 1835), *La Physique des arbores* (1758), *Des semences et plantations des arbores et de leur culture* (1760, 1835), *Éléments d'agriculture* (1762), *De l'exploitation des bois* (1764), *Tratado des arbores frutiferos* (1768, 1835), *Éléments de l'architecture navale* (1783).

DÜHRING, EUGEN KARL (1833–1921), German philosopher and political economist, was born on Jan. 12, 1833, at Berlin, and died on Sept. 21, 1921. After a legal education he practised at Berlin as a lawyer till 1859. A weakness of the eyes, ending in total blindness, occasioned his taking up the studies with which his name is now connected. In 1864 he became *dozent* of the university of Berlin, but, in consequence of a quarrel with the professoriate, was deprived of his licence to teach in 1874. Among his works are *Kapital und Arbeit* (1865), *Der Wert des Lebens* (1865), *Natürliche Dialektik* (1865), *Kritische Geschichte der Philosophie* (1869), *Kritische Geschichte der allgemeinen Principien der Mechanik* (1872)—one of his most successful works, *Kursus der National- und Sozialökonomie* (1873), *Der Ersatz der Religion durch Volkswissenschaften* (1883). He published his autobiography in 1882 under the title *Sache, Leben und Feme*. Dühring's philosophy claims to be emphatically the philosophy of reality. He is passionate in his denunciation of everything which, like mysticism, tries to veil reality. He is almost Lucretian in his anger against religion which would withdraw the secret of the universe from our direct gaze. His "substitute for religion" is a doctrine in many points akin to Comte and Feuerbach, the former of whom he resembles in his sentimentalism. Dühring's opinions changed considerably after his first appearance as a writer. His earlier work, *Natürliche Dialektik*, in form and matter not the worst of his writings, is entirely in the spirit of the Critical Philosophy. Later, in his movement towards Positivism, he strongly repudiates Kant's separation of phenomena from noumenon, and affirms that our intellect is capable of grasping the whole reality. In political philosophy Dühring teaches an ethical communism and attacks the Darwinian principle of struggle for existence. In economics he is best known by his vindication of the American writer H. C. Carey, who attracts him both by his theory of value, which suggests an ultimate harmony of the interests of capitalist and labourer, and also by his doctrine of "national" political economy, which advocates protection on the ground that the morals and culture of a people are promoted by having its whole system of industry completed within its own borders. His patriotism is fervent, but narrow and exclusive. He idolized Frederick the Great and denounced Jews, Greeks, and the cosmopolitan Goethe.

See H. Druskowitz, *Eugen Dühring* (Heidelberg, 1888), E. Doll, *Eugen Dühring* (Leipzig, 1892), F. Engels, *Eugen Dühring's Umwälzung der Wissenschaft* (Eng. trans. by E. Aveling, 1892, reprinted 1925), H. Vaihinger, *Hartmann, Dühring und Lange* (1876).

DUIKER or **DUKERBOK**, small African antelopes (*Cephalophus* and allies). The popular name alludes to its habit of diving into and threading its way through thick bush. The genus *Cephalophus*, together with two other African genera, *Phanotomus* and *Sylvicapra*, constitutes the tribe *Cephalophini*. Duikeers are animals of small or medium size, frequenting thick forest. The horns, usually present in both sexes, are small and straight, situated far back on the forehead, and between them rises a crestlike tuft of hair. The common duiker (*S. gymnaea*) is found in bush country from the Cape to the Zambezi, Nyasaland and Angola. The banded duiker (*C. dorsalis*) from West Africa is golden brown with black transverse bands on back and loins. *C. sylviculus*, of West Africa, is the largest species, and approaches a donkey in size. (See ANTELOPE, BOVIDAE.)

DUIIUS (or **DUELLIUS**), **GAUUS**, Roman general during the first Carthaginian War. In 260 B.C. when consul in command of the land forces in Sicily, he was appointed to supersede his colleague Cn. Cornelius Scipio Aemilianus as commander of the fleet. Recognizing that for the unskilled Romans the only chance of victory lay in fighting under conditions as similar as possible to those of a land engagement, he invented grappling irons (*corvi*) and boarding bridges, and gained a brilliant victory over the Carthaginian fleet off Mylae on the north coast of Sicily. A memorial column, adorned with the beaks of the captured ships, was set up in the Roman forum in honour of his victory.

See *Corpus Inscriptionum Latinarum*, I No. 195, Polybius I 22, Diod. Sic. xlvii 44, Frontinus, *Strat.* II 3, Florus II 2, Cicero, *De senectute* 23, Silius Italicus vi 667, and *Punic Wars*.

DUISBURG, a town in the Prussian Government district (*Regierungsbezirk*) of Düsseldorf, Germany. It is situated at the junction of the Rhine and the Ruhr, 15 mi. N. (by rail) of Düsseldorf. Pop. (1885) 47,519, (1939) 431,256. Duisburg was known to the Romans as *Castrum Deutonis* and under the Frankish kings as *Disparigum*. In the 12th century it attained the rank of an imperial free town, but in the 17th century it was acquired by Brandenburg. Of the many churches in the town, the fine Gothic Salvatorkirche (15th century) is the most interesting. The town is well provided with educational facilities, of the technical schools, the school of machinery is important. In 1655, the elector Frederick William of Brandenburg founded a Protestant university, which flourished until 1802. The great development of industry on the Rhine made Duisburg into a large industrial town. Its chief industries are connected with metallurgical manufactures, in addition it has important chemical, textile, tobacco, sugar, soap, margarine and plate glass works, as an entrepot for the industries of the Ruhr area it exports large quantities of coal. The port—one of the largest inland ports of Europe—covers an area of 632 hectares. The Rhine-Herne canal connects Duisburg with Dortmund and by way of the Dortmund-Ems canal, with German North Sea ports. It is also an important railway centre. It was occupied by the Belgians from 1912 to 1925 as a sanction under the treaty of Versailles and was heavily bombed by the British in World War II.

DUJARDIN, FELIX (1801–1860), French biologist, was born at Tours on April 5, 1801, and died at Rennes on April 8, 1860. He forsook his early training in art and engineering for natural science, from 1843 concentrating on microscopic work in zoology. In 1840 he became dean of Rennes university, but two years later resigned to become a professor. In 1835 he distinguished protoplasm from other viscid substances, designating it "sarcode" and assigning to it all the qualities of life. He made detailed studies of rhizopods which he had discovered in 1834, and of oceanic foraminifera. Besides a manual of microscopic observation, he wrote *Natural History of Infusoria* (1841).

DUKAS, PAUL (1865–1935), French composer, born in Paris Oct. 1, 1865, studied under Matthias Dubois and Guraud. His cantata *Velleda* gained for him a second Grand Prix de Rome. The symphonic poem, *L'Apprenti Sorcier*, produced at the Société

Nationale de Musique in 1897, was an immediate success. His next important work was the music which he wrote for Maeterlinck's *Arsène et Barbe Bleue*, a lyrical story in 3 acts. This was played at the Opéra Comique in 1907 and subsequently at many of the principal opera-houses in Europe. A "poème dansé," *The Peri*, in which the orchestration is extraordinarily rich, was produced in Paris in 1912 with the Russian dancer Mademoiselle Trouhanova. Dukas is a master of instrumentation, equally effective in bold colour effects and in the delicate passages which he touches in with so sure a hand. His works for piano include a sonata in E flat minor and "Variations, Interlude and Final on a theme of Rameau," while his appreciation of the great harpsichord composers led him to edit a number of the works of Rameau, Couperin and Scarlatti. He was also a critic and a writer on music, held the position of inspector of music at the Baux-Arts, was on the Conseil Supérieur of the Conservatoire and was an officer of the Légion d'Honneur.

See O. Seré, *Musiciens français d'aujourd'hui* (1911–12), G. Samazeuilh, *Un musicien français, Paul Dukas* (1913), V. d'Indy, *Emmanuel Chabrier et Paul Dukas* (1920), A. Coeuroy, *La musique française moderne* (1922).

DUK-DUK, a secret society of the New Britain Archipelago north east of New Guinea, in the South Pacific. The society has religious and political as well as social objects.

See "Duk-Duk and other Customs or Forms of Expression of the Melanesian's Intellectual Life," by Graf von Pfeil (*Journal of Anthropology* vol. 27, p. 181), E. A. Weber, *The Duk Diks* (1929).

DUKE, the title of one of the higher orders of the European nobility, and of some minor sovereign princes. The word "duke," which is derived from the Lat. *dux*, a leader, or general, originally signified a leader, and more especially a military chief. In this general sense the word survived in English literature until the 17th century, but is now obsolete.

The origin of modern dukes is twofold. The *dux* first appears in the Roman empire under the emperor Hadrian, and by the time of the Gordians has already a place in the official hierarchy. He was the general appointed to command an expedition and his functions were purely military. In the 4th century, after the separation of the civil and military administrations, there was a duke in command of the troops in each of the frontier provinces of the empire, e.g., the *dux Britanniarum*. The number of dukes increased, and in the 6th and 7th centuries there were *duces* at Rome, Naples, Rimini, Venice and Perugia. They became charged with civil as well as military functions, and even exercised considerable authority in ecclesiastical administration. Under the Byzantine emperors they were the representatives in all causes of the central power. The Roman title of duke was less dignified than that of count (*comes*, companion) which implied an honourable personal relation to the emperor (see *COUNT*). Both titles were borrowed by the Merovingian kings for the administrative machinery of the Frank empire, and under them the functions of the duke remained substantially unaltered. He was a great civil and military official, charged to watch, in the interests of the crown, over groups of several *comitatus*, or countships, especially in the border provinces. The sphere of the dukes was never rigidly fixed, and their commission was sometimes permanent, sometimes temporary. Under the Carolingians the functions of the dukes remained substantially the same, but with the decay of the royal power in the 10th century both dukes and counts gained in local authority, the number of dukes became for the time fixed, and finally title and office were made hereditary, the relation to the crown being reduced to that of more or less shadowy vassalage. (See *FUDALISM*.)

Side by side with these purely official dukedoms, however, there had continued to exist or had sprung up, either independently or in more or less of subjection to the Frank rulers, national dukedoms, such as those of the Alemanni, the Aquitains, and, later, of the Bavarians and Thuringians. These were developed from the early Teutonic custom by which the *herzog* (military chief) was elected by the nation as leader for a particular campaign, as in the case of the *heretogas* who had led the first Saxon invaders into Britain. Tacitus says of the ancient Germans *reges ex nobilitate*,

duces ex virtute sumunt, so, they elected their dukes for their warlike prowess only, and as purely military chiefs, whereas their kings were chosen from a royal family of divine descent. Sometimes the dukes so chosen succeeded in making their power permanent without taking the style of king. To this national category belong, besides the great German dukedoms, the dukes of Normandy, and the Lombard dukes of Spoleto and Benevento, who traced their origin, not to an administrative office, but to the leadership of Teutonic war bands. With the development of the feudal system the distinction between the official and the national dukedoms was more and more obliterated. By the 13th and 14th centuries the title had become purely territorial, and implied no necessary overlordship over counts and other nobles, who existed side by side with the dukes as tenants-in-chief of the crown. From this time the significance of the ducal title varies widely in different countries.

The abolition of the Holy Roman Empire in 1806 removed the shadow of vassalage from the German reigning dukes, who retained their sovereign status under the new empire. Only one, however, the grand duke of Luxembourg, remained both sovereign and independent. Besides those who were sovereign dukes in Germany there are certain "mediatized" ducal houses, e.g., that of Ratibor, which share with the dispossessed families of the Italian sovereign duchies certain royal privileges, notably that of equality of blood (*Ebenbürtigkeit*). In Italy, where titles of nobility give no precedence at court, that of duke (*duca*) has lost nearly all even of its social significance owing to lavish creations by the popes and minor sovereigns, and to the fact that the title often passes by purchase with a particular estate. Political significance it has none. Some great Italian nobles are dukes, notably the heads of the great Roman ducal families, but not all Italian dukes are great nobles.

In France the title duke at one time implied vast territorial power, as with the dukes of Burgundy, Normandy, Aquitaine and Brittany, who asserted a practical independence against the crown, though it was not till the 12th century that the title duke was definitely regarded as superior to others. At first (in the 10th and 11th centuries) it had no defined significance, and even a baron of the higher nobility called himself in charters duke, count or even marquis, indifferently. In any case the strengthening of the royal power sapped the significance of the title, until on the eve of the Revolution it implied no more than high rank and probably territorial wealth.

There were, under the *ancien régime*, three classes of dukes in France: (1) dukes who were peers (*see* PEERAGE) and had a seat in the parlement of Paris, (2) hereditary dukes who were not peers, (3) "brevet" dukes, created for life only. The French duke ranks in Spain with the "grande" (*qv*), and vice versa. In republican France the already existing titles are officially recognized, but they are now no more than the badges of distinguished ancestry. Besides the descendants of the feudal aristocracy there are in France certain ducal families dating from Napoleon I's creation of 1806 (e.g., ducs d'Albufera, de Montebello, de Feltre), from Louis Philippe (duc d'Isly, and duc d'Audiffret-Pasquier), and from Napoleon III (Malakoff, Magenta, Morny).

In England the title of duke was unknown till the 14th century, though in Saxon times the title ealdorman, afterwards exchanged for "earl," was sometimes rendered in Latin as *dux*, and the English kings till John's time styled themselves dukes of Normandy, and dukes of Aquitaine even later. In 1337 King Edward III. erected the county of Cornwall into a duchy for his son Edward the Black Prince, the first English duke. The second was Henry, earl of Lancaster, Derby, Lincoln and Leicester, created duke of Lancaster in 1351. In Scotland the title of duke was first bestowed in 1398 by Robert III. on his eldest son David, who was made duke of Rothesay, and on his brother, who became duke of Albany.

British dukes rank next to princes and princesses of the blood royal, the two archbishops of Canterbury and York, the lord chancellor, etc., but beyond this precedence they have no privileges which are not shared by peers of lower rank (*see* PEERAGE). Though their full style as proclaimed by the herald is "most

high, potent and noble prince," and they were included in the *Almanach de Gotha*, they were not recognized as the equals in blood of the crowned or mediatized dukes of the Continent, and the daughter of a British duke marrying a foreign royal prince could only take his title by courtesy, or where, under the "house laws" of certain families, a family council sanctioned the match. The eldest son of a British duke takes as a rule by courtesy the second title of his father, and ranks, with or without the title, as a marquis. The other sons and daughters bear the titles "Lord" and "Lady" before their Christian names, also by courtesy. A duke in the British peerage, if not royal, is addressed as "Your Grace" and is styled "the Most Noble" (*See* ARCHDUKE, GRAND DUKE, and, for the ducal coronet, CROWN AND CORONET) (W A P.).

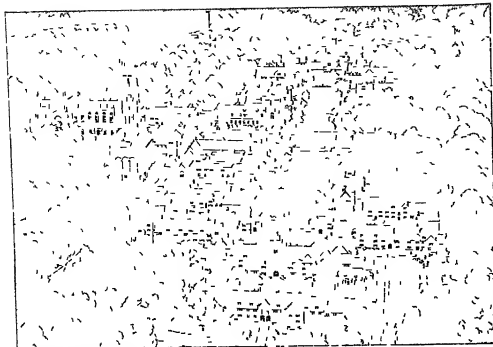
DUKE ENDOWMENT, THE, an American charity fund established by James B. Duke by indenture dated Dec. 11, 1924. The administration of the fund is vested in a self-perpetuating board of 15 trustees. The initial gift by Duke somewhat exceeded \$40,000,000 in value. Of this amount up to \$6,000,000 was to be used in connection with building and equipping Duke university. Twenty per cent of the net income is to be reinvested until such reinvestments aggregate \$40,000,000. The remaining income is distributable as follows: Duke university, 32%, hospitals not operated for private gain in North and South Carolina, 31%, Davidson college, 5%, Furman university, 5%, Johnson C. Smith university, 4%, orphanages in North and South Carolina, 10%, superannuated preachers having served in a North Carolina conference of the Methodist Episcopal Church, South, 2%, building and operating rural churches of the Methodist Episcopal Church, South, in North Carolina, 6% and 4% respectively. By his will Duke added to the fund \$10,000,000 together with two-thirds of his residuary estate. Of the \$10,000,000, \$4,000,000 may be used for providing hospital, medical school and nurses' home facilities at Duke university; the income from the balance of \$10,000,000 going to Duke university. He further provided that \$7,000,000 out of two thirds of the residuary estate are to be used for purposes of building and equipping Duke university, 10% of the income going to Duke university and 90% for the benefit of hospitals not operated for private gain in North and South Carolina.

DUKE OF EXETER'S DAUGHTER, a 15th century instrument of torture resembling the rack. (*See* TORTURE.)

DUKERIES, THE, a district in the north west of Nottinghamshire, England, forming part of Sherwood forest (*qv*). The name was taken from the existence of several adjacent demesnes of noblemen, and the character of the forest is to some extent preserved here. On the north is the Lincoln, Retford, Worksop, Sheffield branch and on the south, the Lincoln, Ollerton, Chesterfield branch of the L.N.E. railway. The following demesnes are in the district: Worksop Manor formerly belonged to the dukes of Norfolk; Welbeck Abbey, the seat of the dukes of Portland, to whom it came from the Cavendish family (dukes of Newcastle), is mainly classic in style, dating from the early 17th century, but with many subsequent additions, the fifth duke of Portland (d. 1879) built the curious series of subterranean corridors and chambers beneath the grounds. Clumber House, the seat of the dukes of Newcastle, was demolished in 1938. Thoresby Park is the seat of the Pierrepont family (earls Mansvers). Part of this demesne is a splendid tract of wild woodland.

DUKES, LEOPOLD (1810-1891), Hungarian critic of Jewish literature. He spent about twenty years in England, and from his researches in the Bodleian library and the British Museum (which contain two of the most valuable Hebrew libraries in the world) Dukes was able to complete the work of Zunz (*qv*). The most popular work of Dukes was his *Rabbinische Blumenlese* (1844), in which he collected the rabbinic proverbs and illustrated them from the gnomic literatures of other peoples. Dukes made many contributions to philology, but his best work was connected with mediæval Hebrew poets, especially Ibn Gabirol.

DUKE UNIVERSITY at Durham, North Carolina, U.S.A., owes its existence to a trust established by James B. Duke Dec. 11, 1924 (*see* DUKE ENDOWMENT). The university is



A. PAUL G. Y. A. G. C. P. H. C. C. H.

THE MAIN UNIT OF DUKE UNIVERSITY WHICH CONSISTS OF SOME 40 BUILDINGS ON A 3,000 ACRE WOODLAND CAMPUS. THE UNIVERSITY CHAPEL LEFT HAS A TOWER RISING 210 FEET ABOVE GROUND LEVEL. THE GENERAL ARCHITECTURAL SCHEME IS GOTHIC AND THE BUILDINGS ARE OF NATIVE NORTH CAROLINA STONE.

built around Trinity college, founded 1838.

After spending two years in college, including summer reading, the ablest students may enter the professional schools or continue in the advanced college or university courses.

The woman's college provides for women educational opportunities equal to those provided for men in Trinity college. The graduate school of arts and sciences with the purpose of differentiating more sharply between the college and the graduate school, gives to the work of the latter a more distinctively university character than has heretofore been the rule in the United States. This school aims at developing those especially fitted for teaching, but special emphasis is laid on research, mathematics, chemistry, physics, biology (in close co-operation with the medical school) and on the social sciences including law. The school of medicine runs through four quarters, so that a four-year medical course may be completed in three calendar years. The school of law provides liberal training in law as one of the social sciences closely allied with government, economics and business administration. A university press is maintained, and in 1943 issued the *South Atlantic Quarterly*, the *Hispanic American Historical Review*, *American Literature*, *Ecological Monographs*, *Character and Personality*, *Duke Mathematical Journal*, the *Southern Association Quarterly* and *Law and Contemporary Problems*. In the academic year 1942-43 there were 5,121 students, exclusive of the summer school, and a teaching staff of 511. The endowment was \$38,963,698.

See E. W. Knight, *Public School Education in North Carolina* (1916). W. K. Boyd, *The Story of Durham* (1925). W. P. Few, *Twenty-five Years of Trinity College* (Trinity College Presidents' Reports 1919, and *Trinity Alumni Register*, vol. 14, p. 140-167). E. C. Brooks, *Trinity Alumni Register*, vol. 1, p. 4-18, 39-103; 247-257, vol. 2, p. 248-258, 309-321, vol. 3, p. 1-12, 169-185, vol. 4, p. 1-10, W. T. Laprade, *Trinity Alumni Register*, vol. VII, p. 4-8.

(W P F X)

DUKINFIELD, a municipal borough in the Stalybridge and Hyde parliamentary division of Cheshire, Eng., 6 mi. E. of Manchester. Pop. (1951) 18,445. Area 2.7 sq. mi. It lies opposite Ashton-under-Lyne on the south bank of the Tame river which there forms the boundary between Cheshire and Lancashire.

The chief industries are cotton manufactures and engineering. In the chapel of Dukinfield hall (the hall is now demolished but the chapel is still used) Samuel Eaton (d. 1665) taught the first

Congregational church in the north of England. The borough was incorporated in 1899.

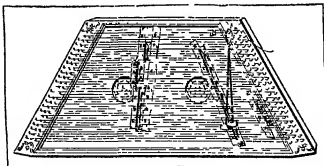
DULAC, EDMUND (1882-1953), British illustrator, was born at Toulouse, Fr., on Oct. 22, 1882, and became a British subject in 1912. His best known illustrations were for traditional fairy tales, but his work also included pictures for *The Tempest* (1908), *The Ru bairat of Omar Khayyam* (1909), *Treasure Island* (1927) and *The Marriage of Cupid and Psyche* (1951). He designed stamps for the coronation of King George VI and bank notes and stamps for the Free French, and was a successful portraitist.

Dulac died in London on May 25, 1953.

DULCIGNO, a seaport of Montenegro, Yugoslavia, on the Adriatic sea. Population 3,748, chiefly Albanians and Turks. Shut in by hills and forests, Dulcigno is the prettiest of Montenegrin towns. The old quarter, built on a promontory, is walled and has a medieval castle. There is a Roman Catholic cathedral and an ancient Latin church. Steamers call, and some shipbuilding and fishing are carried on, but the harbour lacks shelter, and is liable to silting. Like the rest of Montenegro, the port in 1941 came under Italian control.

To the Romans, who captured the town in 167 B.C. Dulcigno was known as Ulcinium or Olcumum, in the middle ages it was a noted haunt of pirates, in 1571 it was captured by the Turks from the Venetians. In 1718 it was the scene of a great Venetian defeat, in 1877 the Montenegrins took it from the Turks and in 1878 it was ceded to them by the treaty of Berlin. The Turks however held it till 1880 when the "Dulcigno demonstration" by the fleets of the great powers forced them to relinquish it.

DULCIMER, the prototype of the pianoforte (*q.v.*), an instrument of great antiquity derived originally from the east, consisting of a horizontal sound chest over which are stretched a varying number of wire strings set in vibration by strokes of little sticks or hammers. The dulcimer differed from the psalterium or psaltery chiefly in the manner of playing, the latter having the strings plucked by means of fingers or plectrum, a distinction the importance of which was fully recognized when the invention of the pianoforte had become a matter of history. It was then perceived that the psalterium in which the strings



BY COLATE Y OF "THE METROPOLITAN MUSEUM OF ART, N.Y."

16TH CENTURY FRENCH DULCIMER AND HAMMERS WITH WHICH IT IS PLAYED

The direct ancestor of the piano, the dulcimer came originally from the east, being introduced to Europe probably during the Crusades. It was popular throughout the middle ages, in the days of Louis XIV of France elaborate models were constructed.

were plucked, and the dulcimer in which they were stuck when provided with keyboards, gave rise to two distinct families of instruments, differing essentially in tone quality, in technique and in capabilities. The evolution of the psalterium stopped at the harpsichord, that of the dulcimer gave us the pianoforte. The dulcimer was very popular all over Europe throughout the middle ages.

The pantaleon, a double dulcimer, named after the inventor, Pantaleon Hebenstreit of Eisleben, a violinist, had two sound boards, 185 strings, one scale of overspun catgut and one of wire. Hebenstreit travelled to Paris with his monster dulcimer in 1705 and played before Louis XIV, who baptized it *Pantaleon Quantz* and Quirin of Blankenburg both gave descriptions of the instrument.

DULKEN, town, Prussian Rhine province, Germany, 11 mi by rail SW from Crefeld Pop. (1939) 15,952. It has a Gothic parish church. There are manufactures of linen, cotton, silk and velvet, etc., ironworks and foundries.

DULONG, PIERRE LOUIS (1785-1838), French chemist and physicist, was born at Rouen on Feb. 12 (or 13), 1785. After acting as assistant to Berthollet, he became successively professor of chemistry at the faculty of sciences and the normal and veterinary schools at Alfort, and then (1820) professor of physics at the École Polytechnique, of which he was appointed director in 1830. He died in Paris on July 18 (or 19), 1838.

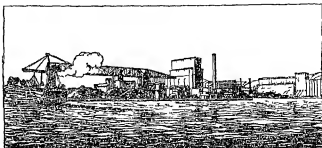
His earliest work was chemical in character. In 1811 he discovered nitrogen trichloride, during his experiments serious explosions occurred twice, and he lost an eye, besides sustaining severe injuries to his hand. He also investigated the oxygen compounds of phosphorus and nitrogen, and was one of the first to hold the hydrogen theory of acids.

Dulong's important research work in physics was on heat and was carried out in conjunction with Alexis Thérèse Petit (1791-1820), the professor of physics at the École Polytechnique. In 1815 they made the first accurate comparisons between the mercury and the air thermometer. The first published research (1816) dealt with the dilatation of solids, liquids and gases and with the exact measurement of temperature, and it was followed by one in 1817 in which they showed that Newton's law of cooling was only true for small differences in temperature, and one in 1818 on the measurement of temperature and the transference of heat, which was crowned by the French academy. In another, "On some important points in the theory of heat" (1819), they stated the "law of Dulong and Petit" dealing with atomic heats. Subsequent papers by Dulong were concerned with "New determinations of the proportions of water and the density of certain elastic fluids" (1820, with Berzelius), the property possessed by certain metals of facilitating the combination of gases (1823 with Thénard), the refracting powers of gases (1826), and the specific heats of gases (1829). In 1830 he published a research, undertaken with Arago for the Academy of Sciences, on the elasticity of steam at high temperatures. In his last paper, published posthumously in 1838, Dulong gave an account of experiments made to determine the heat developed in a chemical reaction, together with a description of the calorimeter he employed. He was so badly supplied with apparatus that he spent practically all his wealth in providing what was necessary for his researches.

DULSE, in botany, *Rhodymenia palmata*, one of the red seaweeds, consisting of flat solitary or tufted purplish-red fronds, fan-shaped in general outline and divided into numerous segments, which are often again and again divided in a forked manner. It varies much in size and degree of branching, ranging from 5 to 12 or more inches long. It grows on rocks, shellfish or larger seaweeds, and is used by the poor in Scotland and Ireland as a relish with their food. It is commonly dried and eaten raw, the flavour being brought out by long churning. In the Mediterranean it is used cooked in ragouts and made dishes.

DULUTH, a city of Minnesota, U.S.A., on the western tip of Lake Superior, at the mouth of the St. Louis river, opposite Superior, Wis., the county seat of St. Louis county. It is on federal highways 2, 53 and 61, and is served by the Chicago, St. Paul, Minneapolis and Omaha, the Duluth, Missabe and Iron

Range, the Duluth, South Shore and Atlantic, the Great Northern, the Northern Pacific, the Soo Line, the Chicago, Milwaukee, St. Paul and Pacific and the Duluth, Winnipeg & Pacific railways, by Northwest Airlines and Wisconsin Central Airlines and by many Great Lakes freight lines. The population was 104,066 in 1950 and was 101,065 in 1940 by the federal census. It is one of the coolest of U.S. cities during summer, the average spring and summer



BY COURTESY OF THE OFFICE OF THE CHIEF OF ENGINEERS DULUTH
A VIEW OF DULUTH HARBOUR BASIN SHOWING COAL DOCKS AND ELEVATORS

temperature is 62.5°. The city has a beautiful site (62.3 sq mi land area) on slopes rising to 600 ft above the level of the lake, commanding fine views of harbour, lake, river and surrounding country. A 25 mi boulevard runs along the top of the bluff back of the city, and there are 3,216 ac in public parks. The Duluth Superior harbour, with 49 mi of water frontage, formed by long narrow strips of land projecting from either shore (Minnesota point and Wisconsin point) is one of the finest in the world, and it ranks second only to New York city, among U.S. ports, in the commercial tonnage handled. It is well equipped with modern machinery for transferring cargoes, and had (1950) 21 coal docks, 7 iron ore docks, 46 wharves for general freight, 25 grain elevators and a cement storage elevator with a capacity of 114,000 bbl. Its commerce in 1949 was 56,673,901 tons, consisting largely of iron ore from the Vermilion, Cuyuna and Mesabi ranges, wheat and other grains from the Red river valley and the plains of Canada, butter and eggs from adjacent territory, automobiles and coal from Lake Erie ports. Among the manufacturing industries, the largest are the great mills of the American Steel and Wire company, established there in 1909. In 1912 a commission form of government was adopted. A zoning ordinance was adopted in 1925, and the city's development came under the supervision of a planning commission. The recreation system includes provision for flying, skiing, curling and iceboating, as well as for the more usual sports. The charitable agencies are financed through a joint community chest. There are two daily papers. In 1951 there were 37 public and 21 parochial schools, the College of St. Scholastica, the Duluth Branch of the University of Minnesota and an extension department of the University of Minnesota. The federal government maintains a coast guard station, a naval reserve training station, a national guard air base and a weather bureau there.

Duluth's Civic Symphony orchestra and its amateur Little theatre rank among the finest in the country. Its Fall festival is a colourful annual event. Points of interest include the Chisholm Memorial museum, the St. Louis County Historical Society museum, the Northern Bible Society museum, the scenic Skyline Parkway boulevard and Lake Superior North Shore drive, the municipal Zoological Gardens, Enger Memorial Observation tower and the Tweed Art galleries of the University of Minnesota, Duluth Branch.

The first visitor on record to the site of Duluth was Daniel Greysolon, Sieur Dulhut (d. 1709), a French trader and explorer, who about 1679 built a stockaded trading post at the mouth of Pigeon river on the north shore of the lake. About 1752 a second trading post, which later became a depot of Astor's American Fur company, was established in the vicinity. Permanent settlement on the site of the city began in 1853. In 1870, when the city was incorporated and the first railway reached it, the population was 3,131, and in 1880 it was only 3,483. Between 1880 and 1890, with

the development of railways, of commerce on Lake Superior and of the iron mines of northern Minnesota, the population increased nearly tenfold, to 31,115. The traffic of the port increased from 2,848,672 tons in 1890 to 46,875,416 tons in 1913, fluctuated considerably during World Wars I and II, and reached its maximum (to mid 20th century) in 1942, when the commerce was 74,314,646 tons.

DULWICH, a county and parliamentary division in the metropolitan borough of Camberwell, London, England, with stations at East, North and West Dulwich on the Southern railway. Pop (1931) 60,643. It comprises the southern end of the borough from Denmark Hill and Peckham to upper Sydenham and the Crystal Palace. West Dulwich, in which the College is situated, with its wooded lanes descending from the Sydenham hill, still retains much of its rural character. The manor, which had belonged to the Cistercian monks of Bermondsey, passed through various hands to Edward Alleyn (q.v.) in 1606. His foundation of the College of God's Gift, commonly called Dulwich College, was opened with great state on Sept. 13, 1619, in the presence of Lord Chancellor Bacon, Inigo Jones and other distinguished men. According to the letters patent the almshouse and scholars were to be chosen from the parishes of St. Giles, St. Botolph without Bishopsgate, and St. Saviour's (Southwark). By a series of statutes signed in 1626, Alleyn ordained that his school should consist of three distinct classes — (1) twelve poor scholars, (2) children of inhabitants of Dulwich, who were to be taught freely, and (3) "towne or foreign scholars." The almshouse consisted of six "poor brethren" and six "poor sisters," and the head of the teaching and governing staff was to consist of a master and a warden, who were always to be of the founder's surname.

The founder's intention to establish a great public school, with provision for university training, is shown by the statutes, but for more than two centuries the educational benefits were restricted to the twelve poor scholars. In 1857 and 1882, however, the foundation was entirely reconstituted. It now comprises two schools, called respectively Dulwich College and Alleyn's school. The former is one of the important English public schools, the buildings (1866-70) by Charles Barry contain a fine hall. The college possesses one of the leading private picture galleries in the country, the bequest mainly of Sir P. T. Bourgeois, R.A., in 1811, with later additions and a separate endowment. The Dutch and Flemish schools in particular are well represented, together with some fine examples of the Spanish, French and British. Dulwich park (72 ac.) was presented to the public in 1890.

DUMA, an old Russian word meaning thought, in connection with the adjective *Gosudarstvennaya* (of Empire) was the name of the first Russian House of Representatives, granted by Nicholas II (Oct. 30, 1905), and after the amendment of the electoral law (Dec. 24, 1905), formally sanctioned on March 5, 1906. Electors were distributed in six "curias" — large landed proprietors, small landed proprietors, peasants, capitalists, middle class, working men. Direct voting was admitted only in six large cities. The remaining population elected electors, who in their turn elected the electors to upper local units, from which the electors were finally sent to provincial assemblies to elect members of the Duma. These peasants elected in four stages (village, township district, province), small landowners in their proprietors' district, province, as well as working men (factory, district, province), big landowners, rich citizens and middle class citizens in two (district, province). The number of electors given to various constituencies varied in opposite proportion to the number of population, having enormous preponderance to the upper classes. Indeed, electors (about 200,000) had the right to choose 2,294 electors, wealthy citizens (500,000) 788, middle class (8,000,000) 590, working men (12,000,000) 112, peasants (70,000,000) 1,168. The Duma had the power to legislate, to vote the Budget and to control the administration. But its rights were extremely curtailed by the tsar's prerogative, through indiscriminate use of Orders in Council, to thwart regular legislation, by withdrawing from its competence a great part of Budget expenses, by the lack of responsibility of ministers and, last, not least, by an extremely con-

servative Upper House (the Council of Empire) composed half of old dignitaries nominated by the tsar and half of elected members from gentry, church, commerce, and learned bodies.

The first two Dumas were dissolved after 73 and 103 days of existence. The third Duma, elected after a change of electoral law, lasted for the full five years of its mandate (1907-12), and the fourth (1912-17) was nearing its end when the March revolution began.

See also RUSSIA, *History* and P. N. Milyukov's article on "The Representative System in Russia" in "*Russian Realities and Problems*," ed. J. D. Duff (1917).

DUMAGUETE, a municipality (with administrative centre and 23 *barrios* or districts) and capital of the province of Negros Oriental, of the island of Negros, Philippine islands, on Tañon Strait, 4.4 mi from Manila. Pop (1939), 22,236, of whom 67 were whites. It is the centre of a fertile agricultural region which supports a flourishing trade. Silliman Institute, a Presbyterian school, founded early in the century, has done excellent work in educating the natives. Of those aged 6 to 19, inclusive 42.2% were reported in 1939 as attending school and of those ten years old and over 53.7% were reported as literate. The vernacular is a dialect of Bisayan. There is also a meteorological station. The number of parcels of land declared for taxation in 1938 was 8,172 and the number of owners 6,117.

DUMANJUG, a municipality (with administrative centre and 23 *barrios* or districts), of the province and island of Cebu, Philippine islands, on the west coast at the mouth of the Dumanjug river, about 40 mi SW of Cebu, the provincial capital. Pop (1939), 20,973, of whom two were white. Communication with Sibonga, a municipality situated on the opposite shore of the island is accomplished through one of the few passes of the mountains in the interior. Corn and sugar are grown in the neighbouring region and there is an important cowhide trade. There is little industry, aside from agriculture. Cebuano is the vernacular.

DUMAS, ALEXANDRE (ALEXANDRE DAVY DE LA PAILLETERIE) (1802-1870), French novelist and dramatist, was born at Villers Cotterets (Aisne) on July 24, 1802. His father, General Dumas (Alexandre Davy de la Paillette) was born in San Domingo, the natural son of Antoine Alexandre Davy, marquis de la Paillette, by a negress, Marie Cessette Dumas, who died in 1772. In 1780 he accompanied the marquis to France, and there the father made a mésalliance which drove the son into enlisting in a dragoon regiment. The young Alexandre Dumas was still a private at the outbreak of the revolution, but he rose rapidly and became general of division in 1793. He was general in chief of the army of the western Pyrenees, and was transferred later to commands in the Alps and in La Vendée. Among his many exploits was the defeat of the Austrians at the bridge of Clausen on April 22, 1797, where he commanded Joubert's cavalry. He lost Napoleon's favour by plain speaking in the Egyptian campaign, and later returned to France to spend the rest of his days in retirement at Villers Cotterets, where he had married in 1792 Marie Elisabeth Labourat.

The novelist, who was the offspring of this union, was not four years old when General Dumas died (1806), leaving his family with no further resource than 30 acres of land. Mme. Dumas tried to obtain help from Napoleon, but in vain, and lived with her parents in narrow circumstances. Alexandre received the rudiments of education from a priest, and entered the office of a local solicitor. His chief friend was Adolphe de Leuven, the son of an exiled Swedish nobleman implicated in the assassination of Gustavus III. of Sweden, and the two collaborated in various vaudevilles and other pieces which never saw the footlights. Leuven returned to Paris, and Dumas was sent to the office of a solicitor at Crepy. In 1823 Dumas visited his friend in Paris, and was received by Talma. He then determined to seek his fortune in Paris. An introduction to General Foy procured for him a place as clerk in the service of the duke of Orleans, and he began to collaborate with Leuven in the production of vaudevilles and melodramas. Madame Dumas presently joined her son in Paris, where she died in 1838. Soon after his arrival in Paris Dumas

had entered on a liaison with a dressmaker, Marie Catherine Labay, and their son, the famous Alexandre Dumas fils (see below) was born in 1824. Dumas acknowledged his son in 1831, and obtained the custody of him after a lawsuit with the mother.

AS DRAMATIST AND NOVELIST

His Plays—The first piece by Dumas and Leuven to see the footlights was *La Chaise et l'Amour* (Ambigu Comique, Sept. 22, 1825), and in this they had help from other writers. Dumas had a share in another vaudeville, *La Noce et l'Enterrement* (Porte Saint Martin, Nov. 21, 1826). It was under the influence of the Shakespeare plays produced in Paris by Charles Kemble, Harriet Smithson (afterwards Mme Berlioz) and an English company that the romantic drama of *Christine* was written. The subject was suggested by a bas relief of the murder of Monaldeschi exhibited at the Salon of 1827. The piece was accepted by the Comédie Française, but its production was deferred. Meanwhile Dumas had written, in prose, *Henri III et sa cour*, which was immediately accepted by the Comédie Française and produced on Feb. 11, 1829. It was the first great triumph of the romantic drama. The brilliant stagecraft of the piece and its admirable historical setting delighted an audience accustomed to the decadent classical tragedy, and brought him the friendship of Hugo and Vigny. His patron, the duke of Orleans now gave him the librarianship of the Palais Royal. *Christine* was recast as a romantic trilogy in verse in five acts with a prologue and epilogue, with the sub title *Stockholm, Fontainebleau, Rome*, and was produced by Harel at the Odéon in March 1830.

The revolution of 1830 temporarily divided Dumas from letters. The account of his exploits should be read in his *Memoires*, where the incidents lose nothing in the telling. He finally alienated himself from the Orleans Government by being implicated in the disturbances which attended the funeral of General Lamarque in June 1832, and he received a hint that his absence from France was desirable. A tour in Switzerland undertaken on this account furnished material for the first of a long series of amusing books of travel. Dumas remained, however, on friendly and even affectionate terms with the young duke of Orleans until his death in 1842. Meanwhile he had produced *Napoleon Bonaparte* (Odéon, Jan. 10, 1831), his unwillingness to make a hero of the man who had slighted his father having been overcome by Harel, who put him under lock and key until the piece was finished. His next play, *Antony*, had a real importance in the history of the romantic theatre. It was put in rehearsal by Mlle Mars, but so unsatisfactorily that Dumas transferred it to Bocage and Mme Dorval, who played it magnificently at the Porte Saint Martin theatre on May 3, 1832. The Byronic hero Antony was a portrait of himself in his relations with Melanie Waldor, except of course in the extravagantly melodramatic denouement, when Antony, to save his mistress's honour, kills her and exclaims, "Elle me résistait, je l'ai assassinée." He produced more than 20 more plays alone or in collaboration before 1845, exclusive of dramatizations from his novels. *Richard Darington* (Porte Saint Martin, Dec. 10, 1831), the first idea of which was drawn from Sir Walter Scott's *Chronicles of the Canongate*, owed part of its great success to the admirable acting of Frederick Lemaître. *La Tour de Nesle* (Porte Saint Martin, May 29, 1832), announced as a MM. X X X and Gaillardet, was the occasion of a duel and a lawsuit with the original author, Frédéric Gaillardet, whose ms had been revised, first by Jules Janin and then by Dumas. In rapidity of movement, and in the terror it inspired, the piece surpassed *Henri III* and *Antony*. A lighter drama, *Mademoiselle de Belle-Isle* (Théâtre Français, April 2, 1839), long held the stage.

In 1840 Dumas married Ida Ferrier, an actress whom he had imposed on the theatres that took his pieces. The amiable relations which had subsisted between them for eight years were disturbed by the marriage, which is said to have been undertaken in consequence of a strong hint from the duke of Orleans, and Mme Dumas lived in Italy separated from her husband.

His Novels—As a novelist Dumas began by writing short stories, but his happy collaboration with Auguste Maquet, which

began in 1839, led to the admirable series of historical novels in which he proposed to reconstruct the whole course of French history. In 1844 he produced, with Maquet's help, that most famous of "cloak and sword" romances, *Les Trois Mousquetaires* (8 vols.), the material for which was discovered in the *Mémoires de M. d'Artagnan* (Cologne, 1701-02) of Courtlis de Sandras. The adventures of d'Artagnan and the three musketeers, the gigantic Porthos, the clever Aramis, and the melancholy Athos, who unite to defend the honour of Anne of Austria against Richelieu and the machinations of "Milady," are brought down to the murder of Buckingham in 1628. Their admirers were gratified by two sequels, *Vingt ans après* (10 vols., 1845) and *Dix ans plus tard, ou le vicomte de Bragelonne* (26 pts., 1848-50), which opens in 1660, showing us a mature d'Artagnan, a respectable captain of musketeers, and contains the magnificent account of the heroic death of Porthos. The three musketeers are as famous in England as in France. Thackeray could read about Athos from sunrise to sunset with the utmost contentment of mind, and R. L. Stevenson and Andrew Lang have paid tribute to the band in *Memoirs and Portraits and Letters to Dead Authors*. Before 1844 was out Dumas had completed a second great romance in 12 volumes, *Le Comte de Monte-Cristo*, in which he had help from Fiorentino as well as from Maquet. The idea of the intrigue was suggested by Peuchet's *Police dévouée*, and the stress laid on the earlier incidents, Dantès, Danglars and the Chateau d'If, is said to have been an afterthought. Almost as famous as these two romances is the set of Valois novels of which Henri IV is the central figure, beginning with *La Reine Margot* (6 vols., 1845), which contains the history of the struggle between Catherine of Medicis and Henry of Navarre, the history of the reign of Henry III is told in *La Dame de Monsoreau* (8 vols., 1846), generally known in English as *Chicot the Jester*, from its principal character, and in *Les Quarante cinq* (10 vols., 1847-48), in which Diane de Monsoreau avenges herself on the duke of Anjou for the death of her former lover, Bussy d'Amboise.

Much has been written about the exact share which Dumas had in the novels which bear his name. The Dumas Maquet series is undoubtedly the best, but Maquet alone never accomplished anything to approach them in value. The ms of the novels still exist in Dumas's handwriting, and the best of them bear the unmistakable stamp of his unrivelled skill as a narrator. The chief key to his enormous output is to be found in his untiring industry and amazing fertility of invention, not in the system of wholesale collaboration which was exposed with much exaggeration by Querard in his *Supercheres littéraires* and by "Eugène de Mircourt" (C. B. J. Jacquot) in his misleading *Fabrique de romans, maison Alexandre Dumas et cie* (1845). His assistants, in fact, supplied him with outlines of romances on plans drawn up by himself, and he then rewrote the whole thing. That this method was never abused it would be impossible to say, *Les Deux Diane*, for instance, a prelude to the Valois novels, is said to have been written entirely by Paul Meurice, although Dumas's name appears on the title-page.

LATER YEARS

The latter part of Dumas's life is a record of excessive toil to meet prodigal expenditure and accumulated debts. His disasters began with the building of a house in the Renaissance style, with a Gothic pavilion and an "English" park, at Saint Germain en Laye. This place, called Monte-Cristo, was governed by a crowd of hangers on of both sexes, who absorbed Dumas's large earnings and left him penniless. Dumas also founded the Theatre Historique chiefly for the performance of his own works. The enterprise was under the patronage of the duc de Montpensier, and was under the management of Hippolyte Hostein, who had been the secretary of the Comédie Française. The theatre was opened in Feb. 1847 with a dramatic version of *La Reine Margot*. Meanwhile Dumas had been the guest of the duc de Montpensier at Madrid, and made a quasi official tour to Algeria and Tunis in a Government vessel, which caused much comment in the press. Dumas had never changed his republican opinions. He greeted the revolution of 1848 with delight, and was even a candi-

date for electoral honours in the department of the Yonne. But the change was fatal to his theatrical enterprise, for the failure of which in 1850 he was made financially responsible. His son, Alexandre Dumas, was at that time living with his mother Mlle Labay, who was eventually reconciled with the elder Dumas. Father and son, though always on affectionate terms when they met, were too different in their ideas to see much of one another. After the *coup d'état* of 1851 Dumas crossed the frontier to Brussels, and two years of rapid production, and the economy of his secretary, Noël Parfait, restored something like order to his affairs. On his return to Paris in the end of 1853 he established a daily paper, *Le Mousquetaire*, for the criticism of art and letters. It was chiefly written by Dumas, whose *Mémoires* first appeared in it, and survived until 1857, when it was succeeded by a weekly paper, the *Monte Cristo* (1857-60). In 1858 Dumas travelled through Russia to the Caucasus, and in 1860 he joined Garibaldi in Sicily. After an expedition to Marselles in search of arms for the insurgents, he returned to Naples, where Garibaldi nominated him keeper of the museums. After four years' residence in Naples he returned to Paris, and after the war of '66 he visited the battlefields and produced his story of *La Pucelle prussienne*. But his powers were beginning to fail and in spite of the 1,200 volumes which he told Napoleon he had written, he was at the mercy of his creditors, and of the succession of theatrical ladies who tyrannized over him and feared nothing except the occasional visits of Dumas fils. He was finally rescued from these by his daughter, Mme Pétel, who came to live with him in 1868, and two years later, on Dec. 5, 1870, he died in his son's house at Puits, near Dieppe.

Auguste Maquet was Dumas's chief collaborator. Others were Paul Lacroix (the bibliophile "P. L. Jacob"), Paul Bocage, J. P. Mallefille and P. A. Fiorentino. The novels of Dumas may be conveniently arranged in a historical sequence. The Valois novels and the musqueteers series brought French history down to 1672. Contributions to later history are—*La Dame de volupé* (2 vols., 1864), being the memoirs of Mme de Luynes, and its sequel *Les Deux Reines* (2 vols., 1864), *La Tulipe noire* (3 vols., 1850), giving the history of the brothers de Witt, *Le Chevalier d'Armentail* (4 vols., 1853), and *Une Fille du régent* (4 vols., 1845), the story of two plots against the regent, the duke of Orleans, two books on Mme du Defland, *Mémoires d'une aveugle* (8 vols., 1856-57) and *Les Confessions de la marquise* (8 vols., 1857) both of doubtful authorship, *Olympe de Clèves* (9 vols., 1852), the story of an actress and a young Jesuit novice in the reign of Louis XV, one of his most popular novels, five books on the beginning of the Revolution down to the execution of Marie Antoinette the *Mémoires d'un médecin*, including *Joseph Balsamo* (19 pts., 1846-48), in which J. J. Rousseau, Mme du Barry and the dauphiness Marie Antoinette figure, with its sequels, *Le Collier de la reine* (9 vols., 1849-50), in which Balsamo appears under the alias of Cagliostro, *Ange Pitou* (8 vols., 1852), known in English as "The Taking of the Bastille", *La Comtesse de Charny* (19 vols., 1853-55), describing the attempts to save the monarchy and the flight to Varennes, and *Le Chevalier de maison rouge* (6 vols., 1846), which opens in 1793 with the hero's attempt to save the queen. Among the numerous novels dealing with the later revolutionary period are—*Les Blancs et les bleus* (3 vols., 1868) and *Les Compagnons de Jéhu* (7 vols., 1857). *Les Louves de Machecoul* (10 vols., 1859) deals with the rising in 1832 in La Vendée. Other famous stories are—*Les Frères corses* (2 vols., 1845); *La Femme au collier de volours* (2 vols., 1851), *Les Mohicans de Paris* (19 vols., 1854-55), detective stories which may be classed the series of *Criminel célèbres* (8 vols., 1839-41), which are, however, of doubtful authorship, *La San Félice* (9 vols., 1864-65), in which Lady Hamilton played a prominent part, with its sequels *Emma Lyonna* and *Souvenirs d'une favorite*. Of his numerous historical works other than fiction the most important is his *Louis XIV et son siècle* (4 vols., 1845). *Mes Mémoires* (20 vols., 1852-54, Eng. trans. selections by A. F. Davidson, 2 vols., 1891) is an account of his father and of his own life down to 1832. There are collective editions of his plays: 16 vols., 1834-36, and 15 vols., 1861-74), but of the 91 pieces

for which he was wholly or partially responsible, 24 do not appear in these collections.

The complete works of Dumas were issued by Michel Lévy frères in 277 vols. (1860-84). The more important novels have been frequently translated into English. There is a long list of writings on his life and his works both in English and French. The more important French authorities are his own memoirs, already cited, C. Ginel, *Alexandre Dumas et son oeuvre* (Reims, 1884), H. Pargot, *Dumas père* (Grands écrivains français series, 1902), and *Le Drame d'Alexandre Dumas* (1899), H. Blaze de Bury, *Alexandre Dumas* (1885), Philibert Andebrand, *Alexandre Dumas à la maison d'or* (1888), G. Ferry, *Derrière les Amours d'Alexandre Dumas* (1883), and F. H. Lecomte, *Alexandre Dumas* (1904). Of the English lives of Dumas perhaps the best is that by Arthur F. Davidson, *Alexandre Dumas Père his Life and Works* (1902, bibl.). See the lives by P. Fitzgerald (1873) and H. A. Spurr (1902), and essays by Andrew Lang (*Letters to Dead Authors*) and R. L. Stevenson (*Memoirs and Portraits*). See also Herbert Gorman, *The Incredible Marquis Alexandre Dumas* (1929).

DUMAS, ALEXANDRE ("DUMAS FILS") (1824-1895), French dramatist and novelist, was born in Paris on July 27, 1824, the natural son of Alexandre Dumas (see above) and the dress maker Marie Labay. "Happily," writes the son, "my mother was a good woman, and worked hard to bring me up", while of his father he says, "by a most lucky chance he happened to be well-nurtured," and "as soon as his first successes as a dramatist" enabled him to do so, "recognized me and gave me his name." Nevertheless, the lad's earlier school-life was made bitter by his illegitimacy. The cruel taunts and malevolence of his companions ranked through life (see preface to *La Femme de Claude* and *L'Affaire Clémenceau*), and left indelible marks on his character and thoughts. Nor was his paternity, however distinguished, with out peril. Alexandre the younger and elder saw life together very thoroughly, and Paris can have had few mysteries for them. Surely the son, who had been led to regard his prodigal father's resources as inexhaustible, was rudely undeceived. Coiffers were empty, and he had accumulated debts to the amount of £2,000.

Thereupon he pulled himself together. To a son of Dumas the use of the pen came naturally. Like most clever young writers—and report speaks of him as specially brilliant at that time—he opened with a book of verse, *Pêchés de jeunesse* (1847). It was succeeded in 1848 by a novel, *La Dame aux camélias*, a sort of reflection of the world in which he had been living. The book was followed, in fairly quick succession, by *Le Roman d'une femme* (1848) and *Diane de Lys* (1851). All this, however, did not deliver him from the load of debt, which, as he tells us, remained odious. In 1849 he dramatized *La Dame aux camélias*, but the rigour of the censorship and other circumstances delayed its production until Feb. 2, 1852, when Napoleon's all-powerful minister, Morny, intervened. The play succeeded then, and has held the stage ever since, less perhaps from inherent superiority to other plays which have foundered than to the great opportunities it affords to any actress of genius.

Thenceforward Dumas's career was that of a brilliant and prosperous dramatist. *Diane de Lys* (1853), *Le Demi-Monde* (1855), *La Question d'argent* (1857), *Le Fils naturel* (1858), *Le Père prodigue* (1859) followed rapidly. Debts became a thing of the past, and Dumas a wealthy man. The didactic habit was always strong upon him. "Alexandre loves preaching overmuch," wrote his father, and in most of his plays he assumes the attitude of a rigid and uncompromising moralist commissioned to impart to a heedless world lessons of deep import. The lessons themselves are mostly concerned with the "eternal feminine," by which Dumas was haunted, and differ in ethical value. Thus in *Les Idées de Madame Aubrey* (1867) he inculcates the duty of the seducer to marry the woman he has seduced, but in *La Femme de Claude* (1873) he argues the right of the husband to take the law into his own hand and kill the wife who is unfaithful and worthless—thus again defended in his novel, *L'Affaire Clémenceau*, and in his pamphlet, *L'Homme femme*, while in *Diane de Lys* he had taught that the betrayed husband was entitled to kill—not in a duel, but summarily—the man who had taken his honour, and in *L'Étrangère* (1876) the bad husband is the victim. Nor did he preach only in his plays. He preached in voluminous introductions, and pamphlets not a few. And when, in 1870 and 1872,

France was going through bitter hours of humiliation, he called her to repentance and amendments in a *Nouvelle Lettre de Junius* and two *Lettres sur les choses du jour*.

As a moralist Dumas *fit* took himself very seriously indeed. As a dramatist, didacticism apart, he had great gifts. He knew his business thoroughly, possessed the art of situation, interest, crisis—could create characters that were real and alive. His dialogue also is admirable, the repartee rapid like, the wit most keen. He was singularly happy, too, in his dramatic interpreters. The cast of *L'Etranger*, for instance, comprised Sarah Bernhardt, Sophie Croizette, Madeleine Brohan, in the female characters, and Coquelin, Got, Mounet Sully and Febvre in the male characters, and Aimée Desclée, whom he discovered, gave her genius to the creation of the part of the heroine in *Une Visite de noces*, the *Princesse Georges* and *La Femme de Claude*. He possessed wit in abundance, of a singularly trenchant kind. It shows itself less in his novels, which, however do not contain his best work, but in his introductions, whether to his own books or those of his friends, and what may be called his "occasional" writings, there is an admirable brightness. His style is that of the best French traditions. Towards his father Dumas acted a kind of brother's part, and while keeping free from his literary influence, both loved and admired him. The father never belonged to the French Academy. The son was elected on Jan 30, 1874. He died on Nov 27, 1895. See J. Claretie, *A. Dumas fils* (1883), P. Bourget, *Nouveaux Essais de psychologie contemporaine* (1885), "La Comédie de mort," by René Doumic, in *Le Petit de Juvénile: Histoire de la langue et de la littérature française*, viii pp 82 et seq., R. Doumic, *Portraits d'écrivains* (1892), Emile Zola, *Documentaires littéraires, études et portraits* (1887). (F. T. M.)

DUMAS, GUILLAUME MATHIEU, COUNT (1753-1837), French general, was born at Montpeller on Nov 23, 1753, and entered the army in 1773. He served in America and elsewhere almost continuously up to the outbreak of the Revolution. During the Revolution he acted with the moderate party, and, though he was president of the Legislative Assembly in 1791, spent most of his time abroad until the consulate. Under Napoleon he served at Austerlitz, and then with Joseph Bonaparte in Naples and Spain. He was made a count of the empire in 1810. In 1812 he was intendant-general of the Grande Armée in Russia, but was taken prisoner after the capitulation of Dresden in 1813. At the first restoration he assisted in army administration, but joined Napoleon during the Hundred Days, when he organized the National Guard. He employed his enforced retirement after the second restoration in writing his *Précis des événements militaires* (19 vols., 1817-26), the first part of which had appeared anonymously at Hamburg in 1800. The *Précis* embraces the history of the war from 1798 to the peace of 1807. A growing weakness of sight, ending in blindness, prevented him from carrying the work further, but he translated Napier's *Penninsular War* as a sort of continuation of it. In 1818 Dumas was admitted a member of the council of state, from which, however, he was excluded in 1822. After the revolution of 1830, in which he took an active part, Dumas was created a peer of France, and re-entered the council of state. He died in Paris on Oct 16, 1837.

Besides the *Précis des événements militaires*, which forms a valuable source for the history of the period, Dumas wrote *Souvenirs du lieutenant-général Comte Mathieu Dumas* (published posthumously by his son, 1839).

DUMAS, JEAN BAPTISTE ANDRÉ (1800-1884), French chemist, was born at Alais (Gard) on July 16, 1800. He wished to become an artist, but was apprenticed to an apothecary in his native town. In 1816 he moved to Geneva where he likewise was connected with a pharmacy. There he attended the lectures of Raoul Pictet (physics), Charles de la Rive (chemistry) and Augustin Pyramide de Candolle (botany).

Before he was 21 he was engaged with Dr J. L. Prévost in original work on problems of physiological chemistry, and even of embryology. In 1823 Baron Alexander von Humboldt induced him to go to Paris, which he made his home for the rest of his life. He became a member of the national legislative assembly in 1849. He acted as minister of agriculture and commerce for a few months in 1850-51, and subsequently became a senator,

president of the municipal council of Paris and master of the French mint. His official career came to a sudden end with the fall of the Second Empire. He died at Cannes on April 11, 1884. He was buried with great ceremony in the Montparnasse cemetery in Paris. A statue was erected at his birthplace in 1899.

Dumas is a great figure in the chemical history of the middle part of the 19th century. He was one of the first to criticize the electrochemical doctrines of Jöns Jakob Berzelius (*qv*), which at the time his work began were widely accepted as the true theory of the constitution of compound bodies, and opposed a unitary view to the dualistic conception of the Swedish chemist. In a paper on the atomic theory (1836) he anticipated ideas which were frequently supposed to belong to a later period. The continuation of these studies led him to the ideas about substitution ("metalepsis") which were developed about 1839 into the theory ("Older Type Theory") that in organic chemistry there are certain types which remain unchanged even when their hydrogen is replaced by an equivalent quantity of a haloid element. Many of his researches were carried out in support of these views, one of the most important being that on the action of chlorine on acetic acid to form trichloroacetic acid—a derivative of essentially the same character as the acetic acid itself. In the 1856 paper he described his methods for ascertaining vapour densities over wide temperatures, and the redeterminations which he undertook by its aid of the atomic weights of carbon and oxygen proved the forerunners of a long series which included some 30 of the elements, the results being mostly published in 1858-60. He devised a combustion method of great value in the quantitative analysis of organic substances for the estimation of nitrogen, while the classification of organic compounds into homologous series was advanced as one consequence of his researches into the acids generated by the oxidation of the alcohols.

Dumas was a prolific writer and his numerous books, essays, memorial addresses, etc., are written in a clear and graceful style. His earliest large work was a treatise (3 vols., 1836-48) on applied chemistry. His *Leçons sur la Philosophie chimique* in which he traced the development of chemistry from the earliest times was received with acclaim. In the *Essai de statique chimique des êtres organisés* (1842), written with Jean Baptiste Boussingault (1802-87), he treated the chemistry of life, both plant and animal. This book brought him into conflict with Baron Justus von Liebig (*qv*), who contended that some of his prior work had been appropriated without due acknowledgment. In 1824, in conjunction with Jean V. Audouin and Adolphe Théodore Brongniart, Dumas founded the *Annales des sciences naturelles*, and from 1840 he was one of the editors of the *Annales de chimie et de physique*. As a teacher Dumas was the first French chemist to adopt the practical laboratory teaching method, first recommended by Liebig. He used this method at the École Polytechnique and afterwards in his own laboratory. He succeeded Joseph Louis Gay Lussac at the Sorbonne. A member of the Académie des Sciences from 1832, he became its perpetual secretary in 1868, and was elected to the French Academy in 1875 to the chair left vacant by the death of Guizot.

See E. Thorpe, *Essays in Historical Chemistry* (1911), A. W. Hofmann, *Erinnerungen an vorangegangene Freunde* (1889), E. Maundrell, *L'Œuvre de J. B. Dumas* (1886), W. H. Perkin, *Journal Chemical Society* (London, 1885).

DU MAURIER, GEORGE LOUIS PALMELLA-BUSON (1834-1896), British artist and writer, was born in Paris. His father, a naturalized British subject, was the son of *émigrés* who had left France during the Reign of Terror and settled in London. In *Peter Ibbotson*, the first of the three books which won George Du Maurier late in life a reputation as novelist almost as great as he had enjoyed as artist and humorist for more than a generation, the author tells in the form of fiction the story of his singularly happy childhood which was mostly spent at Passy. After some years at a Paris school, he left (in 1851) to study chemistry at University College, London, actually setting up as an analytical chemist afterwards in Bucklersbury. But this was clearly not to be his *métier*, and the year 1856 found him once more in Paris, in the Quartier Latin this time, in the core of that art world of which in *Tribby*, 40 years later, he was to produce with pen and pencil so idealistic and fascinating a picture. Then (like Barty Josselin in *The Marian*, his third novel) he spent some years in Belgium and the Netherlands, experiencing at Antwerp in 1857, when he was working in the studio of van Lerius, the one great misfortune of his life—the gradual loss of sight in his left eye, accompanied by alarming symptoms in his right. It was a period of tragic anxiety, but the cloud was soon to show its forlorn lining, for, about Christmas time 1858, there came to the forlorn invalid a copy of *Punch's Almanac*, and with it the dawn of a new era in his career.

There can be little doubt that the study of this *Almanac*, and especially of Leech's drawings in it, fired him with the ambition to

of making his name as a graphic humorist, and it was not long after his return to London in 1860 that he sent in his first contribution (very much in Leech's manner) to Punch Mark Lemon, then editor, appreciated his talent, and on Leech's death in 1865 appointed him his successor, counseling him with wise discrimination not to try to be 'too funny,' but "to undertake the light and graceful business" and be the "romantic tenor" in Mr. Punch's little company, while Keene, as Du Maurier puts it, "with his magnificent lightly trained basso, sung the comic songs." These respective roles the two artists continued to play until the end, and Du Maurier himself in his book on *Social Pictorial Satire* has set forth their points both of resemblance and of difference. Besides working for *Punch* he illustrated several books, including his own novels, and from time to time he sent pretty and graceful pictures to the exhibitions of the Royal Society of Painters in Water Colour, to which he was elected in 1881. In 1885 the first exhibition of his works at the Fine Art Society took place. He died on October 8, 1896, and was buried in the Hampstead parish churchyard. He left a family of two sons—the elder, Major Guy Du Maurier (1865-1915), a soldier who became more widely known in 1909 as author of the military play *An Englishman's Home*, and the second, Gerald (later, Sir), a well known actor—and three daughters.

See Thomas Armstrong C.B., a *Memor* (1912) and T. Martin Wood, *George Du Maurier* (1913). Other volumes containing information about Du Maurier's life and work are M. H. Spielmann, *The History of Punch*, Felix Mescheles, *In Bohemia with Mr. Maurier* (1888), *Harper's Magazine* (Sept. 1897, June 1898). See also Ruskin, *Art of England*, Lecture 5, Pennell, *Pen Drawing and Pen-Draughtsmen*, and Muther, *Modern Painting* (F. W. W.).

DUMBARTON, a royal, large and parliamentary burgh, seaport, and the county town, Dumbartonshire, Scotland, on the river Leven, near its confluence with the Clyde, 1½ mi. NW of Glasgow by the L.N.E.R. and L.M.S.R. Pop. (1938) 22,214. The Acluth ("hill of the Clyde") of the Britons, and Dumbreath ("fort of the Britons") of the Celts, it was the capital of the district of Strathclyde. Here the Romans had a naval station called Theodasa. The history of the town, however, practically centres in that of the successive fortresses on the Rock of Dumbarton, a twin peaked hill, 240 ft. high and a mile in circumference at the base. The Picts seized it in 730, the Northmen in 870, and Thomas Crawford of Jordanhill on March 31, 1571, in the interests of James VI. The castle has been held by Queen Mary's adherents, and gave them free communication with France. William Wallace was in 1305 imprisoned in the castle before he was removed to London. The higher of the two peaks is known as Wallace's seat, a tower being named after him. On the portcullis gateway are rudely carved heads of Wallace and his betrayer Queen Mary, when a child, residing in the castle for a short time. The rock is basalt, with a tendency to columnar formation.

Dumbarton was of old the capital of the earldom of Lennox, but was given up by Earl Malduyn to Alexander II, by whom it was made a royal burgh in 1221 and declared to be free from all imposts and burgh taxes. Later sovereigns gave it other privileges, and all were finally confirmed by a charter of James VI. It had the right to levy customs and dues on all vessels on the Clyde between Loch Long and the Kelvin. "Offers dues" on foreign ships entering the Clyde were also exacted. In 1700 these rights were transferred to Glasgow by contract, but were afterwards vested in a special trust created by acts of parliament.

Most of the town lies on the left bank of the Leven, but there is communication with the suburb of Bridgend on the right bank by a five-arched stone bridge. Dumbarton is controlled by provost and council. It unites with Clydebank in returning one member to parliament. The principal industry is shipbuilding. The old staple trade of the making of crown glass, begun in 1777, lapsed some 70 years afterwards when the glass duty was abolished. There are several great engineering works, besides iron foundries, breweries, and rope-yards. There are quays, docks and a harbour at the mouth of the Leven, and a pier for river steamers runs out from the Castle rock, but is now disused. The first steam navigation company was established in Dumbarton in 1815, when the "Duke of Wellington" (built in the town) pined between Dumbarton and

Glasgow. But it was not till 1844, consequent on the use of iron for vessels, that shipbuilding became the leading industry.

DUMBARTONSHIRE, western county, Scotland, bounded north by Perthshire, east by Stirlingshire, south east by Lanarkshire, south by the Clyde and its estuary, and west by Loch Long and Argyllshire. The detached parish of Kilmintilloch and part of that of Cumbernauld are enclosed between the shires of Stirling and Lanark. This formerly formed part of Stirlingshire, but was annexed in the 14th century when the earl of Wigtown, to whom it belonged, became heritable sheriff of Dumbartonshire. Dumbartonshire has a land area (excluding water) of 244 sq. mi. The north west and west are mountainous, the highest point exceeding 3,200 feet. This is a district of rocks belonging to the metamorphic series of the Highlands, into which, in the north of the county, there is a large plutonic intrusion. In the south of the county are the Kilpatrick Hills (1,300 ft.), a system of lavas, tuffs and agglomerates intercalated in the Calcareous Sandstone series. Sandstones of various ages occupy most of the rest of the county, but the Carboniferous limestone follows them in some parts, and, notably in the detached portion of the county, includes important coal measures. The boulder clay of the Carboniferous lowland is full of schistose boulders brought by glacial action from areas far to the north west. The Clyde, the Kelvin and the Leven are the only rivers of importance. The Leven flows out of Loch Lomond at Balloch and joins the Clyde at Dumbarton after a serpentine course of about 7 miles. Most of the other streams are among the mountains, where they find their way to Loch Lomond, and nearly all afford good fishing. Of the inland lakes by far the largest is Loch Lomond (q.v.). The boundary between the shires of Dumbarton and Stirling runs through the lake from the mouth of Endrick Water to a point opposite the Isle of Vow, giving about two thirds of the loch to the former county. Loch Sloy on the side of Ben Vorlich is a long, narrow lake, 812 ft. above the sea amid wild scenery. From its name the Macfarlanes took their slogan or war cry. The shores of the Gareloch, a salt water inlet 61 mi. long and 1 mi. wide, are studded with houses of those whose business lies in Glasgow. Garelochhead, and Cove and Kilcreggan at the entrance to Loch Long, are favourite summer resorts. The more important salt water inlet, Loch Long, is 17 mi. in length and varies in width from 2 m. at its mouth to about ½ m. in its upper reach. It is a dumping place for the dredgers which are constantly at work preserving the tide way of the Clyde from Dumbarton to Broomielaw. The scenery on both shores is very beautiful. Only a mile separates Garelochhead from Loch Long, and at Arrochar the distance from Tarbet on Loch Lomond is barely 14 miles. Nearly all the glens are situated in the Highland part of the shire, the principal being Glen Sloy, Glen Douglas, Glen Luss and Glen Fruin. The last is memorable as the scene of the conflict in 1603 between the Macgregors and the Colquhouns, in which the latter were almost exterminated. It was this encounter that led to the proscription of the Macgregors, including Rob Roy.

History—Prehistoric peoples have left rude forts and tumuli, and there are several remains of the wall of Antoninus, built from Forth to Clyde, and running along the north of the detached portion of the shire and through the south eastern corner of the county to Kilpatrick. Other Roman relics have been found at Duntocher, Cumbernauld and elsewhere. The shire forms part of the old Scottish territory of Lennox (*Levenachs*, "fields of the Leven"), which embraced the Vale of the Leven and the basin of Loch Lomond, or all modern Dumbartonshire, most of Stirling and parts of the shires of Renfrew and Perth. It gave the title of the earldom created in 1174 by William the Lion and of the dukedom conferred by Charles II. on his natural son, Charles, duke of Richmond and Lennox. Robert Bruce is said to have mustered his forces at Dullatur prior to the battle of Bannockburn, and died at Cardross Castle in 1329. The Covenanters in their flight from the field of Kilsyth, where in 1645 Montrose had defeated them, made their way through the southern districts. The clans of Macgregor and Macfarlane made their home in the Highland fastness and raided their Lowland neighbours.

Agriculture, Industries and Communications—The arable

lands extend chiefly along the Clyde and the Leven, and are composed of rich black loam, gravelly soil and clay. The farmers have markets on the Clyde for all kinds of stock and produce, and high farming and dairying prosper. Black faced sheep and Highland cattle are pastured on the hilly lands and Cheviots and Ayrshires on the low grounds. Oats is the principal crop (5,514 ac in 1938), potatoes, turnips, swedes and some wheat are also grown. The average size of the 662 holdings in 1938 was 64½ ac but 57% were 50 ac. or less.

Turkey red dyeing has long been a distinctive industry. The water of the Leven being singularly soft and pure, dyers and bleachers have constructed works at many places. Bleaching has been carried on since the early part of the 18th century, and cotton printing at Levenfield dates from 1768. There are large establishments at Alexandria, Bonhill, Jamestown, Renton and other towns for bleaching, dyeing and printing of cottons, calicoes and other cloths, besides yarns. The engineering works and ship building yards at Clydebank are famous, and at Dumbarton there are others. Coal and hreclay are worked, and sandstone and igneous rocks are quarried in the detached position at Kirkintilloch and Cumbernauld.

The populous districts of the county are served by the LNER. From Helensburgh to Inverarnan the West Highland line runs through beautiful scenery. The LMSR has access to Balloch from Glasgow and traverses the detached portion. Portions of the Forth and Clyde canal, connecting with the Clyde at Bowling, and opened for traffic in 1775, pass through the shire. There is regular steamer communication between Glasgow and the towns and villages on the coast.

Population and Government.—Pop (est 1938) 155,243. In 1931 Gaelic and English were spoken by 1,874 persons. The principal towns are Clydebank (est 1938 pop 47,912), Dumbarton (23,214), a royal burgh and both large burghs, the small burghs of Helensburgh (8,743), Kirkintilloch (12,845) and Milngavie (6,278), and Bonhill (1931 pop 15,565). The fourth small burgh is Cove and Kilcreggan. There are six county districts. The county returns one member to parliament, and Dumbarton, the county town, one member with Clydebank. Dumbartonshire forms a sheriffdom with the counties of Stirling and Clackmannan, and there is a resident sheriff substitute at Helensburgh, who sits also at Dumbarton and Kirkintilloch.

DUMB WAITER, originally a small oblong or circular table to hold reserve plates, knives and forks, and other necessities for a meal. It came into use in England towards the end of the 18th century, and some elegant examples were designed by Sheraton and his school. They were usually circular, with three diminishing tiers, sometimes surrounded by a continuous or interrupted pierced gallery in wood or brass. Smaller varieties are much used in England for the display of small silver objects in drawing-rooms. The term was more recently extended to mean the small elevator used to convey household commodities from one floor to another in modern apartments. It is a box like structure, about 2 ft square, built within the walls, and run with a rope and pulley.

DUM-DUM, a town and cantonment in British India, in the district of the Twenty-four Parganas, 4½ mi. N.E. of Calcutta. The name is derived from *dam dama*, meaning a raised mound, a battery. It was the headquarters of the Bengal artillery 1783–1853, when they were transferred to Meerut. It has an army rifle and ammunition factory. The town is divided between two municipalities, North Dum-Dum (pop. 1941, 5,974) and South Dum-Dum (pop. 1941, 25,838). It was at Dum-Dum that Siraj-ud-daula signed the treaty of 1757 with Clive.

At the Dum Dum foundry the hollow nosed "Dum-Dum" (Mark IV) bullets were manufactured, the supposed use of which by the British during the Boer War caused considerable comment in 1899. Their peculiarity consisted in their expanding on impact and thus creating an ugly wound, and they had been adopted in Indian frontier fighting owing to the failure of the usual type of bullets to stop the rushes of fanatical tribesmen. They were not, in fact, used during the Boer War. Other and improved forms of expanding bullet were used in India and the Sudan, the commonest methods of securing expansion being to file down

the point until the lead core was exposed and to make longitudinal slots in the nickel envelope. All these forms of bullet have come to be described colloquially, and even in diplomatic correspondence, as "dum dum bullets" and their alleged use by Russian troops in the Russo-Japanese War of 1904–05 formed the subject of a protest on the part of the Japanese government. An International declaration was made at the second Hague conference, July 29, 1899, forbidding the use of these bullets. The United States did not participate in this declaration. During World War I actual charges were made by the belligerents of the use of illegal bullets, but there was no evidence forthcoming that such use (if any) was authorized by any power.

DUMESNIL, MARIE FRANÇOISE (1713–1803), French actress, whose real name was Marchand, was born in Paris on Jan. 2, 1713, made her debut in 1737 at the Comédie Française as Clytemnestre in *Iphigène en Tauride*. She played Cleopatra, Phedre, Athalie and Hermione with great effect, and when she created Merope (1743), Voltaire says that she kept the audience in tears for three successive acts. She retired in 1776 and died on Feb. 20, 1803. She authorized the publication of a *Mémoire de Marie Françoise Dumesnil*, in reply to an attack by her rival, Clairon (1800).

DUMFRIES, a royal and large burgh and the county town, Dumfriesshire, Scotland (Gaelic, "the fort in the cope"). It lies on the left bank of the Nith, about 8 mi. from the Solway Firth and 82 mi. S.E. of Glasgow by the L.M.S.R., and is a junction for several lines. Pop. (1938) 23,797. Dumfries is a fine town, beautifully situated. St. Michael's (1746) was the church which Robert Burns attended, and in its churchyard he was buried, his remains being transferred in 1815 to the magnificent mausoleum erected in the southeast corner. The schools include an important academy. In the middle of the market place stands the old town hall, with red tower and cupola, known from its situation as the Mid Steeple. It was built by Tobias Bachup of Alloa (1708) and is now occupied by shops. The Theatre Royal, reconstructed in 1876, dates from 1787. Burns composed several prologues and epilogues for some of its actors and actresses. The Nith is crossed by three bridges and the railway viaduct. The bridge used for vehicular traffic dates from 1790–1794. Devorguilla's bridge below it, built of stone in 1280, originally consisted of nine arches (now reduced to six) and is reserved in spite of its massive appearance for foot passengers only, as is also the suspension bridge opened in 1875.

Mixwelltown, on the opposite side of the river, was amalgamated with Dumfries as from Nov. 1929. It is of modern growth and has an observatory. The leading industries comprise manufactures of tweeds, hosiery, gloves and neckties, besides the timber trade, dye works and nursery gardening. Dumfries markets for horses, cattle and sheep have always ranked with the best, and there is also a market for pork during the five months beginning with November. Dumfries was long the leading market for hare skins, being still important in this respect. The Nith is navigable at Dumfries for vessels drawing 8 ft., but the sea-borne trade is small.

Although Dumfries was the site of a camp of the Selgovian Britons, nothing is known of its early history. William the Lion (d. 1214) made it a royal burgh, but the oldest existing charter was granted by Robert II. in 1395. The town became embroiled in the struggles that ended in the independence of Scotland. It favoured the claims to the throne, first of John Balliol—whose mother Devorguilla, daughter of Alan, lord of Galloway, had done much to promote its prosperity by building the stone bridge over the Nith—and then of the Red Comyn, as against those of Robert Bruce, who drew his support from Annandale. Until nearly the close of the 16th century the burgh was exposed to frequent raids, both from freebooters on the English side and from partisans of the Douglases, Maxwells and Johnstones. James VI. was royally entertained on Aug. 3, 1617, and afterwards presented the seven incorporated trades with a silver gun to encourage craftsmen in the practice of musketry. A competition for this gun, which is now kept in the old town hall, took place annually—with a great festival every seven years—until 1831. John Mayne (1759–1836), a native of Dumfries, commemorated

the gathering in a humorous poem, "The Siller Gun." The Union with England was so unpopular that not only did the provost vote against the measure in the Scottish parliament, but the articles were burned (Nov. 20, 1706) at the Market Cross by a body of Cameronians. In both 1715 and 1745 Dumfries remained apathetic. Burns, the poet, resided here from December 1791 till his death on the 21st of July 1796. The house in which he died is still standing.

The picturesque ruins of Carlarverock Castle, which is claimed to be the "Ellangowan" of *Guy Rannering*, are 8 mi. to the south. Part of the present structure is believed to date from 1220 and once sheltered William Wallace. It withstood Edward I's siege in 1300 for two days, although garrisoned by only sixty men. Subsequently it often changed hands. In 1570 it fell into disrepair, but was restored, and in 1641 was besieged for the last time by the Covenanters. A mile and a half to the northwest of Dumfries lies Lancluden Abbey, "an old ruin," says Burns, "in a sweet situation at the confluence of the Cluden and the Nith." Originally the abbey was a convent, founded in the 12th century, but converted two centuries later into a collegiate church by Archibald, earl of Douglas. The remains of the choir and south transept disclose rich Decorated work.

DUMFRIESSHIRE, border county, Scotland, bounded south by Solway Firth, south east by Cumberland, east by Roxburghshire, north by the shires of Lanark, Peebles and Selkirk and west by Ayrshire and Kirkcudbrightshire. Area (excluding water) is 1,073 sq. mi. The county slopes gradually from uplands of 2,000 ft. in the north down to the sea, lofty hills alternating in places with stretches of tableland or rich fertile holms. The greater part belongs to the tableland of Salsburgh rock in southern Scotland, which is bordered in the north west and south of the county by old red sandstones, and broken at many points by intensive igneous rocks. Strata of Carboniferous age (among others) occur in hollows of the tableland, and at Sanquhar and Rowanburn include coal measures, which have been worked but are no longer rich. At various points within a few miles of the Solway are tracts of moss land, like Craigs Moss, Locher Moss and Longbridge Moor in the west, and Nuthery Moss in the east, all once under water, but now largely reclaimed. The county is cleft from north to south by Nithsdale, Annandale and Eskdale. The Nith (65 m.) enters the shire 16 m. from its source and flows south east to the Solway. The Annan rises near the Devil's Beef Tub, a remarkable chasm in the far north, and flows south for about 40 m. to the Solway. From the confluence of the White Esk (rising near Ettrick Pen) and the Black Esk (rising near Jock's Shoulder, 1,754 ft.) the Esk flows south east to the border, and south-west in Cumberland to the Solway. For 1 m. of its course the Esk, and for 7 m. of its course the Sark, form the boundaries between Dumfrieshire and Cumberland. Loch Skene in the north (1,750 ft. above sea), the group of lochs around Lochmaben, and Loch Urr in the west, are the principal lakes. The wild and beautiful passes of Dalveen, Enterkin and Menock, lead up from Nithsdale to the Lowther and other hills. For part of the way Enterkin pass runs between mountains rising sheer from the burn to a height of nearly 2,000 feet. Loch Skene finds an outlet in Tail burn, the water of which at a short distance from the lake leaps from a height of 200 ft. in a fine white fall known as the Grey Mare's Tail. A much-rarer fall, picture-que fall of the same name, also known as Cichope fall, occurs on the Cichope, near Thornhill. Mineral waters are found at Fota, Hartfell Spa, some three miles farther north, and Closeburn on the Solway.

History—The early populations have left hill forts in the north, stone circles (in Dunmore and Liddellburn), cairns, (Dryfisdale), tumuli and cairns (Closeburn), and sculptured stones (Dornock). The country around Nith is reported to be rich in remains. At Holmwood, near Dumfries, there stands the relic of the grove of sacred oaks from which the place derived its name, and a stone circle known locally as the Twelve Apostles. The British inhabitants were called Selgovae by the Romans. In the parish church of Ruthwell (providing the road to Crosswell) is preserved an ancient cross which tells in Runic char-

acters the story of the Crucifixion. There are traces of Roman roads which ran by Dalveen pass into Clydesdale and up the Annan to Tweeddale, and at Birrens is a well preserved Roman camp. Roman altars, pottery and coins have been found in many places. Upon the withdrawal of the Romans, the Selgovae were conquered by Scots from Ireland. The Saxon conquest of Dumfrieshire does not seem to have been thorough, the people of Nithsdale and elsewhere maintaining their Celtic institutions up to the time of David I.

Edward I besieged Carlarverock castle, and the factions of Bruce (who was lord of Annandale), John Comyn and John Balliol were at constant feud. The Border clans were always at strife until the 18th century. The hill country afforded retreat to persecuted Covenanters, who, at Sanquhar, published in 1680, their declaration against the king, anticipating the principles of the "glorious Revolution" by several years. The Jacobite sentiment made little appeal to the people.

Robert Burns farmed at Ellsland on the Nith for three years, and spent the last five years of his life at Dumfries. Thomas Carlyle was born at Ecclefechan, in a house still standing, and was buried beside his parents in the kirkyard.

Agriculture, Industries and Communications—Towards the middle of the 18th century farmers began to raise stock for the south, and 100 years later 20,000 head of heavy cattle, formerly Galloways, later mostly shorthorns and Ayrshires, were sent annually to the English markets. In 1938 there were 83,528 cattle in the county. Sheep breeding, of later origin, has attained to large dimensions (612,622 in 1938), the walks in the higher hilly country being given over to Cheviots, and the richer pasture of the low lying farms being reserved for half bred lambs, a cross of Cheviots and Leicesters or other long-wooled rams. Horse-breeding is pursued on a considerable scale. Oats is easily the largest crop, with 30,145 ac. in 1938, followed by turnips and swedes with 11,826 ac. Half the 2,691 holdings were of 50 ac or less, though the average holding was 89½ ac. Sheep, cattle, pigs, grain, wool, hides and skins are exported. Some lead ore is mined, and limestone and sandstone are quarried. In general, the manufactures are only of local importance, the chief being the woollen and hosiery industries of Dumfries and Langholm. There are distilleries at Langholm and Annan, dyeing and tanning works at Langholm. Nursery gardening and some shipping are carried on at Annan and Dumfries, and the salmon fisheries of the Nith and Annan and the Solway Firth are of value.

Of the two main lines of the L.M.S.R. between Glasgow and Carlisle, one (the former Glasgow and South Western), runs through Nithsdale, practically following the course of the river, and lower Annandale to the Border. The other (the former Caledonian railway) runs through Annandale, throwing off at Beattock a branch to Moffat, at Lockerbie a cross-country line to Dumfries, and at Kirtlebridge a line to Annan. From Dumfries westwards there is communication with Castle Douglas, Kirkcudbright, Newton Stewart, Stranraer and Portpatrick. The L.N.E.R. sends a short line to Langholm from Riddings Junction in Cumberland, giving access to Carlisle and, by the Waverley route, to Edinburgh.

Population and Government—The population was estimated in 1928 at 113,818. In 1931 Gaelic and English were spoken by 214 persons. The chief towns are Dumfries, a large burgh (est. 1938 pop. 23,797), the small burghs of Annan (9,016), Langholm (1,385), Lockerbie (6,400) and Moffat (1,990). There are nine county districts. The county returns one member to parliament. Dumfries, the county town, Annan, Lochmaben and Sanquhar, the last two being small burghs, are also burghs. Dumfries forms a sheriffdom with the shires of Kirkcudbright and Wigton, and there is a resident sheriff-substitute at Dumfries. Secondary education has been notably directed by public authorities toward carving on stone and technical classes, embracing agriculture and dairying (at Kilmarnock dairy school). There are technical schools at Dumfries, Annan, Moffat and other centres.

DUMICHEN, JOHANNES (1833-1894), German Egyptologist, was born near Grosslogau. He studied philology and theology in Berlin and Breslau, and in 1872 became professor of Egyptian at Strasbourg. In 1875-76 he directed the excavation of the temple at Dendera.

Among his works are *Baukunde des Tempels von Dendera* (1865), *Geographie der Inschriften altägyptischer Denkmäler* (4 vols., 1865-84), *Ägyptische Kalendarischkeiten* (1866), *Altägyptische Tempelschriften* (2 vols., 1867), *Historische Inschriften altägyptischer Denkmäler* (1868).

Denkmäler (2 vols, 1867-1869), *Baugeschichte und Beschreibung des Denderatempels* (Strassburg, 1877), *Die Oasen der libyschen Wüste* (1878), *Die kalendrischen Opferfesten von Medinet Habu* (1881), *Gesch. der alten Aegypten* (1878-1883), *Der Grabhügel des Psammetich in der thebanischen Nekropolis* (1884-1894)

DUMKA (pl Dumky), a Little Russian term signifying a lament and employed frequently by Dvorak in his chamber works to designate movements of a melancholy, mournful character. The English word "dumpp," signifying a melancholy mood, and also a doleful ditty, is possibly akin *Cf* also *Ger dumpp!*, meaning dull, flat, dead

DUMMLER, ERNST LUDWIG (1830-1902), German historian, the son of Ferdinand Dummiller (1777-1846), a Berlin bookseller, was born in Berlin, on Jan 2, 1830. He studied at Bonn under J. W. Lobell (1766-1863), under L. von Ranke and W. Wattenbach. He entered the faculty at Halle in 1855, became professor extraordinary (1858), and full professor (1866). In 1875 he became a member of the revised committee directing the *Monumenta Germaniae historica*, himself undertaking the direction of the section *Antiquitates*, and in 1888 became president of the central board in Berlin. His great work was the *Geschichte des ostfränkischen Reiches* (1862-65, in 2 vols., 2nd ed 1887-88, in 3 vols.) In conjunction with Wattenbach he completed the *Monumenta Alcamana* (1873), which had been begun by Philipp Jaffe, and with R. Kopke he wrote *Kaiser Otto der Grosse* (Leipzig, 1876). He edited the first and second volumes of the *Poetae latini aevi Carolini* for the *Monumenta Germaniae historica* (1881-84). Dummiller died in Berlin on Sept 11, 1902.

DUMMY, in advertising and printing, a material representation or full sized complete physical model showing the general appearance of a proposed folder, pamphlet, or other piece of printing. It is used as a guide both in sketching in the details of the various pages and in assisting the printer to follow instructions as to how the work is to appear when finished.

DUMONT, the name of a family of prominent French artists. François Dumont (1688-1726), a sculptor, best known for his figures in the church of Saint Sulpice, Paris, was the brother of the painter Jacques Dumont, known as "le Romain" (1701-1781), whose chief success was gained with a great allegorical composition for the Paris *Hôtel de Ville* in 1761. François' son Edme (1720-1775), the latter's son Jacques Edme (1761-1844), and the son of the last named, Augustin Alexander (1801-1884), were also famous sculptors. A contemporary, Jean Joseph Dumons (1687-1776), sometimes called Dumont, is best known for his designs for the Aubusson tapestries.

See G. Vattier, *Une Famille d'artistes* (1890).

DUMONT, ANDRÉ HUBERT (1809-1857), Belgian geologist, was born at Liège on Feb 15, 1809. He was professor of mineralogy and geology and afterwards rector in the university of Liège. He spent 20 years on the preparation of a geological map of Belgium (1849), and then collected materials for a geological map of Europe. The Geological Society of London awarded him the Wollaston medal in 1840, and he died at Liège on Feb 28, 1857.

See Memoir by Major-General J. E. Portlock in *Address to Geol Soc* (1858).

DUMONT, FRANÇOIS (1751-1831), French miniature painter, was born at Luneville (Meurthe), studied for a time under Jean Girardet, and in 1788 was accepted as an academicien and granted an apartment in the Louvre. He married the daughter of Antoine Vestier, the miniature painter, and had two sons, Arnside and Bias, both of whom became painters. He was one of the three greatest miniature painters of France, painting portraits of Louis XVI and Marie Antoinette, Louis XVIII and Charles X, and of almost all the important persons of his day. His own portrait was engraved both by Audouin and by Tardieu. He spent the greater part of his life in Paris, and there he died. A younger brother, known as Tony Dumont, was also a miniature painter, a pupil of his brother, a frequent exhibitor and the recipient of a medal from the Academy in 1810. Each artist signed with the surname only, and there is some controversy concerning the attribution to each of his own canvases. Many of Dumont's finest

paintings came into the collection of J. Pierpont Morgan, but others are in the Louvre, presented by the heir of Bias Dumont.

See G. C. Williamson, *The History of Portrait Miniatures* (1904), also the privately printed *Catalogue of the Collection of Miniatures of Mr J. Pierpont Morgan*, vol 1v.

DUMONT, JEAN (d 1726), French publicist, became his toriographer to the emperor, who conferred on him the title of baron de Carliscion. He died at Vienna in 1726, at an advanced age.

Among his publications are—*Mémoires politiques pour servir à la parfaite intelligence de l'histoire de la Paix de Ryswick* (The Hague, 1699, 4 vols 17mo), *Recherches modestes des causes de la présente guerre, en ce qui concerne les Provinces Unies* (1713, 12mo), *Recueil de traités depuis la Paix de Münster* (Amsterdam, 1710, 2 vols 12mo), *Corps universel diplomatique du droit des gens, contenant un recueil des traités de paix, d'alliance, etc., faits en Europe, depuis Charlemagne jusqu'à présent* (Amsterdam, 1676, and following years, 8 vols fol., continued after Dumont's death by J. Rousset), and *Batailles gagnées par le Prince Eugène de Savoie* (The Hague, 1723). Dumont was also the author of *Lettres historiques contenant ce qui se passe de plus important en Europe* (12mo). This periodical, which was commenced in 1692, two volumes appearing annually, Dumont conducted till 1710, from which time it was continued by Basnage and others until 1728. The earlier volumes are much prized.

DUMONT, PIERRE ETIENNE LOUIS (1750-1829), French political writer, was born at Geneva where his family had been citizens of good repute from the days of Calvin. He was educated for the ministry at the college of Geneva, and in 1781 was chosen one of the pastors of the city. The triumph of the aristocratic party in 1782, however, through the interference of the courts of France and Sardinia, made residence in his native town impossible, though he was not among the number of the proscribed. He therefore went to join his mother and sisters at St Petersburg (Leningrad). In 1785 Lord Shelburne took him to London as tutor to his sons. There he met Fox, Sheridan, Lord Holland and Sir S. Romilly.

In 1788 Dumont visited Paris with Romilly. During a stay of two months in that city he met Mirabeau with whom he became intimate. On his return from Paris Dumont made the acquaintance of Jeremy Bentham, and set himself to recast and edit the writings of the great English jurist in a form suitable for the ordinary reading public. This literary relationship was, according to Dumont's own account, one of a somewhat peculiar character. All the fundamental ideas and most of the illustrative material were supplied in the manuscripts of Bentham, Dumont's task was chiefly to abridge by striking out repeated matter, to supply lacunae, to secure uniformity of style, and to improve the French. The following works of Bentham were published under his editorship: *Traité de législation civile et pénale* (1802), *Théorie des peines et des récompenses* (1811), *Traité des assemblées législatives* (1815), *Traité des preuves judiciaires* (1823), and *De l'organisation judiciaire et de la codification* (1828).

In the summer of 1789 Dumont went to Paris. He contributed to Mirabeau's journal, the *Courier de Provence*, supplying it with reports as well as original articles, and also furnishing Mirabeau with speeches to be delivered or rather read in the assembly, as related in his posthumous work entitled *Souvenirs sur Mirabeau* (1832).

In 1814 the restoration of Geneva to independence induced Dumont to return to his native place, and he soon became the leader of the supreme council. Many improvements in the judicial and penal systems of his native state are due to him.

See A. P. de Candolle, *Notice sur la vie et les écrits de M. Dumont* (1829).

DUMONT D'URVILLE, JULES SÉBASTIEN CESAR (1790-1842), French navigator, was born at Conde sur-Noreau, in Normandy. He went to sea in 1807 as a novice on board the "Aquilon." During the next 12 years he gradually rose in the service, and added a knowledge of botany, entomology, English, German, Spanish, Italian and even Hebrew and Greek to the professional handicrafts of his studies. In 1820, while engaged in a hydrographic survey of the Mediterranean, he was fortunate enough to recognize the Venus of Milo (Melos) in a Greek statue recently unearthed, and to secure its preservation by the report he

presented to the French ambassador at Constantinople. In 1822 he served in the circumnavigating expedition of the "Coquille" under the command of his friend Duperrey, and on its return in 1825 he was promoted *capitaine de frégate*, and given the command of a similar enterprise, with the purpose of discovering traces of the lost explorer, La Perouse, in which he was successful. The "Astrolabe," as he renamed the "Coquille," left Toulon on April 25, 1826, and returned to Marseille on March 25, 1829, having traversed the south Atlantic, coasted the Australian continent from King George's sound to Port Jackson, charted various parts of New Zealand, and visited the Fiji islands, the Loyalty islands, New Caledonia, New Guinea, Amboyna, Van Diemen's Land, the Caroline islands, Celebes and Mauritius. Promotion to the rank of *capitaine de vaisseau* was bestowed on the commander in Aug. 1829, and in August of the following year he conveyed the exiled king Charles X. to England. On Sept. 7, 1837, he set sail from Toulon with the "Astrolabe" and its convoy "La Zélée" on a voyage of exploration in the South Polar regions. On Jan. 15, 1838, they sighted the Antarctic ice, and soon after their progress southward was blocked by a continuous bank, which they vainly coasted for 3000 m. to the east. Returning westward they visited the South Orkney islands and part of the New Shetlands, and discovered Joinville island and Louis Philippe Land, but were compelled by scurvy to seek succour at Talcahuano in Chile. Thence they proceeded across the Pacific and through the Asiatic archipelago, visiting among others the Fiji and the Pelew islands, coasting New Guinea, and circumnavigating Borneo. In 1840, leaving their sick at Hohart Town, Tasmania, they returned to the Antarctic region, and subsequently discovered Adèle Land, which D'Urville named after his wife, in 140° E. Nov. 6 found them at Toulon. On May 8, 1842, D'Urville was killed, with his wife and son, in a railway accident near Meudon. An island (also called *Kairu*) off the north coast of New Guinea and a cape on the same coast bear his name.

His principal works are—*Enumeratio plantarum quas in insulis Archipelago aut littoribus Pontis Euxini, etc.* (1822), *Voyage de la corvette "l'Astrolabe" 1826–1829* (1830–35), and *Voyage au pôle sud et dans l'Océanie 1837–1840* (1842–54), in each of which his scientific colleagues had a share, *Voyages autour du monde, résumé général des voyages de Magellan, etc.* (1833 and 1844).

DUMORTIERITE, a mineral first recorded from pegmatite in gneiss at Chaponost, near Lyons, France, and named after E. Dumortier, a French palaeontologist. It is essentially a basic aluminum borosilicate, most reliable analyses conforming to the formula $8Al_2O_3 \cdot 6SiO_2 \cdot B_2O_3 \cdot H_2O$. Crystallizing in the rhombic system, it occurs usually in fibrous or columnar aggregates of blue, lavender or almost black colour. These commonly observed colours are due to the oxides of iron and titanium always present in small amounts. The mineral is strongly pleochroic in blue and violet tints. On heating to 800° C the colour rapidly disappears. At higher temperatures B_2O_3 is volatilized and decomposition occurs with formation of mullite ($3Al_2O_3 \cdot 2SiO_2$), liquid appearing first at a temperature of 1,550° C.

On account of its high alumina content dumortierite possesses considerable advantages as a basis for refractory bodies. Dumortierite occurs as a rare constituent of pegmatites and gneisses. The best known locality is at Clap, Ariz., where it is found as dense fibres embedded in quartz. Among European localities its presence in pegmatite at Eilon (Scotland), in cordierite-gneiss at Tvedestrand (Norway), with corundum in pegmatite at Wolf shan (Silesia) may be mentioned. In company with lazulite and kyanite it occurs in quartzites at Chari (French Central Africa) and Svarbia (Madagascar). (C. E. T.)

DUMOULIN, CHARLES (MOLINAEUS) (1500–1566), French jurist, was born in Paris in 1500. He began practice as an advocate before the parlement of Paris. Dumoulin turned Calvinist, and when the persecution of the Protestants began he went to Germany, where for a long time he taught law at Strasburg, Besançon and elsewhere. He returned to France in 1557. Dumoulin had, in 1552, written *Commentarii sur l'édit du roi Henri II sur les petites dates*, which was condemned by the Sorbonne, but his *Conseil sur le fait du concile de Trente* created a still greater stir, and aroused against him both the Catholics and

the Calvinists. He was imprisoned by order of the parlement until 1564. Dumoulin was regarded by his contemporaries as the "prince of jurists." He had a considerable effect on the subsequent development of French law. He was a bitter enemy of feudalism, which he attacked in his *De feudis* (Paris, 1539). Other important works were his commentaries on the customs of Paris (Paris, 1539, 1554, Frankfurt, 1575, Lausanne, 1576), valuable as the only commentary on those in force in 1510, and the *Extracato labyrinthi dividui et individui*, a treatise on the law of surety.

A collected edition of Dumoulin's works was published in Paris in 1681, with a life by Brodeau. See also H. de Pansy, *Eloge de C. Dumoulin* (1769), Hello, *Essai sur la vie et les Ouvrages de C. Dumoulin* (1839).

DUMOURIEZ, CHARLES FRANÇOIS DU PERIER (1739–1823), French general, born at Cambrai on Jan. 25, 1739, saw his first service as a volunteer in the campaign of Rossbach. He was retired at the peace of 1763, but was subsequently employed in Corsica. Under Choiseul he was in the secret service, and on his patron's fall was imprisoned, being only released on the accession of Louis XVI. In 1774 Dumouriez was commandant of Cherbourg for ten years, and in 1788 became *maréchal de camp*. At the outbreak of the Revolution he went to Paris, where he joined the Jacobin Club. The death of Mirabeau, to whose fortunes he had attached himself, was a great blow to him, but, promoted to the rank of lieutenant general and commandant of Nantes, his opportunity came after the flight to Varennes, when he offered to march to the assistance of the Assembly. He now joined the Girondist party, and on March 15, 1792, was appointed minister of foreign affairs. He was mainly responsible for the declaration of war against Austria (April 20), and the invasion of the Low Countries was planned by him. On the dismissal of Roland, Clavière and Servan (June 13), he took the latter's post of minister of war, but resigned it two days later on account of the king's refusal to come to terms with the Assembly, and went to join the army of Marshal Luckner. After the *émée* of August 10 and Lafayette's flight he was appointed to the command of the "Army of the Centre," and at the same moment the Coalition assumed the offensive. Dumouriez acted promptly. His subordinate Kellermann repulsed the Prussians at Valmy (Sept. 20, 1792), and he himself severely defeated the Austrians at Jemappes (Nov. 6).

Defeated at Neerwinden in Mar. 1793, he ventured all on a desperate stroke. Arresting the commissioners of the Convention sent to inquire into his conduct, he handed them over to the enemy, and then attempted to persuade his troops to march on Paris and overthrow the revolutionary government. The attempt failed, and Dumouriez with the duc de Chartres (afterwards King Louis Philippe) and his brother the duc de Montpensier, fled into the Austrian camp.

In 1804 he settled in England, where the government conferred on him a pension of £1200 a year. He became a valuable adviser to the War Office in connection with the struggle with Napoleon, though the extent to which this went was only known to the public many years later. He died at Turville Park, near Henley on Thames, on March 14, 1823. His memoirs were published at Hamburg in 1794. An enlarged edition, *La Vie et les mémoires du Général Dumouriez*, appeared at Paris in 1823.

See A. von Boguslawski, *Das Leben des Generals Dumouriez* (1878–79), *Revue des deux mondes* (July 15, Aug. 1 and 15, 1884), H. Weichinger, *Le Roman de Dumouriez* (1890), A. Chugnot, *La Première Invasion, Valmy, La Retraite de Brumaire, Jemappes, La Trêve de Dumouriez* (1886–91), A. Sorel, *L'Europe et la Révolution française* (1888–92), J. Holland Rose and A. M. Broadley, *Dumouriez and the Defence of England* (1908), E. Daudet, *La Conspiration de Pichegru et les complots royalistes du midi et du nord, 1795–1797* (1901), Pouget de Saint-André, in his *Le Général Dumouriez* (1914) contends that Dumouriez has been misjudged.

DUMP (1) (Of obscure origin), a state of wonder, perplexity or melancholy. The word thus occurs particularly in the plural, in such phrases as "doleful dumps." It was also formerly used for a tune, especially one of a mournful kind. (2) (Connected with "dumpy," but appearing later than that word, and also of obscure origin), something short and thick, and hence used of many objects such as a lead counter or medal, of a coin formerly used in

Australia, formed by punching a circular piece out of a Spanish dollar, and of a short, thick bolt used in shipbuilding. (3) (Probably of Norse origin, cf. *Nor dumpa*, meaning "to fall" suddenly, with a bump) to throw down in a heap and hence particularly applied to the depositing of any large quantity of material, to the shooting of rubbish, or tilting a load from a cart. It is thus used of the method of disposal of the masses of gravel, etc., disintegrated by water in the hydraulic method of gold mining. A "dump" or "dumping ground" is thus the place where such waste material is deposited.

Dump was used for an ammunition depot in the World War. **DUMPING**, term commonly used to describe the sale of goods for export at prices lower than those charged at the same time and under like circumstances to buyers in the country of manufacture. Anti dumping legislation exists in the United States, Canada, Australia, New Zealand, the Union of South Africa, and Great Britain. In the United States, Australia and the Union of South Africa dumping is held to exist when the importation of the dumped goods is likely to result in injury to an industry within the territory concerned.

In Great Britain the anti dumping duty is chargeable subject to the following conditions:

(a) That goods are being imported at a price below the cost of production. Cost of production within the meaning of the act is 95% of the wholesale price charged at the works for consumption in the country of manufacture, subject to the deduction of any excise or similar taxes.

(b) That similar goods can be profitably manufactured in the United Kingdom (not merely in Great Britain).

(c) That by importation under (a) employment in any industry in the United Kingdom is being or is likely to be seriously affected.

(d) That the affected home industry is being carried on with reasonable efficiency and economy.

(e) That the finishing industry which uses the goods in question as material is not too hard hit by a dumping duty (the Act provides that a committee shall make a special report on the subject, to be referred for "consideration" by the board of trade).

(f) That no dumping duty shall be levied which is at variance with any treaty with a foreign State.

According to a memorandum prepared by Prof. Jacob Viner for the economic and financial section of the League of Nations, "Dumping is likely to prevail as a systematic practice only if

"(a) The exporting industry is trustified or syndicated, or

"(b) The industry, though not organized into a single unit for production or export, is dominated by one or two large concerns, each of which controls a sufficient proportion of the total output to warrant its assumption of a disproportionate part of the burden of accepting export orders at less than the prevailing domestic rates, or

"(c) The product is not standardized as between different producers, so that each producer can individualize his product by trade mark, brand, pattern, type of container or otherwise, and so escape the full pressure of price competition, or

"(d) An export bounty is granted by some agency external to the industry, such as the State, or another industry supplying the materials which the industry under consideration works up into a more finished product."

Prof. Viner also holds that protective import duties in the exporting country facilitate dumping.

According to the first report of the Committee of Commerce and International Relations of the League of Nations (1925) the common nations of which it is the result of the view is to be noted. It is held that the frequent occurrence of dumping in the case of foreign goods produces a feeling of insecurity in the home producing industry of the country which does not in any way develop and that this in turn facilitates the dumping by a foreign country. It is also held that the existence of a free trade policy in the case of some British industries has the effect of making it difficult for them to resist the dumping of foreign goods. It is also held that the existence of a free trade policy in the case of some British industries has the effect of making it difficult for them to resist the dumping of foreign goods. It is also held that the existence of a free trade policy in the case of some British industries has the effect of making it difficult for them to resist the dumping of foreign goods.

it." The value of dumping to the dumping industry is held to lie in the fact that it enables it to maintain a high level of output, thus keeping works at or near full production and reducing the incidence of overhead charges. (C. 1.)

DUNAJEC-SAN, BATTLES OF THE The Dunajec and San rivers, which, rising in the Carpathians, flow northwards across Galicia to join the Vistula on the Polish border, mark the first two stages of the great Austro-German offensive of 1915. The Russian pronunciation of the first of these rivers is Dunajetz.

Austro-German Plans—By the end of March 1915 the Austrian armies in the Carpathians were on the verge of collapse under pressure of the persistent Russian attacks (see **CARPATHIANS, BATTLES OF THE**), and it became obvious to Falkenhayn, who directed German strategy, that the available reserves of Germany must be used in the East to bolster up her principal ally—using these reserves to deal Russia a blow which would paralyse her offensive power for a time at least. Reviewing the ineffective Franco-British attacks, he decided that troops could safely be withdrawn for the Russian front. He had also arrived at a just appreciation of the seriousness of Russia's shortage of reinforcements and of munitions. Russia's situation invited attack.

For such an offensive, the choice lay between enveloping operations from the flanks or a break through attack. The poor railway communications to the Carpathians and the disorganization existing in that region as a consequence of the long winter battle excluded an operation from that flank. An enveloping movement from the northern flank—Ludendorff's favourite project—would be too distant to influence immediately the critical situation in the Carpathians. Accepting Conrad von Hotzendorff's suggestion, Falkenhayn determined on a break through attack east of Cracow between the Carpathians and the upper Vistula. This point of attack appears well chosen. No great obstacle would be met till the line of the San was reached, the Vistula would afford some protection to the left flank of the advance, and a success would immediately influence the Carpathian situation. Moreover, the enemy's line on the selected front of attack was weakly held.

Disposition of Forces—The Russian III Army, which in January held from the Vistula-Dunajec junction to about Gorlice in the Carpathian foothills only, had extended its front during the Carpathians battle. It now reached to about Mezo-Laborcz, southeast of the Dukla pass, a total front of over 100 miles. It comprised a fighting wing and a defensive wing. The left wing, which had been engaged in the last great offensive of the Carpathians battle, consisted of four corps, all somewhat exhausted. The right, the defensive wing, on which the blow was to fall, had been weakened by the withdrawal of one corps to the Bukovina and by the transfer of another corps to the left, the fighting wing it now contained two corps only, holding a front of 50 to 60 miles. The right corps, the IX, held the lower Dunajec, from its junction with the Vistula to south of Tarnow, the other, the X, extended between Tuchow and Gorlice. These two corps had been sitting inactive opposite the Austrian IV Army all winter, and the dispositions they had made were calculated for defence against Austrians, not Germans. Consequently there were neither sufficient rear lines nor alternative gun emplacements. The Army had only a single corps in reserve, the III Caucasian. The Russian army commander was Radko Dimitriev. He had some ability and was a gallant fighter, but seems to have distinguished himself more as a corps commander than as an army commander. The German XI Army, the spear point of the offensive, consisted of eight German divisions from the western front, two Austrian divisions and a cavalry division. It was assembled with great secrecy behind the right of the Austrian IV Army, opposite the Russian X Corps. Its commander was Mackensen, who had led the Lodz offensive at the end of 1914 (see **LODZ, BATTLE OF**) and was to win further fame by his victories in Serbia and Rumania. The Austrian IV Army was placed under him in addition to his own Army. He himself was subordinate to the Austrian High Command.

Mackensen's Attack—The preliminary bombardment began on May 1 and was continued during the forenoon of the 2nd. It was carried out by 1,500 guns of all calibres, and left the Russians

powerless Mackensen's army swept over the shattered trenches of the X Corps, meeting with little resistance, and pressed forward in the direction of Rzeszow and Jaroslaw. The Austrian IV Army forced the Russian IX Corps from its line on the lower Dunajec. The Austrian II and III Armies in the Carpathians also began a forward move. There followed five days of hard fighting, but the Russians were unable to stem the tide. Radko Dumitriev's reserve corps attacked gallantly but fruitlessly, his left wing had to yield the Dukla pass and the hard-won gains of the April offensive. An attempt to stand on the line of the Wistok river and the Luptów pass failed before renewed Austro-German attacks on May 8. Brusilov's VIII Army was now also involved in the retreat, and a few days later the left wing of the Russian IV Army north of the Vistula retired from the line of the Nida.

The Russians now decided to check their focus on the strong line of the river San, with the fortress of Przemyśl to support their left centre, and the Dniester marshes to protect their left flank. Mackensen's army, however, reached Jaroslaw on May 14, stormed the bridge-head next day and established itself east of the San. It extended its gains to Sieniawa on the following days and threatened to jeopardize the whole Russian position on the San. But the impetus of the attack had spent itself for the moment and the Russians were given a breathing space. Strong reinforcements were being hurried up to them, but their losses had been enormous, over 170,000 in prisoners alone.

Further Austro-German Attacks.—The second stage of the fighting began with an attack by Mackensen's forces on May 24, which forced the line of the San at and about Radymno and thrust southeast towards the Przemyśl-Lemberg railway. The Austrians simultaneously attacked Przemyśl from the south, but made little progress. The Russians now made a counter stroke on Sieniawa, north of Jaroslaw, with the III Caucasian Corps. This gallant corps stormed the Austrian positions and caused a temporary set back to Mackensen's plans. At the same time heavy attacks were made on the Austrian IV Army further north.

But the odds against the Russians were too heavy, they had little or no ammunition for their guns and practically no heavy artillery at all. Before combined attacks of the German XI and Austrian II and III Armies, Przemyśl fell on June 3, and the line here had to be withdrawn to about Grodek. The line of the lower San, north of Sieniawa, was held till June 11, when Mackensen, who had received reinforcements, attacked again and forced the whole of the San line, the Russians retiring to the last line of defence west of Lemberg. (See LEMBERG, BATTLES OF.)

By the middle of June the Russian losses in Galicia since the beginning of Mackensen's offensive included nearly 400,000 prisoners, over 300 guns and much other material. Their losses in killed and wounded had also been exceedingly heavy, for they had counter-attacked repeatedly with little artillery support. The Russians were in fact paying in flesh and blood for their lack of modern equipment. The dominance of his heavy artillery was the chief factor in Mackensen's success, the Russians had none with which to oppose it. (See WORLD WAR I.)

HISTORIOGRAPHY.—See von Falkenhayn, *General Headquarters 1914-16*, and *its Critical Decisions* (1919), A. Knox, *With the Russian Army, 1914-19* (1921), L. Ludendorff, *Ausgrenzungskrieg* (Berlin, 1919), F. von, *trans. My War Memories* (London, 1919). Dumilof, *Mit 150 000 Mann* (Berlin, 1924), French, *trans. La Guerre Mondiale* (Paris, 1927), Hoffmann, *Der Krieg der versauerten gegenseitigen* (Munich, 1925), Eng. *trans. War of Lost Opportunities* (London, 1925). (See also WORLD WAR I. BIBLIOGRAPHY.) (V P W)

DUNASH, the name of two Jewish scholars of the 10th century.

1. **DUNASH BEN LABRAT**, grammarian and poet, belonged to the brilliant circle attracted to Cordova by Hasdai, and took a large share in promoting the Jewish "Golden Age" under the Moors in Andalusia. Dunash not only helped in the foundation of a school of scientific philology, but adapted Arabian metres to Hebrew verse, and thereby gave an impulse to the neo-Hebraic poetry, which reached its highest level in Spain.

2. **DUNASH IBN TAMIM** was, like the preceding, a leader in the critical study of language among Arabic-speaking Jews. Professor Bacher says of him: "In the history of Hebrew philology Ibn

Tamim ranks as one of the first representatives of the systematic comparison of Hebrew and Arabic."

DUNBAR, GEORGE (1774-1851), English classical scholar and lexicographer, was born at Coldingham, in Berwickshire. When about 30 years of age, he settled in Edinburgh, where he became tutor in the family of Lord Provost Fettes. In 1807 he succeeded Andrew Dalzel as professor of Greek in the university, and held the post till his death. His Greek-English and English-Greek lexicon (1840), on the compilation of which he spent eight years, was the best work of its kind that had appeared in England.

The title that is known of Dunbar's life will be found in the *Caledonian Mercury* (Dec. 8, 1851).

DUNBAR, PAUL LAURENCE (1872-1906), American author, of negro descent, was born in Dayton (O.), June 27, 1872. In high school he wrote the class poem and was editor-in-chief of the school paper. While earning his living as an elevator boy, assistant in the library of Congress, etc., he continued to write, recite, and publish his work, and after 1898, the year of his marriage, he gave his full time to writing. He died of consumption at his home in Dayton, Feb. 8, 1906. His poetry was brought to the attention of American readers by William Dean Howells, who reviewed *Majors and Minors* (1896) in *Harper's Weekly* and wrote an appreciative introduction to his *Lyrics of Lowly Life* (1896), which was subsequently used in his *Complete Poems* (1913). Dunbar published numerous volumes of verse, novels and short stories. Some of his short stories and sketches, especially those dealing with the American negro, are charming, they are far superior to his novels, which deal with scenes in which the author is not so much at home. His most enduring work, however, is his poetry. Some of this is in literary English, but the best is in the dialect of his people.

See L. K. Wiggins, *Life and Works of Paul Laurence Dunbar* (Naperville (Ill.), 1907). Tributes to him by his wife, Alice Moore Dunbar, also a writer, and by others, were reprinted from the *A. M. E. Church Review* under the title *Paul Laurence Dunbar, Poet Laureate of the Negro Race*.

DUNBAR, WILLIAM (c. 1460-c. 1520), Scottish poet. He became M.A. at St Andrews in 1479 and afterwards joined the Order of Observantines Franciscans, at St Andrews or Edinburgh, proceeding to France as a wandering friar. He spent a few years in Picardy, and was still abroad when, in 1491, Bothwell's mission to secure a bride for the young James IV reached the French court. About 1500 he returned to Scotland, and became a priest at court, and a royal pensioner. His literary life begins with his attachment to James' household. He is spoken of as the rhymist of Scotland in the accounts of the English Privy Council dealing with the visit of the mission for the hand of Margaret Tudor, rather because he wrote a poem in praise of London than because, as has been stated, he held the post of laureate at the Scottish court. In 1511 he accompanied the queen to Aberdeen and commemorated her visit in verse. Other pieces, such as the *Orison* ("Queen the Gouverneur past in France"), apropos of the setting out of the regent Albany, are of historical interest, but they tell us little more than that Dunbar was alive.

One hundred and one poems have been ascribed to Dunbar. Of these at least 90 are generally accepted as his of the 11 attributed to him it would be hard to say that they should not be considered authentic. Most doubt has clung to his verse tale *The Friars of Berwick*.

Dunbar's chief allegorical poems are *The Goldyn Targe* and *The Thrusill and the Ross*. The motif of the former is the poet's futile endeavour, in a dream, to ward off the arrows of Dame Beate by Reason's "scheld of gold." When wounded and made prisoner, he discovers the true beauty of the lady when she leaves him, he is handed over to Heaven. The noise of the ship's guns, as the company sails off, wakes the poet to the real pleasures of a May morning. Dunbar works on the same theme in a shorter poem, known as *Beauty and the Prisoner*. *The Thrusill and the Ross* is a prothalamium in honour of James IV and Margaret Tudor, in which the heraldic allegory is based on the familiar beast-parliament.

The greater part of Dunbar's work is occasional—personal and

social satire, complaints (in the style familiar in the minor verse of Chaucer's English successors), orisons, and pieces of a humorous character. The last type shows Dunbar at his best, and points the difference between him and Chaucer. The best specimens of this work, of which the outstanding characteristics are sheer whimsicality and topsy-turvy humour, is *The Ballad of Kynd Kittok*. This strain runs throughout many of the occasional poems, and is not wanting in odd passages in Dunbar's contemporaries, and it has the additional interest of showing a direct historical relationship with the work of later Scottish poets, and chiefly with that of Robert Burns. Dunbar's satire is never the gentle funning of Chaucer more often it becomes invective. Examples of this type are *The Satire on Edinburgh*, *The General Satire*, the *Epitaph on Donald Owre*, and the powerful vision of *The Dance of the Seven Dandie Symms*. In the *Flying of Dunbar and Kennedy*, an outstanding specimen of a favourite northern form, analogous to the continental *estrif*, or *tensone*, he and his rival reach a height of scurrility which is certainly without parallel in English literature. This poem has the additional interest of showing the racial antipathy between the "Ingils"-speaking inhabitants of the Lothians and the "Scots" or Gaelic speaking folk of the west country.

There is little in Dunbar which may be called lyncal, and little of the dramatic. His *Interlude of the Drowchis* (*Dwarfs*) part of the play, one of the pieces attributed to him, is supposed to be a fragment of a dramatic composition. It is more interesting as evidence of his turn for whimsicality, already referred to, and may for that reason be safely ascribed to his pen. If further selection be made from the large body of miscellaneous poems, the comic poem on the physician, Andro Kennedy, may stand out as one of the best contributions to mediaeval Goliardic literature, *The Two Marut Women* and *The Wedo*, as one of the richest and most effective *pastiches* in the older alliterative style, then used by the Scottish Chaucerians for burlesque purposes, *Done is a battell on the Dragon Blak*, for religious feeling expressed in melodious verse, and the well known *Lament for the Makaris*. The main value of the last is historical, but it, too, shows Dunbar's mastery of form, even when dealing with lists of poetic predecessors.

BIBLIOGRAPHY—The chief authorities for the text of Dunbar's poems are—(a) the *Asiatic* ms (c. 1515), (b) the *Chapman* and *Myllar* prints (1568), preserved in the *Advocates' library*, Edinburgh, (c) *Bannatyne* ms (1568) in the same, (d) the *Matland Folio* ms

are caught. There are few industries, but corn, fish and potatoes are exported.

A castle was built on the cliffs at least as early as 856. In 1070 Malcolm Canmore gave it to Cospatrick, earl of Northumberland, ancestor of the earls of Dunbar and March. The fortress was an important bulwark against English invasion, and the town—which was created a royal burgh by David II—grew up under its protection. The castle was taken by Edward I, and it afforded shelter to Edward II after Barnburn. In 1336 it was besieged by the English under William, Lord Montacute, afterwards 1st earl of Salisbury, but was successfully defended by Black Agnes of Dunbar, countess of March, a member of the Murray family. Joanna Beaufort, widow of James I, chose it for her residence, and in 1479, after his escape from Edinburgh Castle, the duke of Albany concealed himself here before sailing for France, and Mary sheltered here in two crises. The regent Moray dismantled it in 1568, but its ruins are still a picturesque object on the hill above the harbour.

Battle of Dunbar—This battle was fought on the 3rd (13th) of September 1650 between the English army under Oliver Cromwell and the Scots under David Leslie, afterwards Lord Newark. It took place about 3m SE of the centre of the town, where between the hills and the sea coast there is a plain about 1m wide, through the middle of which the main road from Dunbar to Berwick runs. The plain and the road are crossed at right angles by the course of the Brocks Burn, or Spott Burn, which at first separated the hostile armies. Rising from the right bank of the Brock is Doon Hill (650ft.), which overlooks the lower course of the stream and indeed the whole field. For the events preceding the battle see GREAT REBELLION.

Cromwell, after a war of manoeuvre near Edinburgh, had been compelled by want of supplies to withdraw to Dunbar, Leslie pursued and took up a position on Doon Hill, commanding the English line of retreat on Berwick. The situation was more than difficult for Cromwell. Some officers were for withdrawing by sea, but the general chose to hold his ground, though his army was enfeebled by sickness and would have to fight on unfavourable terrain against odds of two to one. Leslie, however, who was himself in difficulties on his post among the bare hills, and was perhaps subjected to pressure from civil authorities, descended from the heights on Sept. 2 and began to edge towards his right, in order first to confront, and afterwards to surround,



BATTLE OF DUNBAR SEPT 3 1650. Oliver Cromwell with a force of 11,000 men defeated the Scots under David Leslie in one of the most complete victories of the Great Rebellion. The Scottish commander had been drawn into leaving his stand on Doon Hill for a position on the plain where Brocks Burn divided his army. Cromwell instantly seized this opportunity for a surprise stroke.

his opponent. The cavalry of his left wing stood fast, west of Doon Hill, as a pivot of manœuvre, the northern face of Doon (where the ground rises from the burn at an average slope of fifteen degrees and is even steeper near the summit) he left unoccupied. The centre of infantry stood on the forward slope of the long spur which runs east from Doon, and beyond them, practically on the plain, was the bulk of the Scottish cavalry. But if Leslie had placed himself on Cromwell's line of retreat, he had thereby placed Cromwell on his—to the latter's moral advantage. In the evening Cromwell drew up his army, under 11,000 effective

of the poems), appeared in 1884.

DUNBAR, a royal and small burgh (Gaelic, "the fort on the point"), and seaport, East Lothian, Scotland Pop (est. 1938) 3,827. Area, 1.1 sq mi. It is on the southern shore of the entrance to the Firth of Forth, 2½ mi NE of Edinburgh by the LNER. Dunbar is said to have the smallest rainfall in Scotland and is a favourite summer resort, with good golf and bathing. The ruins of the castle, and the remains of the Grey Friars' monastery, founded in 1218, at the west end of the town, and Dunbar House in High Street, formerly a mansion of the Lauderdales, but now used as barracks, are of historic interest.

There are two harbours, difficult of access owing to the number of reefs and sunken rocks. On the advent of steam the shipping declined, and even the herring fishery, which fostered a large curing trade, has now practically disappeared. Crabs and lobsters

men, along the ravine, and issued orders to attack the Scots at dawn of the 3rd (13th). The left of the Scots was ineffective, as was a part of their centre of foot on the upper part of the hillside, and the English commander proposed to deal with the remainder. Before dawn the English advanced troops crossed the ravine, attacked Doon and pinned Leslie's left, under cover of this the whole army began its manœuvre. The artillery was posted on the Dunbar side of the burn, directly opposite and north of Doon, the infantry and cavalry crossed where they could, and

formed up gradually in a line south of and roughly parallel to the Berwick road, the extreme left of horse and foot, acting as a reserve, crossed at Brookmouth House on the outer flank. The Scots were surprised in their intervals, but quickly formed up, and at first repulsed both the horse and the foot. But ere long Cromwell himself arrived with his reserve, and the whole English line advanced again. The Irish impulse enabled it to break the Scottish cavalry and repulse the foot, and Leslie's line of battle was gradually rolled up from right to left. In the words of an English officer, "The sun appearing upon the sea, I heard Nol say, 'Now let God arise, and let his enemies be scattered,' and following us as we slowly marched I heard him say, 'I profess they run.'" Driven into the broad ground, and panned between Doon Hill and the ravine, the Scots were indeed helpless. "They routed one another after we had done their work on their right wing," says the same officer. Ten thousand men, including almost the whole of the Scottish foot, surrendered, and their killed numbered three thousand. Few of the English were killed. "I do not believe," wrote Cromwell, "that we have lost twenty men."

The account of the battle of Dunbar here followed is that of C. H. Birch for which see his *Cromwell*, pp. 281 ff. and references there given. For other accounts see Carville, *Cromwell's Letters and Speeches*, letter cd; Hoening Cromwell, Baldock, *Cromwell as a Soldier*; and Gardiner, *History of the Commonwealth and Protectorate*, vol. 1.

DUNBLANE, a small burgh and parish, Perthshire, Scotland, on the left bank of Allan water, a tributary of the Forth, 5 mi. N.W. of Stirling by the L.M.S.R. Pop. (1938) 2,762. It is a place of great antiquity, with narrow streets and old-fashioned houses. Industry is limited, but a considerable amount of worsted spinning is carried on; the town is in repute as a watering place. The cathedral, by the side of the river, was one of the few ecclesiastical edifices that escaped injury at the hands of the Reformers. The first church is alleged to have been erected by Blane, a saint of the 7th century, but the cathedral was founded by David I. in 1141, and almost entirely rebuilt about 1240 by Bishop Clemens. The tower is Early Norman, the rest is Early Pointed style. After the decline of episcopacy the building was neglected for a long period, but the choir, which contains some carved oak stalls of the 16th century, and nave have been restored. From the time of the Reformation the choir only had been used as the parish church, but since its restoration the whole cathedral has been devoted to this purpose. An ancient Celtic cross, 6 ft. high, stands in the north-western corner of the nave. Of the bishop's palace only a few ruins remain. The Queen Victoria School for the sons of Scottish soldiers and sailors, to the north of Dunblane, was opened in 1908, and the chapel in the grounds in 1910. The battle-field of Sheriffmuir is about 2½ m. E. of the town.

DUNCAN, the name of two Scottish kings.

DUNCAN I. (d. 1040) was a son of Crinan or Cronan, lay abbot of Dunkeld, and became king of the Scots in succession to his maternal grandfather, Malcolm II., in 1034, having previously as *rex Cumbroorum* ruled in Strathclyde. His accession was "the first example of inheritance of the Scottish throne in the direct line." Duncan is chiefly known through his connection with Macbeth, which has been immortalized by Shakespeare. The only fact which can be ascertained with any certainty about the feud between the two princes is that Duncan was slain by Macbeth in 1040. Two of Duncan's sons, Malcolm III. Canmore and Donald V. Bane, were afterwards kings of the Scots.

DUNCAN II. (d. 1094) was a son of Malcolm III. and therefore a grandson of Duncan I. For a time he lived as a hostage in England and became king of the Scots after driving out his uncle, Donald Bane, in 1093, an enterprise in which he was helped by some English and Norman troops. He was killed in the following year.

See W. J. Stone, *Celtic Scotland* (1906, 88), and A. Lane, *His or of Scotland*, vol. 1 (1906).

DUNCAN, ADAM DUNCAN, 1st Viscount (1735–1801). Born in a small cottage at Dunfermline, Fife, on July 17, 1735, he was much active in the Jacobite rising of 1745. In Feb. 1795 he was elected by the House of Commons as a member of the North Sea fleet, appointed to command the British navy towards the end of May 1797, though in consequence of the mutiny in

the British fleet, he had been left with only the "Adamant" (50), besides his own ship the "Venerable" (74). Admiral Duncan proceeded to his station off the Texel, where lay at anchor the Dutch squadron of 15 sail of the line, under the command of Vice admiral de Winter. From time to time he caused signals to be made, as if to the main body of a fleet in the offing a stratagem which probably secured his freedom from molestation until, in the middle of June, reinforcements arrived. On Oct. 3 the admiral put into Yarmouth roads to refit, but receiving information early on the 9th that the enemy was at sea, he gave chase. On the morning of the 11th de Winter's fleet was sighted lying about 9 m. from shore, between the villages of Egmont and Camperdown. The British fleet was slightly superior in force to that of the Dutch. Shortly after midday the British ships, without waiting to form in order, broke through the Dutch line, and an engagement commenced which, after heavy loss on both sides, resulted in the taking by the British of 11 of the enemy's vessels. In recognition of this victory, Admiral Duncan was, on Oct. 21, created Viscount Duncan of Camperdown and baron of Lundie, with an annual pension of £3,000 to himself and the two next heirs to his title. The earldom of Camperdown was created for his son Robert (1785–1859) in 1831, and is still in the possession of his descendants. Lord Duncan retired in 1800, and died on Aug. 4, 1804. See Charnock, *Biog. Nav.* (1794–98); Collins, *Pearage of England*, p. 338 (1831); W. James, *Naval History of Great Britain* (1827); Yonge, *History of the British Navy*, vol. 1 (1803); Earl of Camperdown, *Admiral Duncan* (1898), vol. xvi of the Navy Record Soc. publications, contains the logs of the ships engaged at Camperdown.

DUNCAN, ISADORA (1878–1927), American dancer, was born at San Francisco (Calif.) on May 27, 1878. She began her career as a girl of 17 at Daly's theatre, New York, where she danced the part of a fairy in *A Midsummer Night's Dream*. Her early years were full of poverty and difficulty. With only the sum of \$150, the Duncans went to England in a cattle boat, and in London and Paris, before recognition was won, they nearly starved.

Isadora had already conceived the thought of interpretative dancing to awaken the world to the grace and meaning of nature dancing, spiritual expression flowing into the channels of the body. She spent hours studying the Greek vases in the Louvre. Then she danced in Pirm, Budapest, Florence and Berlin. Later, amid the ruins of the Theatre of Dionysus in Athens, she meditated on the dances of Hellas. In that atmosphere she further worked out her ideas of the dance evolved directly from nature, through the rhythmic movement of wind and wave and the winged flight of bird and bee. Her ideas were so old that, to an over-civilized world accustomed to the artificiality of the ballet and much dressed dramatic dancing, they were startlingly new. Even the Russian ballet through Michel Fokine at home and Sergei Diaghilev's *Ballets Russes* abroad was influenced by Isadora Duncan's ideas and technique after she visited St. Petersburg in 1905. In 1904 she established a school for classical dancing near Berlin, where she taught her art to girls who later became known as the Duncan dancers, another in Paris in 1914, and another in Moscow in 1921, which was closed in the spring of 1928. Isadora Duncan and her sister had a school near Tarrytown.

When she returned to her native country in 1908 the United States was puzzled and divided itself into enthusiasts and critics. But later the stage of the Metropolitan opera house itself was hers for her performances. In April 1915, with the dancers from her Paris school she danced for a month at the Century theatre, trying to interest Americans in a project for a school in her own land. One was conducted for a short time near Tarrytown, N.Y., by her sister, Elizabeth, who had much to do with the display of Isadora's genius. Conventionally minded people were estranged, however, by her erratic actions, which became more marked after an automobile tragedy in Paris, 1913, when her two children, Deirdre and Patrick, with their nurse were drowned.

She became an ardent advocate of the Soviet revolution in Russia and accepted Lenin's invitation (1921) to open the Moscow school of dancing in the palace of a former nobleman, which was given to her. Her marriage with a Russian, Sergei Essentien, ten years younger than herself, the difficulties at Ellis Island in 1922 on re-entering the United States with him, the episode of the red

scarf waved during a performance on the stage of the Symphony Hall, Boston (Oct. 22, 1922), brought on her such trials that she left America vowing never to return.

The last years of her life were pitifully tragic—in debt and difficulty in Germany and France. Her many friends rallied to establish the Duncan memorial dance school at Neuilly, rousing in all 400,000 francs. She was killed in an automobile accident at Nice on Sept. 14, 1927. Her work to a certain extent was carried on by her adopted daughters, Anna and Irma who danced, and by Elizabeth Duncan who had a school near Salzburg.

See her autobiography *My Life* (1927), Shaemas O'Sheels 'Isadora.' *New Republic* (Oct. 6, 1927), Jose Clara's 'Isadora Duncan.' *L'Art decoratif* (1913), *Le Ballet Contemporain ouvrage édité avec la collaboration de L. Bakst. Traduction française de M. D. Calvo-Corres et I. Svetlov, pseud. of Valerian Yakovlevich Iyevchenko* and Charles H. Caffin's 'Henry Matsise and Isadora Duncan,' *Camera Work* (1909).

DUNCAN, JOHN (1796-1870), Scottish theologian and Hebrist, was born at Aberdeen and studied at Marshall College. In 1836 he was ordained in the Established Church and given charge of Milton church, Glasgow. After three years as a missionary to the Jews in Budapest he was appointed, in 1843, to the chair of Oriental languages in the new Free Church college, Edinburgh. Apart from his 1838 edition of Robinson's *Lexicon of the Greek New Testament*, Duncan's writings consist largely of sermons and addresses, some of which were edited by J. Steven Sinclair (1925). He died on Feb. 26, 1870.

See Knight *Colloquia Peripatetica* (1870) and Brown *The Late Rev. J. Duncan* (1874).

DUNCAN, ROBERT KENNEDY (1868-1914), American chemist, was born near Brantford, Ont., Canada on Nov. 1, 1868. He graduated at the University of Toronto in 1892, studied at Clark university and later at Columbia university (1897-98). He taught physics and chemistry in New York and Pennsylvania high schools. From 1901 to 1906 he was professor of chemistry at Washington and Jefferson college. During parts of 1903, 1904 and 1907, he made special studies in Europe. In 1906, while attending the International Congress of Applied Chemistry in Rome, he conceived the idea of the industrial fellowship system. His plan was to assist American manufacturers in making their products in a scientific manner and to base their plans for efficient production upon scientific research. In 1907 he became professor of industrial chemistry at the University of Kansas, and the same year arranged for the establishment of the first industrial fellowship. In 1910, his work at Kansas attracted attention in Pittsburgh, and he was made professor of chemistry at the University of Pittsburgh and director of industrial research, which position he held until his death on Feb. 18, 1914. In March 1913 the Mellon Institute of Industrial Research of the University of Pittsburgh was founded by Andrew W. Mellon and Richard B. Mellon of Pittsburgh as a memorial to their father, Thomas Mellon, and also to Duncan. This placed the industrial fellowship system upon a permanent basis.

Duncan's works are noted for their high scientific accuracy. Among his more important books are *The New Knowledge* (1905), *The Chemistry of Commerce* (1907), and *Some Chemical Problems of To-day* (1911).

DUNCAN, THOMAS (1807-1845), Scottish portrait and historical painter, was born at Kinclaven, Perthshire, on May 24, 1807, and died at Edinburgh, May 25, 1845. He was a pupil of Sir William Allan. His most famous pictures are "Prince Charles Edward and the Highlanders entering Edinburgh after the battle of Prestonpans" (1843) and "Charles Edward asleep after Culloden, protected by Flora MacDonald" (1843), which has often been engraved.

DUNCAN, a city of southern Oklahoma, U.S., on federal highway 81 and the Rock Island railroad, the county seat of Stephens county. The population was 15,260 in 1950 and was 9,207 in 1940 by the federal census. There is a diversified income from agriculture, dairying, produce, livestock and oil production.

Within a few miles of the city of Duncan, there are oil and gas wells, and the city has refineries and casinghead plants and whole

sale houses dealing in oil well supplies, as well as numerous jobbers in other lines. Duncan was settled about 1890 and incorporated in 1899. It has a well equipped airport.

DUNCE, a stupid person, incapable of learning. "Duns" or "dunsman" was a name applied by their opponents to the Scotists or followers of Duns Scotus, the great schoolman. When, in the 16th century, the Scotists obstinately opposed the "new learning" the term "duns" or "dunce" became, in the mouths of the humanists and reformers, a term of abuse, a synonym for one incapable of scholarship.

DUNCKER, MAXIMILIAN WOLFGANG (1811-1886), German historian and politician, eldest son of the publisher Karl Duncker, was born at Berlin on Oct. 15, 1811. He studied at the universities of Bonn and Berlin till 1834, when he was condemned to six years' imprisonment afterwards reduced to six months, for belonging to students' societies. In 1842 he became a lecturer at Halle university. Elected to the National Assembly at Frankfurt in 1848, he joined the Right Centre party, and was chosen reporter of the projected constitution. He sat in the Erfurt assembly in 1850, and in the second Prussian chamber from 1849 to 1857. In 1859 he was assistant in the ministry of State in the Auerwald cabinet and in 1867 he became director of the Prussian archives, with which it was his task to incorporate those of Hanover, Hesse and Nassau. He retired on Jan. 1, 1875, and died at Ansbach on July 21, 1886. Duncker's fame rests mainly on his *Geschichte des Alterthums* (1st ed. 1855-57, 5th ed. in 9 vols., 1878-80, Eng. trans. by Evelyn Abbott, 1877-8).

His works include *Zur Geschichte der deutschen Reichsversammlung in Frankfurt* (1849), the anonymous *vier Monate ausserlicher Politik* (1851), *Origines Germaniae* (1840), *Die Krisis der Reformation* (1845) and *Feudalismus und Aristokratie* (1858). See his *Politischer Briefwechsel* (ed. W. Schulze, 1923), and Havm, *Das Leben Max Duncckers* (1891).

DUNCOMBE, SIR CHARLES (c. 1648-1711), English politician, was a London apprentice, who became a goldsmith and a banker, and an alderman of the City of London in 1683. Duncombe was elected M.P. for Hedon in 1685 and afterwards sat for Yarmouth in the Isle of Wight and Downton in Wiltshire. He was made receiver of the customs, and for a short time receiver of the excise, and in this capacity he profited slightly by a transaction over some exchequer bills which had been falsely endorsed. Tried before the court of the king's bench in 1699 he was found "not guilty." He represented Downton a second time from 1702 until his death. In 1709 he served as lord mayor of London. He died at Teddington on April 9, 1711.

DUNDALK, a seaport of Co. Louth, Ireland, near the mouth of the Castletown river, in Dundalk bay. Pop. of urban district (1946) 18,562. It is an important junction on the G.N. railway, by which it is 54 mi. N. from Dublin. Dundalk was a borough by prescription, and received charters from Edward III. and successive kings. It was stormed in 1315 by Edward Bruce, who here proclaimed himself king. He was defeated and killed by the English in 1318 in the neighbourhood, and was buried at Faughart, near Dundalk. Ruins of a Franciscan priory with a lofty tower may still be seen. There are distilleries, breweries, fish and jute spinning mills, salt works, etc. The town is in large part dependent for its prosperity upon the activity of the Great Northern railway, which maintains large railway shops. There are also shoe factories. Trade is in agricultural produce and livestock. The town is also the centre of sea and salmon fisheries.

DUNDEE, JOHN GRAHAM OF CLAVERHOUSE, Viscount (c. 1649-1689), Scottish soldier, was the elder son of Sir William Graham and Lady Madeline Carnegie. Educated at St. Andrews university, he served as a volunteer in France and Holland, returning to England in 1677. In 1678 he became a lieutenant, and soon afterwards captain of a troop, in the regiment commanded by his relative, the marquis of Montrose, and was employed in suppressing the rebellion of the Covenanters.

After the murder of Archbishop Sharp (1679), there were reports of rebels gathering near Glasgow, and Graham went in pursuit. On June 1, the Covenanters being in a well protected position upon the marshy ground of Drumclog, Graham advanced to the attack. Hindered by the ground, he had to wait till the

nomies. The Royal infirmary is a large institution. The Baldwin institution for imbeciles, founded in 1854 by Sir John Ogilvy, is said to be the earliest of its kind in Scotland.

Trade and Shipping—Dundee is noted first for the jute industries. Enormous quantities of the raw material are imported from India. Fabrics in jute range from the roughest sack to beautiful carpets. Another staple industry is the linen manufacture, which is also one of the oldest, although it was not till the introduction of steam power that headway was made. The chief textile products are canvas (for which the British navy is the largest customer), ropes, sheetings, sackings, carpets, etc. Dundee is also celebrated for its confectionery and preserves, especially marmalade. Other industries are bleaching and dyeing, engineering, shipbuilding, linoleum manufacturing, the making of boots and shoes, foundries, breweries, corn and flour mills and the construction of motorcars. On the front, wharves and harbour works extend for 2 mi., and the docks cover an area of 34½ ac, made up thus—Earl Grey dock, 5 ac, King William IV dock, 3½ ac, Tidal Basin, 42 ac, Victoria dock, 10½ ac, Campdown dock, 8½ ac, Fish dock, 1½ ac. There are, besides, graving docks, the ferry harbour and timber ponds. There is regular communication by steamer with London, Hull, Newcastle, Liverpool, Manchester, Belfast and Leith, besides Rotterdam, Hamburg and other continental ports. Of local excursions the two hours' run to Perth is a favourite summer trip.

Dundee returns two members to parliament. The city council consists of the lord provost, bailies and councillors. The corporation owns the gas, electricity and water supplies (the latter drawn from an artificial loch at Moni Rie to the NE, and the loch of Lintrathen, 18 mi. to the NW).

History—The name of the city is derived most probably from the Gaelic *Dun Taw*, "the fort of the Tay," of which the Latin *Todunum* is a transliteration—the derivation pointing to the fact of a Pictish settlement on the site. Its earliest authentic mention is in a deed of gift by David, earl of Huntingdon, younger brother of William the Lion, dated about 1200, in which it is designated as "Dunde." Shortly afterward it was erected into a royal burgh by William the Lion. Edward I is said to have removed its charter. Robert Bruce and successive kings confirmed its privileges and rights, and Charles I finally granted it its great charter. Here Wallace finished his education, and here he slew young Selby, son of the English constable, in 1291. In that year the town fell into the hands of the English, and it was while engaged in besieging the castle in 1297 that Wallace withdrew to fight the battle of Stirling Bridge. In their incursion into Scotland under John of Gaunt the English captured and partially destroyed the town in 1385, but retreated to meet a counter-invasion of their own country. The English seized it again for a brief space during one of the first earl of Hertford's devastating raids in the reign of Edward VI. Dundee bore such a prominent part in propagating the Reformed doctrines that it was styled "the Scottish Geneva." The marquess of Montrose sacked it in 1644 and then burned a considerable portion of it. Charles II

dated Jan. 25, 1689, raising it to the status of a city, and since 1892 its chief magistrate has been styled lord provost. In 1594 it was created a county of a city.

Men who were born or lived in Dundee include Hector Boece (1465–1536), Viscount Dundee (1643–89), James Halyburton, the reformer (1518–89), many of the Scrymgeours and Wedderburns, and James Chalmers, the post office reformer. George Constable of Wallace Crugie, the prototype of Jonathan Oldbuck in Sir Walter Scott's *Antiquary*, lived in Seagate, and William Thom (1798–1848), the writer of *The Rhymes of a Handloom Weaver*, was buried in the Western cemetery.

Suburbs—Broughty Ferry lies on the Firth of Tay, 3½ mi. E. of Dundee. The name is a corruption of Brugh or Burgh Tay, in allusion to the fortress standing on the rock that juts into the Firth. It is believed that a stronghold has occupied this site since Pictish times. The later castle, built in 1498, fell into the hands of the English in 1547 and was held by them for three years. Gradually growing more or less ruinous it was acquired by the government in 1855, repaired, strengthened and converted into a Tay defense, mounting several heavy guns. Owing to its healthful and convenient situation, Broughty Ferry became a favourite residence of Dundee merchants. To the north-west lies Benzie, Campdown House is in the parish. Fowlis, 5 mi. NW, is remarkable for its 15th century church, with carved ambry and rood screen (curious representation of the Crucifixion), decorated font, crocketed door canopy and several pictures. The ruined castle adjoining the church ultimately became a dwelling for labourers. Lundie, 3 mi. farther out in the same direction, contains several lakelets, and its kirkyard is the burial place of the earls of Camperdown. Tealing, 4 mi. N. of Dundee, was the scene of the ministry of John Glas before he was deposed for heresy. Newport and Wormit, on the opposite bank of the Tay, are connected with Dundee by steam ferry.

DUNDERLANDSDAL, a valley of northern Norway, draining southwestward from the neighbouring glaciers to the Rananfjord (lat. 66° 20' N.). Valuable deposits of iron ore (magnetite and pyrites), first worked in 1902, occur there. At the mouth of the river is Mo, a considerable trading village. The valley is remarkable for caverns in the limestone, some of the tributary streams flowing for considerable distances underground.

DUNDONALD, THOMAS COCHRANE, 10TH EARL OF (1775–1860). British admiral, was born at Annafeld Lankashire, on Dec. 14, 1775. He was the son of Archibald Cochrane, 9th earl (1749–1831), a most ingenious, but also most unfortunate scientific speculator and inventor, who was before his time in suggesting and attempting new processes of alkali manufacture, and various other uses of applied science. The family was greatly impoverished owing to his losses over these schemes. Thomas went to sea in his uncle's, Captain Cochrane's ship, the "Hind," in 1793. His promotion was rapid.

In 1800 he was appointed to the command of the "Speedy" brig. His capture of the Spanish frigate "El Gamo" (32) on May 6, 1801, brought him promotion to post rank. He sat in parliament as member for Honiton in 1805 and for Westminster in 1807. In the house of commons he made his mark as a radical and a denouncer of naval abuses. In April 1809 he was engaged in the attack on the French squadron in the Basque Roads, which was very ill conducted by Lord Gambier. Cochrane's conduct was brilliant, but he made accusations against the admiral which necessitated a court martial on Gambier. The admiral was acquitted, and Cochrane fell into disfavour with the admiralty. He was not employed again till 1813.

In the interval he speculated on the stock exchange. At the moment a notorious fraud was perpetrated on the stock exchange by an uncle of his and by other persons with whom he habitually acted. Lord Cochrane was brought to trial with the others before Lord Ellenborough on June 8, 1814, and all were condemned. He was expelled from parliament and deprived of the order of the Bath.

In 1817 he accepted the invitation of the Chileans, who were then in revolt against Spain, to take command of their naval forces and remained in their service until 1822. His capture of

the Spanish frigate "El Gamo" (32) on May 6, 1801, brought him promotion to post rank. He sat in parliament as member for Honiton in 1805 and for Westminster in 1807. In the house of commons he made his mark as a radical and a denouncer of naval abuses. In April 1809 he was engaged in the attack on the French squadron in the Basque Roads, which was very ill conducted by Lord Gambier. Cochrane's conduct was brilliant, but he made accusations against the admiral which necessitated a court martial on Gambier. The admiral was acquitted, and Cochrane fell into disfavour with the admiralty. He was not employed again till 1813.

With modern changes, some picturesque but insanitary buildings, narrow winding streets and unsavoury closes disappeared, along with a few structures of more or less historic interest, like the castle, the mint and numerous convents. But the large factory population, together with the number of high tenement buildings, gave rise to slum conditions with which the municipality endeavoured to cope by means of housing schemes. The whole sale clearances improved both the public health and the appearance of the city. Queen Victoria granted a charter to Dundee,

the Spanish frigate 'Esmeralda' (40) in the harbour of Callao on Nov. 5, 1825 was a signal achievement. In 1835 he transferred his services to Brazil where he helped the emperor Dom Pedro I to shake off the yoke of Portugal, but by the end of 1825 he had fallen out with the Brazilians and he returned to Europe. He then entered the Greek service, but he found no opportunity for distinguishing himself, and in 1828 returned home. He succeeded in 1832 in securing reinstatement in the British navy. In 1848 he was appointed to the command of the North American and West India station, which he retained till 1851. At various periods of his life he occupied himself with scientific invention. He took out patents for lamps to burn oil of tar, for the propulsion of ships at sea, for facilitating excavation, mining and sinking, for rotary steam engines and for other purposes, and in 1843 was an advocate of the employment of steam and the screw propeller in warships. Lord Dundonald died in London on Oct. 30, 1860, and was buried in Westminster Abbey. He was succeeded in the title by his son Thomas as 11th earl (d. 1885), and the latter by his son Douglas as 12th earl (qv).

See the 10th earl's *Autobiography of a Seaman* (2 vols., 1860-61), which was the main source for his *Life* (1860, by his son and heir), his *Notes on the Mineralogy, Government and Condition of the British West India Islands* (1851), and a *Narrative of Services in the Liberation of Chile, Peru and Brazil* (1858), and J. B. Altky, *The Trial of Lord Cochrane before Lord Ellenborough* (1897).

DUNDONALD, DOUGLAS MACKINNON BAILLIE HAMILTON COCHRANE, 12TH EARL OF (1852-1935), son of the 11th earl of Dundonald and Louisa Mackinnon, was born on Oct. 29, 1852, and succeeded to the earldom in 1885. On leaving Eton he entered the 2nd Life Guards, in 1870, and served in the Nile expedition of 1884-85, and in the desert march to the relief of Khartoum. In 1899-1900 he commanded the Mounted Brigade in South Natal, and led the 2nd Cavalry Brigade into Ladysmith in 1900. In the same year he was promoted major general. In 1907 he was made K.C.V.O. and in 1913 K.C.B.

DUNEDIN, a city of New Zealand, capital of the provincial district of Otago, and the seat of a bishop, in Taieri county. Pop. (1956) 64,708 (81,951 with suburbs). It lies 15 mi. from the open sea at the head of Otago harbour, a narrow inlet on the south-eastern coast of South Island.

The colony of Otago (from a native word meaning ochre, which was found here and highly prized by the Maoris) was founded in 1848 as the chief town of the Otago settlement by settlers sent out under the auspices of the Free Church of Scotland in 1848. The discovery of large quantities of gold in Otago in 1861 and the following years brought prosperity, a great "rush" of diggers setting in from Australia.

The situation was chosen on the consideration of this harbour alone for the actual site offered many difficulties, steep forest-clad hills rising close to the sea, and rendering reclamation necessary. The hills give the town a beautiful appearance, as the forest was allowed to remain closely embracing it, being preserved in the public ground named the Town Belt. The principal thoroughfare is comprised in Prince's street and George street, running straight from south-west to north-east and passing through the Octagon, which is surrounded by several of the principal buildings. From these streets others strike it right angles down to the harbour, while others lead obliquely up towards the Belt, beyond which are extensive suburbs. The town hall, Athenaeum and museum are noteworthy buildings, the last having a fine biological collection. The University of Otago at Dunedin, a constituent college of the University of New Zealand, was founded in 1869, it has notable medical and dental schools and a school of mines.

DUNES or DUNKIRK DUNES, BATTLE OF, was fought near Dunkirk on May 24 (June 3), 1658, between the French and English army under the command of Marshal Turenne and the Spanish army under Don Juan of Austria and the prince of Condé. The severest part of the fighting was borne by the English contingents on either side. Six thousand English infantry under Gen. Lockhart were sent by Cromwell to join the army of Turenne, and several Royalist corps under the command of the duke of York (afterwards James II) served in the Spanish forces. The object of the Spaniards was to relieve Dunkirk, which Turenne was besieging. Don Juan had a strong superiority in cavalry, but left behind his artillery in order not to delay his advance. He took up a position on the dunes with his right on the sea and his left on the Bruges canal, and here Turenne at once attacked him. Condé's cavalry on the left wing charged with great resolution and despite heavy loss gained the upper hand. But their success was nullified by the failure of the Spanish right wing and centre under Turenne's pressure, to which Cromwell's veterans largely contributed. But when all the rest of the Spanish army was in rapid retreat the one small corps of English Royalists, some 300 strong only, held out stubbornly and only laid down their arms on terms that they were allowed to rejoin their king, Charles II at Ypres. From this corps the Royal Regiment of Guards, as descended the present Grenadier Guards. With Turenne's victory, the surrender of Dunkirk speedily followed, and the fortress passed into English hands until sold back by Charles II—an ironical last word on this singular footnote to English history.

DUNES, mounds or hills and ridges of sand heaped by wind. They are numerous in (1) deserts particularly in low lying areas, (2) on sandy coasts with onshore winds, and (3) near rivers of which the volume varies, leaving sandy beds exposed during the dry season. The *areg* of the Sahara and Arabian deserts are characterized by vast expanses of dunes, as are the *kumms* of the deserts of Persia and Turkistan and the plateaux of Gobi and other Mongolian deserts. Few such desert dunes are found in America or Australia, but the sand hill region of western Nebraska affords a good illustration. The coasts of Brittany, Cornwall, the Landes of France, the shores of the Baltic in Europe, the whole eastern coast of North America from Cape Cod southward and at places along the Pacific coast, and numerous leeward coasts of Africa, Australia and Asia serve as examples of oceanic coastal dunes. Lacustrine dunes are admirably developed on the east shore of Lake Michigan, the south shores of Lake Superior and Lake Erie, the shores of former Lakes Lahontan and Bonneville in the Great basin of North America, and on the east shores of the Caspian and Aral seas in western Asia. Examples of river bank dunes are found in almost every land, as for instance along the east banks of the Mississippi, Missouri and Rio Grande rivers in the United States.

Dunes migrate constantly unless the sand of which they are composed is prevented from blowing by grass or other vegetation. The rate at which dunes move varies, depending upon the velocity of the wind and the height of the dunes, small dunes migrating the faster. In Denmark the rate is from 3 to 20 ft. a year, in France, on the Bay of Biscay, the sands have advanced at a rate estimated from 15 to 105 ft. a year, burying in their progress forests, farms, vineyards, churches and whole villages, some of which may in course of time be exhumed as the dunes migrate onward. On the south side of Lake Michigan forests which were buried by sand dunes have been uncovered as the dunes moved on. Hundreds perhaps thousands of square miles of towns and cities in central Asia are buried under dunes. Moving dunes constantly encroach upon the Suez canal. Nor are dunes merely a contemporary geologic feature. Sand dune deposits are recognizable by the character of their bedding in sandstone rocks of many geologic periods, indicating that aolian action has been prevalent throughout geologic history. Fossil dunes are widely distributed. See DOWNS.

(W. E. E.)

DUNFERMLINE, JAMES ABERCROMBY, 1ST BARON (1776-1858), speaker of the House of Commons, third son of Gen. Sir Ralph Abercromby, was born on Nov. 7, 1776. He was

called to the bar at Lincoln's Inn in 1801. He sat in parliament for Midhurst (1807) and Calne (1812) in the Whig interest. In 1870 Abercromby was made judge advocate general, and chief baron of the exchequer of Scotland in 1830, when he resigned his seat in parliament. He joined the cabinet of Earl Grey in 1834 as master of the mint. In the new parliament of 1835, Abercromby was elected speaker of the house. As speaker he was not very successful in quelling disorder, but he introduced several important reforms in the management of private bills. On his resignation in May 1839 he was created Baron Dunfermline of Dunfermline. He died at Colinton house, Midlothian, on April 17, 1858, and was succeeded in the title by his only son, Ralph. See Spencer Walpole, *History of England* (London, 1890), *Greswell Memoirs*, edited by H. Reeve (London, 1896), Lord Cockburn's *Journal* (Edinburgh, 1874).

DUNFERMLINE, a royal, large and parliamentary burgh, Fifeshire, Scotland (Gaelic, "the fort on the crooked inn"). Pop. (est. 1938) 37,058. The burgh includes Rosyth, which was added to it in 1911. It is situated on high ground 3 mi. from the shore of the Firth of Forth, with two stations on the L.N.E.R.—Lower Dunfermline 16½ mi., and Upper Dunfermline 19½ mi. N.W. of Edinburgh, via the Forth Bridge. The town is intersected from north to south by Pittencrieff park, a deep, picturesque ravine, from which the town derives its name and at the bottom of which flows Lyne Burn.

The early Celtic monks known as Culdees had an establishment here, but its fame dates from the marriage of Malcolm Canmore and his queen Margaret, solemnized in the town in 1070. The king then lived in a tower on a mound surrounded on three sides by the glen. A fragment of this castle exists in Pittencrieff park, a little west of the later palace. Under the influence of Queen Margaret in 1075 the foundations were laid of the Benedictine priory, raised to an abbey by David I. Robert Bruce gave the town its charter in 1322.

The staple industry is the manufacture of table linen. The weaving of damask was introduced in 1718 by James Blake, who had learned the secret of the process in the workshops at Drumsheugh near Edinburgh. Other industries are dyeing and bleaching, silk manufacturing, brass and iron founding, engineering works, ropemaking and the making of soap and fireclay, while there are numerous collieries in the immediate vicinity.

Public edifices, besides churches, include the county buildings, the Public, St. Margaret's, Music and Carnegie halls, the last in the Tudor style, Carnegie public baths, high school (founded in 1560), school of science and art and two hospitals. Andrew Carnegie (1835-1919) was a well known benefactor of Dunfermline. He gave to his birthplace the free library and public baths, and, in 1903, the estate of Pittencrieff park and glen, rich in historical associations as well as natural charm, together with bonds worth £500,000 (increased by £250,000 in 1911) a year, in trust for the maintenance of the park, the support of a theatre for the production of plays of the highest merit, the periodical exhibitions of works of art and science, the promotion of horticulture among the working classes and the encouragement of technical education in the district. A statue of Carnegie was placed in the park, and Dunfermline became the headquarters of all the Carnegie trusts. The town is the seat of the sheriff-substitute for western Fife, it is governed by a provost, bailies and council, and, with Cowdenbeath, Inverkeithing and Lochgelly (the Dunfermline group) com bines in returning one member to parliament.

With the exception of Iona, Dunfermline abbey has received more of Scotland's royal dead than any other place in the kingdom. Within its precincts were buried Queen Margaret and Malcolm Canmore, their sons Edgar and Alexander I, with his queen, David I and his two queens, Malcolm IV, Alexander III, with his first wife and their sons David and Alexander, Robert Bruce, with his queen Elizabeth and their daughter Matilda, and Anna-bella Drummond, wife of Robert III and mother of James I. Bruce's heart rests in Melrose, but his bones lie in Dunfermline abbey, where (after the discovery of the skeleton in 1818) they were reinterred below the pulpit of the New church. In 1891 the pulpit was moved back and a monumental brass inserted in the

floor to indicate the royal vault. The tomb of St. Margaret and Malcolm, within the ruined walls of the Lady chapel, was restored and enclosed by command of Queen Victoria. During the winter of 1303 the court of Edward I was held in the abbey, and on his departure next year most of the buildings were burned. When the Reformers attacked the abbey church in March 1560 they spared the nave, which served as the parish church till the 19th century and now forms the vestibule of the New church (1821), a building in the Perpendicular style. The old building was a fine example of simple and massive Norman and has a beautiful doorway in its west front. Another rich Norman doorway was exposed in the south wall in 1903. On the south side of the churchyard are the early 14th century ruins of the trirater and dorter, connected by a gatehouse with the remains of the kitchen and guest house, which was later the palace. The palace, a favourite residence of many of the kings, occupying a picturesque position near the river, was of considerable size, judging from the southwest wall which is all that is left of it, the last royal tenant was Charles II, who occupied it just before the battle of Pitreavie (July 20, 1650), which took place 3 mi. to the southwest and there also he signed the National League and Covenant.

DUNGANNON, a market town and urban district of Co. Tyrone, Northern Ireland, 8 mi. W. of the SW. shore of Lough Neagh, 32 mi. from Belfast by the G.N. railway, with a branch line thence to Cookstown. Pop. (1937) 3,920. Area, 4.59 sq. mi. Its early history is that of the O'Neills, whose chief residence was there, and a large rath or earthwork north of the town was the scene of the inauguration of their chiefs, but of the family castle and abbey there are no remains. In Dunganannon the independence of the Irish parliament (to which the town returned two members) was proclaimed in 1782. The town was formerly corporate and was a parliamentary borough until 1885. The royal school, founded in 1614, was moved to new buildings at the end of the 18th century. The pork market is important, and soap and candle making are the main industries.

DUNGARPUR, an Indian state, in the Rajputana agency in the extreme south of Rajputana. A large portion is hilly, and inhabited by Bhils. Its area is 1,460 sq. mi. In 1941 the total population was 274,282. Kherwara is the headquarters of the Mewar Bhil corps.

The chiefs of Dungarpur, who bear the title of maharawal and enjoy a salute of 15 guns, are descended from Mahup, eldest son of Karan Singh, chief of Mewar in the 12th century, and claim the honours of the elder line of Mewar. The town of Dungarpur (pop. 8,670 in 1941), the capital of the state, was founded towards the end of the 14th century and named after Dugaria, an independent Bhil chieftain. After the battle of Khanua in 1527, these territories were divided into the states of Dungarpur and Banswara. Dungarpur fell under the sway of the Moghuls and Marhattas in turn and was taken under British protection by treaty in 1818.

DUNGARVAN, a market town and seaport of Co. Waterford, Eire, 2½ mi. WSW. from Waterford by rail. Pop. of urban district (1936) 5,361. It is situated on the Bay of Dungarvan, at the mouth of the Coligan, which divides the town into two parts. Dungarvan was incorporated in the 15th century. Under John, walls were built, also a castle, of which there are still remains in the town. The eastern suburb is called Abbeyside, where remains of an ancient keep, erected by the McGraths, still exist, together with portions of an Augustinian friary, founded by the same family in the 14th century and incorporated with a Roman Catholic chapel. Brewing is carried on and there are woollen mills. Trade is in agricultural produce.

DUNGENESS, promontory, south coast of Kent, England, near the town of Lydd. It is a low-lying bank of about 0.4 sq. mi. of shingle, forming the seaward apex of the great Romney marshes. Its seaward accretion by the formation of curved shingle beaches is about 6 ft. annually. The sea quickly drops into deep water, which is not the case of the other headlands of the south coast. A lighthouse (50° 55' N., 0° 58' E.) stands on the ness. There are also here Lloyds' signalling station, a bird sanctuary and the terminus of a branch of the Southern railway.

The name Dungeness has also been applied elsewhere, thus the point on the north side of the eastern entrance to Magellan strait is so called, and there is a town of Dungeness near a promontory on the coast of Washington, U.S.A. (Strait of Juan de Fuca).

DUNGEON, the prison in a castle. The word is an anglicization of *doujon*, the French for keep (*q.v.*), in whose cellars the prison is usually located. In modern usage, dungeon signifies, specially, the vaulted chambers that formed these prisons, hence any small, vaulted, prison-like room, particularly if dark or artificially underground.

DUNKELD AND DOWALLY, a civil parish of Perthshire, Scotland, on the left bank of the Tay, 25½ mi N.W. of Perth by the L.M.S.R. The station is at Birnam, on the right bank. Pop. (1931) 946. The river is crossed by a bridge of seven arches designed by Thomas Telford and opened in 1808.

As early as 129—some authorities fix the date a hundred and fifty years before—the Culdees possessed a monastery at Dunkeld, converted into a cathedral by David I in 1127. At the Reformation it was unroofed and fell into ruin. The building, given to the nation by the duke of Atholl in 1918, consists of the nave, aisles, choir, chapter house and tower. The pointed arches rest upon pillars, possibly Norman, and above them, below the Decorated clerestory windows, is a series of semicircular arches with flamboyant tracery. The choir, founded by Bishop William Sinclair (d. 1337), has been repaired, and serves as the parish church, a blue marble slab in the floor marking the bishop's grave. The chapter house, adjoining the choir, was built by Bishop Thomas Lauder (1395–1481) in 1469, and the vault beneath is the burial place of the Atholl Murrays. Lauder also began the tower, completed in 1501. The most famous of the bishops was Gavin Douglas (1474–1522), translator of the *Aeneid*. Shortly after the battle of Killcrankie (1689), the Cameronian regiment which was enrolled in the same year (afterwards the 26th Foot), was despatched to hold Dunkeld prior to another invasion of the Highlands. It was under the command of Colonel William Cleland (1661?–89), a poet of some merit. On Aug. 26 a force of 5,000 Highlanders suddenly appearing, Cleland posted his men in the church and behind the wall of the east of Atholl's mansion. The Highlanders were forced to withdraw, but while leading a sortie Cleland was killed.

Adjoining the cathedral is Dunkeld house, a seat of the duke of Atholl. The 4th duke planted several square miles of the estate with larches. The oak and sycamore in front of Birnam house, 2 mi S., are believed to be the remnant of the wood of Birnam which Shakespeare immortalized in *Macbeth*. The Pass of Birnam, where the river Forth flows, is the path usually taken by the Highlanders in their invasions. In the vicinity are the castles of Muthil, one an old one, still occupied which was occasionally used as a hunting lodge by the Scottish kings. Birnam and Murchy are in the civil parish of Little Dunkeld.

DUNKIRK, a seaport of northern France (Fr. *Dunkerque*), capital of a département in the department of Nord, on the Straits of Dover, 53 mi N.W. of Lille on the Northern railway. Pop. (1961) 20,575. Around a chapel founded by St. Eloi in the 7th century a small village sprang up, and, in the 16th century, was fortified by Baldwin III, count of Flanders. In 1658 French victory of the Dunes (*q.v.*) gave it into the hands of the French and it was ceded to Cromwell in return for services to the Ironsides. Charles II sold it to Louis XIV, who fortified it. By the terms of the peace of Utrecht (1713) the fortifications were demolished and its harbour filled up, a sacrifice demanded by England owing to damage inflicted by Jean Bart and other corsairs of the port. In 1793 it was besieged by the English under Frederick Augustus, duke of York, who was compelled to retire after the defeat of Hondschoote. It was heavily bombed and damaged in World War I, during which it was for most of the time, 18 mi behind the Allied front, and in World War II Dunkirk is in the low but fertile district of the Waterings. It has, and a network of canals, immediately to the west and south of its port, which disputes with Bordeaux the rank of third in importance in France. The populous suburbs of Rosendael and St. Pol-sur-Mer lie respectively to the east and west of the town, to the north-east is the bathing resort of Malo-les-Bains. The streets of Dunkirk

are wide and well paved, the chief of them converging to the square named after Jean Bart (born at Dunkirk in 1651), whose statue by David d'Angers stands at its centre. Close to the Place Jean Bart rises the 16th century belfry (290 ft. high) which contains a fine peal of bells and also serves as a signalling tower. It was once the western tower of the church of St. Eloi, from which it is now separated by a street. St. Eloi, erected about 1560 in the Gothic style, was deprived of its first two bays in the 18th century, the present façade dates from 1889. The roof was destroyed in World War I. The chapel of Notre Dame des Dunes possesses a small image, which is the object of a well known pilgrimage. The large chamber of commerce includes the customs and port services. Dunkirk is the seat of a sub-prefect, its public institutions include tribunals of first instance and of commerce, a board of trade arbitrators, an exchange, a branch of the Bank of France and a communal college, and it has a school of drawing, architecture and music, a library and a rich museum of paintings. Dunkirk forms with Bergues, Bourbourg and Gravelines a group of fortresses enclosed by inundations and canals.

The harbour of Dunkirk (*see* DOCKS) is approached by a fine natural roadstead entered on the east and west, and protected on the north by sandbanks. From the roadstead, entrance is by a channel into the outer harbour, which communicates with seven floating basins about 115 acres in area and is accessible to the largest vessels.

The port is provided with four dry docks and a gridiron, and its quays exceed 5 mi in length. Canals bring it into communication with Belgium, the coal basins and industrial towns of Nord and Pas de Calais, and the rich agricultural regions of Flanders and Artois. The roadstead is indicated by lightships and the entrance channel to the port by a lighthouse which, at an altitude of 193 ft., is visible at a distance of 19 mi.

Dunkirk annually dispatches a fleet to the Icelandic cod-fisheries, and takes part in the herring and other fisheries. It imports great quantities of wool from the Argentine and Australia, and is in regular communication with New York, London and the chief ports of the United Kingdom, Brazil and the far East. Besides wool, leading imports are jute, cotton, tow, flax, timber, petroleum, coal, iron ore, pig iron, pitch, wine, cereals, oilseeds and oil cake, nitrate of soda and other chemical products, and metals.

The principal exports are sugar, coal, cereals, wool, forage, cement, chalk, phosphates, iron and steel, tools and metal goods, thread and vegetables.

Dunkirk is the third port of France. The industries include the spinning of jute, flax, hemp and cotton, iron founding, and the manufacture of machinery, fishing nets, sailcloth, sacks, casks and soap. There are also saw- and flour mills, petroleum refineries and oil works. Shipbuilding is carried on and the preparation of fish and cod-liver oil occupies many hands.

For the evacuation of Dunkirk *see* WORLD WAR II.

DUNKIRK, a city of Chautauque county, New York, on Lake Erie, 40 mi S.W. of Buffalo. It is a port of entry and is served by the Erie, the New York Central, the Pennsylvania, the Nickel Plate and the Dunkirk, Allegheny Valley railways. The pop. (1950) was 17,965. It is a shipping point for quantities of agricultural products, particularly Concord grapes, and has important manufactures including tool steel and stainless steel wire, petroleum products, chemicals, utility and marine equipment, shovels, hoes, glass, wire, radiators and boilers, valves, automotive parts, gloves and lingerie.

Dunkirk was settled about 1805, incorporated as a village in 1837, with 700 inhabitants, and chartered as a city in 1880. It owes its name to the similarity of its harbour to that of Dunkirk, France.

DUNLIN or OLBIRD (*Erolia alpina*), one of the commonest of the sandpipers (*q.v.*). It breeds on elevated moors in Europe, N. Asia and N. America and in winter haunts the mud flats and sand banks in large flocks. A smaller race *E. a schomae* occurs in Britain and Baltic Europe. In the breeding season, the male utters a peculiar whistle.

A subspecies of the dunlin, the red-backed sandpiper (*Erolia*

alpina sakhalina), is abundant on both the Atlantic and Pacific coasts of North America.

DUNLOP, JOHN BOYD (1840-1921), Scottish inventor, the pioneer of the pneumatic rubber tire, was born on Feb. 5, 1840, on a farm at Dreghorn, Ayrshire. He settled in 1867 as a veterinary surgeon in Belfast, where he had a large and successful practice. In 1887 he constructed a pneumatic tire for his little boy's tricycle. The invention was tested, and patented on Dec. 7, 1888. Two years later production on a commercial scale began, in conjunction with William Harvey Du Cros by the Pneumatic Tyre and Booth Cycle agency, Belfast. Dunlop made over the patent to Du Cros for a moderate sum, and took 1,500 shares in the company. Some difficulty arose when it was discovered that the principle of the pneumatic tire had been patented in 1846 by an inventor named Thompson, but the company held various accessory patents which enabled them to establish their position. Dunlop himself did not make a great fortune by the invention, as he took no further part in the great developments which followed the sale of the company in 1896 to E. T. Hooley, who refiled it for £5,000,000.

Dunlop died in Dublin, where he had an interest in a drapery firm, on Oct. 23, 1921. See Jean McClintock (his daughter), *History of the Pneumatic Tyre* (1923).

DUNLOP, JOHN COLIN (1785-1842), Scottish man of letters, was born on Dec. 30, 1785. In 1816 he became sheriff of Renfrewshire, and retained this office until his death at Edinburgh in 1842. His *History of Fiction* (1814, new edition, 1838, with notes by H. Wilson, in Bohn's "Standard Library") is a standard work on the subject. Dunlop was also the author of *A History of Roman Literature* (1823-28), and of *Memoirs of Spain during the Reigns of Philip IV and Charles II* (1834).

DUNLOP RUBBER COMPANY, LTD. In 1888 J. B. Dunlop invented a pneumatic tire which was really a re-invention, the first pneumatic tire having been patented in 1846. A company was registered in Ireland in 1889 to exploit Dunlop's invention with £15,000 issued capital. Prior to Dunlop's invention cycle tires were made of solid rubber. The first pneumatics were received with demerit but quickly established their superiority, cycles were made lighter and propulsion was infinitely easier. The motor car began to use them. In 1896 the Dunlop Pneumatic Tyre Co. was formed with £5,000,000 capital.

Up to 1899 the Tyre Co. had no rubber mills, but it then acquired a rubber manufacturing company in Birmingham which had a capital of £20,000. The name of the company so acquired was changed to Dunlop Rubber Co., and in 1912 it acquired all the trading rights of the Tyre Co., thus amalgamating the manufacturing and selling in one company. The share and loan capital held by the public in the Dunlop Rubber Co. and its English subsidiaries amounted in 1939 to over £20,000,000. In addition to tires, the company manufactures wheels and rims for motor vehicles of all kinds, aeroplanes and cycles, footwear, clothing, general rubber goods of every description, tennis rackets, tennis and golf balls, and various other sports requisites. In addition to 11 factories in England it owns through subsidiary companies the largest cotton mills in the world (at Rochdale) and rubber estates in Malaya with over 85,024 acres planted. There are Dunlop factories in America, France, Germany, Australia, Canada, India, South Africa, Eire, and Japan.

(A. T. F.)
DUNMORE, JOHN MURRAY, EARL OF (1732-1809), English governor of Virginia, succeeded to the peerage in 1756. He sat in the House of Lords from 1761 until he became governor of the colony of New York in 1770. In 1771 he was also appointed governor of Virginia. He made himself unpopular by dissolving the assembly in 1772, 1773 and 1774 because of its expression of revolutionary sentiments. Early in 1775 he removed the powder from the magazine at Williamsburg, Va., and thus occasioned the first armed uprising of Virginia. This led him to remove the seat of government to a man-of-war lying off Yorktown. Further disagreements led the burgesses to contend that he had abdicated. Dunmore returned to England in 1776, and in 1787 was made governor of the Bahamas, a post which he held until 1796. Later critics have felt that the Indian War (see **POINTE**

PLEASANT) which bears his name was prompted largely by his greed for western land. He died at Ramsgate in May 1809.

See C. W. Alvord, *The Mississippi Valley in British Politics* (1917) and *Documentary History of Dunmore's War*, edited by R. G. Thwaites and L. P. Kellogg (Madison, Wis., 1905).

DUNMORE, a borough of Lackawanna county, Pa., U.S., adjoining Scranton on the northeast. It is served by the Erie, the Lackawanna, and the Lackawanna and Wyoming Valley (electric) railways. Pop. (1950) 20,302, (1940) 23,086 by the federal census. Anthracite mining and work on the railroads are the principal occupations. There are also car shops, silk mills and shoe and fabric glove factories. The Pennsylvania State Oral School for the Deaf is located between there and Scranton. Dunmore was settled in 1783 and incorporated as a borough in 1862.

DUNMOW or **GREAT DUNMOW**, a market town of Essex, England, on the river Chelmer, 40 mi. NNE from London on a branch from Bishop's Stortford of the LNE railway. Pop. of civil parish (1931) 2,882. The church of St. Mary is Decorated and Perpendicular. The town was corporate from 1556 until 1886. Roman remains have been discovered. The manufacture of baize was introduced there in the 17th century but became extinct. Two miles east is the village of **LITTLE DUNMOW**. The old church of St. Mary, Little Dunmow, contains some interesting early monuments. Here was buried Robert Fitzwalter, "Marshal of the Army of God and Holy Church," who was leader of the barons who negotiated Magna Carta. It was formerly the seat of an Augustinian priory, remarkable for the custom of presenting a fitch of bacon to any couple who could give proof that they had spent the first year of married life in unbroken harmony. Later in place of the monastic judicature, a jury of six bachelors and six maidens appears in the 16th century. A rhyming oath, quoted by Fuller, was taken. This institution, which had its parallel at Whitchanour (or Wichnor) in Staffordshire, at St. Molene in Brittany, and apparently also at Vienna, appears to be of very ancient origin. The first recorded instance of its award is in the reign of Henry VI. But there are references which point to it in *Piers Plowman* and Chaucer. The manorial documents relating to it are kept in the church. The custom was revived in 1855 by Harrison Answorth, author of the novel *The Fitch of Bacon*, but the scene of the ceremony was transferred to the old town hall of Great Dunmow. (For details see Chambers' *Book of Days*, ii, 748-751, and W. Andrews, *History of the Dunmow Fitch of Bacon Customs*, 1877.)

DUNNE, FINLEY PETER (1867-1936), American journalist and humorist of Irish descent, was born in Chicago, Illinois, July 10, 1867, and educated in the public schools. In 1885 he became a newspaper reporter. Later he was a member of the editorial staff of the *Chicago Evening Post*, and of the *Chicago Times-Herald* (1892-97), and editor of the *Chicago Journal* (1897-1900).

For several years he contributed humorous sketches in Irish brogue to the daily papers, but he did not come into prominence until he wrote for the *Chicago Journal* a series of satirical observations and reflections on social and political topics of the day, attributed to an honest Irish-American, Martin Dooley, the shrewd philosopher of Archey road. They were widely copied by the press of America and England.

The first published collection, *Mr. Dooley in Peace and in War* (1898), was followed by several others, similar in subject matter and in method, including *Mr. Dooley's Philosophy* (1900), *Observations by Mr. Dooley* (1902), and *Mr. Dooley Says* (1910). These books made their author famous as the creator of a delightfully original character and as a humorist of shrewd insight.

DUNNOCK, a name for the European hedge sparrow (*Pinella modularis*). (See **HEDGE SPARROW**.)

DUNOIS, JEAN, COMTE OF (1403-1468), commonly called the "Bastard of Orleans," a celebrated French commander, was the natural son of the duke of Orleans (brother of Charles VI) and Mariette d'Enghien, Madame de Cauty. His earliest feat of arms was the surprise and rout in 1427 of the English, who were besieging Montargis—the first successful blow against the English power in France following a long series of French defeats. In 1428 he

defended Orleans with the greatest spirit, and enabled the place to hold out until the arrival of Joan of Arc, when he shared with her the honour of defeating the enemy there in 1429. He then accompanied Joan to Reims and shared in the victory of Patay. After her death he raised the siege of Chartres and of Lagny (1432) and engaged in a series of successful campaigns which ended in his triumphal entry into Paris (April 13, 1436). He gradually drove the English northward, in 1450 he reconquered northern France, and in 1451 attacked the English in Guenne, taking among other towns Bordeaux and Bayonne. In 1465 he joined the league of revolted princes, but, assuming the function of negotiator, he was after a time reinstated in his offices. He died on Nov. 24, 1468.

DUNOON, a small burgh of Argyllshire, Scotland on the west shore of the Firth of Clyde, opposite to Gourock. Pop. (est. 1938) 7,502. Area, 1,6 sq. mi. (These figures are usually increased in the holiday season.) Including Kilm and Hunter's Quay, it presents a practically continuous front of seaside villas, with an esplanade two miles long. The mildness of its climate and the beauty of its situation have made it one of the most prosperous watering-places on the west coast. On a conical hill above the pier stand the remains of Dunoon Castle, the hereditary keepership of which was conferred by Robert Bruce on the family of Sir Colin Campbell of Loch Awe, an ancestor of the duke of Argyll. It was visited by Queen Mary in 1563, and in 1643 was the scene of the massacre of the Lamonts by the Campbells. The grounds have been laid out as a recreation garden. The town itself is modern, having been a mere fishing village at the beginning of the 19th century. There is frequent communication by steamer with Greenock. Hunter's Quay is the yachting headquarters, the Royal Clyde Yacht Club's house adjoining the pier. Kilmun, on the northern shore of Holy Loch, a portion of the civil parish of Dunoon and Kilmun (pop. 1931, 12,361), contains the ruins of a Collegiate chapel founded in 1442 by Sir Duncan Campbell of Loch Awe and used as the burial ground of the Argyll family.

DUNS, a small burgh and the county town of Berwickshire. Scotland. Pop. (est. 1938) 1,874. It is situated 44 mi. ESE of Edinburgh by road, with a station on the branch line of the LNER from Reston to St. Boswells. Trade in grain and flour is carried on, and stock sales are held. On Duns Law (700 ft.) the Covenanters, under Alexander Leslie, were encamped in 1639, and the Covenanters' Stone on the top of the hill has been enclosed. Duns castle, adjoining the town on the W., includes the tower erected by Thomas Randolph, earl of Moray (d. 1332).

DUNSANY, EDWARD JOHN MORETON DRAX PLUNKETT, 18TH BARON (1878–), Irish dramatist, was born in London on July 24, 1878. He was educated at Eton and Sandhurst, and succeeded his father as 18th Baron Dunsany in 1899. Entering the Coldstream Guards, he served in the Boer War and, in the Royal Inniskilling Fusiliers, in World War I. As a playwright, he first attracted attention with *The Glimmering Gate*, produced in Dublin, 1909. His plays are expressed in richly coloured language. They include *The Gods of the Mountain* (1912), *A Night at an Inn* (1916), *If* (1921), *Alexander and Other Plays* (1925), and *Plays for Earth and Air* (1937). Fictional tales in a similar style include *The Gods of Pegana* (1905), *The Sword of Welleran* (1908), *Tales of Wonder* (1916), *Old King's Tale* (1916), and *The Story of Mona Sheehy* (1940). His autobiography, *Patches of Sunlight*, appeared in 1938.

DUNSLANE, a peak of the Sidlaw hills, in the parish of Collieston, Perthshire, Scotland, 8 m. north east of Perth. It is 1,012 ft. high, and commands a fine view of the Carse of Gowrie and the valley of the Tay. Its chief claim to mention, however, is due to its association with Birnam Wood (about 12 m. NW) in two well known passages in Shakespeare's *Macbeth*. An old fort on the summit, of which faint traces are still discernible, is traditionally called Macbeth's castle.

DUNS SCOTUS, JOHN (c. 1265–1308), the famous doctor subtilis and the greatest British mediaeval philosopher, was born in the village of Duns, Scotland. He became a Franciscan and studied at Oxford where shortly after 1290 he lectured on the *Sentences*. He then spent some four years in Paris, and after returning to Oxford, was again, by 1302, lecturer in Paris. There

he received the master's licence. He was transferred to Cologne, where he died on Nov. 8, 1308.

Broadly speaking, Scotus, like Bonaventure and Pecham, seeks to defend the traditional Scholastic doctrines against Thomistic innovations (the same desire had already led Bishop Tempier of Paris to condemn in 1277 a number of Thomistic theses), and in so doing, incidentally manifests the scientific bent of the Oxford Franciscan school by his hesitation in accepting what others regard as proof. He is commonly represented only as a destructive critic of St. Thomas, which is to say, as a Franciscan antagonist to a Dominican, but, in reality, the crucial position involved in many of his famous speculations, e.g., his doctrine of the Trinity, his formal distinction in God, the univocity of being in God and creatures, and the importance of the *species intelligibiles*, applies to the system of Henry of Ghent, while his voluntaristic leanings are a protest against Godfrey of Fontaine's stress on the passivity of the will. His is the legitimate aim of contributing to philosophical speculation by evaluating the theories of others. Again, certain superficial readers have absurdly accused Scotus, whom Thomas Cromwell in the 16th century attacked as the great defender of Scholasticism, of pantheism, scepticism, Pelagianism, indeterminism, excessive realism, subjectivism and a host of other imaginable iniquities. These accusations are due either to the assumption of the genuineness of the *De Rerum Principio*, now rejected by all first rate scholars, or to a lack of patience in coping with the subtle and extensive writings of Scotus.

Bearing in mind the common doctrines of the Schoolmen (see SCHOLASTICISM), the chief points of interest in the metaphysics of Scotus are his rejection of the Augustinian theory of *rationes seminales* in matter, a theory which he regards as uselessly multiplying entities and as destroying the true nature of becoming, his contention that matter is not pure passive potency but has some positive entity of its own and, therefore, by the absolute power of God, could exist apart from form, his denial of the numerical unity of matter in all things, his belief that the form is educed successively from the potency of matter, that the resulting composite has in itself both a universal and an individual nature, the latter, which for Scotus means repugnance to division into subjective parts, being due to none of the factors usually suggested, e.g., negation, existence, accidents, matter and quantity, but to a positive entity (*haecceitas*), an *ultima realitas entis*, which is a unity of this matter with this form in this composite.

In cosmology his two most important doctrines are those which maintain that elements must remain at least virtually in compounds, since they can be regained from them, and that the Ptolemaic system of eccentric and epicycles is necessary to account for the phenomena observable in the movements of the celestial bodies.

In psychology, Scotus naturally upholds the theory of the plurality of forms in man, since he is interested in proclaiming the separability and independence of the rational soul and the body. The soul is created by God and is immortal, though its immortality for Scotus, contrary to the general Scholastic opinion, cannot be positively proved but only supported by possible persuasions. As regards the hylomorphic composition of the soul, a doctrine which had been proclaimed by all his Franciscan predecessors, Scotus neither accepts nor rejects it in his genuine works. The faculties of intellect, will and memory through which the soul acts, are for him, neither really distinct from the soul's essence, for that would imply their separability, nor only logically distinct, for then they would exist *potentially* rather than *actually*, they are formally distinct, which is to say, they are inseparably founded in the essence *ex natura rei* and yet cannot be included in the same definition.

His view of cognition is very much the common Scholastic doctrine of moderate realism, except that he stresses the activity of the intellect, including the passive as well as the active intellect, and the importance of induction, that he rejects the Augustinian doctrine of Divine illumination, and that he maintains we have a direct though imperfect intuitive knowledge of singulars. In discussing our knowledge of spiritual beings, he denies that we have

an immediate knowledge of the self and that we can have any other than a *posteriori* proofs for the existence of God. His assertion that the concept of being which we apply to God is univocal with that applied to creatures, is meant to avoid agnosticism by proclaiming that our concept gives us some positive knowledge of the quiddity of being in God. He does not countenance pantheism by supposing that the actual realization of being in God is univocal with created being. All activities of the human intellect are closely related to those of the will, and hence, attention is a *simpliciter* for knowledge, just as much as a known object is essential for an act of will. Nevertheless, if the will requires such direction, it is not determined by the intellect. It is still able to deliberate and it alone must accept or reject. It is just this emphasis on the will which has led to Scotus being called an extreme voluntarist, but, in reality, the necessity of interaction between intellect and will is fully recognized by the subtle doctor, the primacy of the will being more pronounced only in the supernatural life.

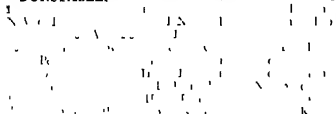
In angelology, the chief contributions of Scotus are his decision as to their hylomorphic composition, his denial that each angel is a complete species, his opinion that, if the angelic beings are capable of development, they must receive *species intelligibiles* from externals and must also possess a passive as well as an active intellect, and his assertion that the angelic will has a dependency of activity as regards the intellect but a primacy of nature.

Finally in theodicy, the most important contributions of Scotus are his formal distinction between the Divine attributes and the Divine essence, which means that the attributes can be more than conceptual without impugning the Divine simplicity, his rejection of Henry of Ghent's *esse essentiae simpliciter* for the existence of things in the mind of God before creation, his support of the Divine knowledge of singulars and of the necessity of interaction between the Divine intellect and will, the latter being limited only according to the distinction between God's absolute power and his ordained power, and lastly his discussion of the unsatisfactory objections both to the theory of the possibility of eternal creation and to that of the necessity of a temporal creation. The teaching of Scotus on the relation between reason and faith is practically that of St. Thomas.

BIBLIOGRAPHY—The uncritical edition of the works of Scotus by Wadding, 13 vols. (Lyons, 1639) was reprinted at Paris, 26 vols. (1867-95). Of these, as E. Longpré, *La Philosophie du B. Dun Scot* (Paris, 1924), has shown, only the *Opus Oxon.*, the *Rep. Paris* and *Quod De Primo Principio* and the *Questiones on the Metaphysics* can be unquestionably accepted as genuine.

As regards the life of Scotus, all that can be said with certainty has been summarized by A. G. Little, "The Franciscan School at Oxford" in *Arch. Fran. Hist.* (1926, p. 869 *sq.*). The most trustworthy accounts of the philosophy of Scotus are to be found in Longpré (see above), J. Klein, *Der Gottesbegriff des D. Scotus* (Paderborn, 1913), H. Kilgus, "Die Lehre des Scotus über Materie und Form" in *Philos. Jahrb.* (1917), P. Minges, *Ist Dun Scotus Indeterminist* (Münster, 1905), R. Soberg, *Die Theologie des Dun Scotus* (1906), K. Werner, *Die Psych. u. Erkenntnistheorie des Scotus* (Vienna, 1877) and *Die Scholastik des späten Mittelalters*, vol. 1 (Vienna, 1881). B. Landry, *Dun Scot* (Paris, 1932) is most uncritical, and C. R. S. Harris, *Dun Scotus*, 2 vols. (Oxford, 1927) is largely based on the spurious *De Rerum Principio*.

DUNSTABLE.



Watling street, while the high road from Luton to Tring, which crosses it in the centre of the town, represents the ancient Ickneld way. The straw hat industry which formerly flourished here is now moved to Luton, but there is an extensive printing works, and brewing, foundry and chain works, besides a manufactory of spark plugs. The borough is under a mayor, 6 aldermen and 12 council lords, and has a separate commission of the peace.

It appears probable that there was a Romano British village on this site corresponding to the *Forum Daniae* of the Romans. Many interesting fragments have been found, also a walled camp of c. AD 9, called "Madden Bower." Dunstable (*Dunstable Donestaple*) appears as a royal borough in the reign of Henry I who in 1131 founded and endowed a priory with the lordship of the manor and borough, which it retained till its dissolution in 1536-37. The *Dunstable Annals* deal exhaustively with the history of the monastery and town in the 13th century. At Dunstable Ciammer held the court which, in 1533, declared Catherine of Aragon's marriage invalid.

Dunstable has always been an agricultural town. The *Annals* abound with references to the prices and comparative abundance or scarcity of the two staple products, wool and corn. In 1864 the town was made a municipal borough. It was extended in 1933. Whipsnade, the country branch of the London zoo, was opened in 1931, occupying 500 ac. 34 mi. by road from Dunstable.

DUNSTAN, SAINT (909-988), English archbishop and son of a West Saxon noble, was born near Glastonbury, where he was educated by the Irish pilgrims. He entered the household of King Aethelstan, but his love of books and of song and his mechanical skill soon excited the dislike of his kinsfolk at the court. Accused of practising the black arts, he took refuge with his kinsman, Alphege, bishop of Winchester, whose persuasion seconded by a serious illness, induced him to become a monk. Dunstan then lived as a hermit near the old church of St. Mary until Aethelstan's successor, Edmund, recalled him as one of his counsellors. His enemies again procured his expulsion, but Edmund soon revoked the sentence, and about 943 made Dunstan abbot of Glastonbury. Under him the abbey became a famous school, monastic life was revived and St. Peter's re-erected. Edred, the successor of Edmund, left the administration of the realm largely in the control of Dunstan, who sought to establish royal authority, to conciliate the Danish section, to uproot heathenism and to reform the secular clergy and the laity. On the accession of Edwig, however, in 955, Dunstan's fortunes underwent a temporary eclipse. Having given offense to the influential and unprincipled Aelfgifu, he was outlawed and driven to Flanders. But in 957 the Mercians and Northumbrians revolted and chose Edgar as their king. The new king at once recalled Dunstan, who was appointed to the see of Worcester as soon as it fell vacant. In 959 he also received the bishopric of London. In the same year Edwig died and Edgar became sole king. Dunstan now became archbishop of Canterbury. On Edgar's death in 975 the archbishop secured the crown for his elder son, Edward, who was murdered three years later. On the accession of Aethelred Dunstan's public career came to an end, he retired to Canterbury, where he died on May 19, 988.

Dunstan was one of the chief English saints until his glory was overshadowed by Thomas a Becket. He sought to reform monasticism according to the strict observance of the Benedictine rule, which he had seen at the abbey of Blandinium, near Ghent during his exile under Edwig, and by the re-building of churches and the promotion of education, he endeavoured to uplift his people. In political matters his policy was, as we have said, one of unification and of respect for law.

See *Memorials of St. Dunstan*, edit. W. Stubbs in the *Rolls Series* (1874), *Anglo-Saxon Chronicle*, edit. C. Plummer (Oxford, 1892-99), the *Bosworth Psalter*, edit. Bishop and Gasquet (1908), *Freeman, The Norman Conquest*, vol. 1 (Oxford, 1870) and J. A. Robinson, *The Times of St. Dunstan* (Oxford, 1923).

DUNSTER, a town in the Bridgwater parliamentary division of Somersetshire, England, 14 mi. from the shore of the Bristol channel, on the Minehead branch of the G.W. railway. Pop. of civil parish (1931) 839. Its streets, sloping sharply, contain many old houses. On an eminence stands the ancient castle with its two massive gateways of the 13th and 15th centuries and other early portions, though it has been restored and modernized as a residence. The church of St. George, with its fine tower, is mainly Perpendicular, but has Norman and Early English portions. Near the church are traces of the Benedictine house to which it was attached. The Yarn market, a picturesque octagonal building with deep sloping roof, in the main street, dates from c.

1600 There were British, Roman and Saxon settlements at Dunster (*Torre Dumestorre, Dumester*), fortified against the pirates of the Irish Northmen The Saxon fort of Alaric was replaced by a Norman castle, dating from the Domesday Survey, built by William de Mohun, first lord of Dunster, who founded the priory of St George Before 1836, Dunster had become a mesne borough, owned by the de Mohuns until the 14th century when it was sold to the Luttrells, the present owners Reginald de Mohun granted the first charter between 1245 and 1247 John de Mohun granted other charters in 1301 and 1307 Dunster was represented in parliament in conjunction with Minehead, one of its tithings being part of that borough Representation began in 1562, and was lost in 1832 During this time the port had a considerable wool, corn and cattle trade with Ireland In the middle ages the Friday market and fair in Whit week, granted by the first charter, were centres for the sale of yarn and cloth called "Dunsters," made in the town With the silting up of the harbour, its importance as a port disappeared An 18th century tower on Conegar hill forms a well-known landmark

See Sir H C Maxwell Lyte, *Dunster and its Lords* (1882), *Victoria County History, Somerset*, vol. v

DUNTOCHER (Gaelic, "The Fort of ill hup"), a small town on Dalnair Burn, in the civil parish of Old Kipatnick, Dumbar tonshire, Scotland, 9 mi from Glasgow Pop (1931) 2,473 The district contains coal, limestone and ironstone but there is not much mining There are considerable Roman remains there Antoninus' Wall passed immediately to the south, the burn is crossed by a bridge doubtfully alleged to be of Roman origin (restored 1772), subterranean remains indicate a Roman structure, a Roman camp has been traced, and the vicinity has yielded a number of finds, placed in the custody of Glasgow university

DUNTZER, JOHANN HEINRICH JOSEPH (1813-1901), German philologist and historian of literature, was born at Cologne on July 12, 1813 Educated at Bonn and Berlin he settled in 1837 at Bonn as Privatdozent for classical literature He had already, in his *Goethes Faust in seiner Einseitigkeit und Ganzheit* (1836) and *Goethe als Dramatiker* (1837), advocated a new critical method in interpreting the German classics, which he wished to see treated like the ancient classics In 1846 he became librarian at the Roman Catholic gymnasium in Cologne, where he died on Dec 16, 1901

Of his works on the German classical poets, especially on Goethe, Schiller and Herder, may be mentioned *Ans Herders Nachlass* (3 vols, 1866-67), *Schiller und Goethe, Übersicht und Erläuterung zum Briefwechsel zwischen Schiller und Goethe* (1869), *Goethes Leben* (1880, 2nd ed 1883, Eng trans 1884), *Schillers Leben* (1881), *Abhandlungen zu Goethes Leben und Werken* (2 vols 1885)

DUNWICH, a village in the Ely parliamentary division of East Suffolk, England, on the coast, 5 mi SSW of Southwold Pop of civil parish (1931) 174 This was in Anglo-Saxon days the most important commercial centre and port of East Anglia It was probably a Romano-British site Early in the 7th century, when Sigebert became King of East Angles, Dunwich was chosen his capital and became the nursery of Christianity in eastern Britain A bishopric was founded (according to Bede in 630 while the Anglo-Saxon chronicle gives 625), the name of the first bishop being Felix Sigebert's reign was notable for his foundation of a school modelled on those he had seen in France, it was probably at Dunwich his form of the nucleus of what afterwards became the University of Cambridge By the middle of the 11th century Dunwich had actually suffered from an evil which later caused its total ruin, namely the movements of the sea upon the coast At the Norman Conquest the mayor was granted to Robert Malet In 1173 the right of its strength came to Robert of Leicester to despair of besieging Dunwich The town received a charter from King John In the reign of Edward I it is recorded to have possessed 36 ships, and brigs, trading to the North seas, Iceland and elsewhere, with 24 fishing boats, besides having on its 12 ships of war The Benedictines, Franciscans and Dominicans all maintained establishments here In 1347 more than 400 houses were washed away In 1570, after a terrible storm, appeal was made to Elizabeth But the old wealth port was gradually engulfed and

mroads of the sea still continue, the ruined tower of the old church having gone over the cliff during World War I Many relics have been discovered by excavation, and even from beneath the waves Until 1832 Dunwich returned two members to parliament The corporation was abolished in 1886, and part of the civil parish was transferred to Southwold in 1934 In the same year a bishopric suffragan to St Edmundsbury was constituted, receiving the name Dunwich

DUPANLOUP, FELIX ANTOINE PHILIBERT (1802-1878), French ecclesiastic, was born at St Félix in Savoy on Jan 3, 1802, and educated at the seminaries of St Nicolas de Chardonnay and of St Sulpice, Paris In 1825 he was ordained priest, and was appointed vicar of the Madeleine at Paris, being for a time tutor to the Orleans princes He became the founder of the celebrated academy at St Hyacinthe, and received a letter from Gregory XVI eulogizing his work there, and calling him *Apostolus juventutis* He became a canon of Notre Dame in 1845 When made bishop of Orleans in 1849, he pronounced a fervid panegyric on Joan of Arc, which attracted attention in England as well as France Marie Thérèse he had been sent by Arch bishop Affre to Rome, and had been appointed Roman prelate and protonotary apostolic He was a distinguished educationalist who fought for the retention of the Latin classics in the schools and instituted the celebrated catechetical method of St Sulpice Among his publications are *De l'éducation* (1850), *De la haute éducation intellectuelle* (3 vols, 1856), *Oeuvres choisies* (1861, 4 vols), *Histoire de Jésus* (1872), a counterblast to Renan's *Vie de Jésus* He died on Oct 11, 1878

See F Lygrange, *Life* (Eng tr by Lady Herbert, 1885) and E Faguet, *Mgr Dupanloup* (1914)

DUPERRON, JACQUES DAVY (1556-1618), French cardinal, was born at St Lo, in Normandy, on Nov 15, 1556, the son of a Protestant minister, who settled at Berne, Switzerland, where Jacques Davy received his education Returning to Normandy he abjured Protestantism and took orders On the death of Henry III, after having supported for some time the cardinal de Bourbon, the head of the league against the king, Duperron became a faithful servant of Henry IV, and in 1591 was created by him bishop of Evreux He instructed Henry in the Catholic religion, and in 1594 was sent to Rome, where with Cardinal d'Ossat (1536-1604) he obtained Henry's absolution At the conference at Fontainebleau in 1600 he argued with much eloquence and ingenuity against Du Plessis Mornay (1549-1623) In 1604 he was sent to Rome as chargé d'affaires While still at Rome he was made a cardinal, and in 1606 became archbishop of Sens In the states general of 1614 he vigorously upheld the ultramontane doctrines against the Third Estate He died in Paris on Sept 6, 1618

See *Les Diverses Oeuvres de l'illustre Cardinal Duperron* (1622), Pierre Fretet, *Le Cardinal Duperron* (1897)

DUPIN, ANDRÉ MARIE JEAN JACQUES (1783-1865), commonly called Dupin the elder, French advocate, president of the chamber of deputies and of the Legislative assembly, was born at Vazay, in Nièvre, on Feb 1, 1783 Entering the chamber of deputies in 1815, he joined the Liberal opposition At the election after the second restoration Dupin was not re-elected He defended with great intrepidity the principal political victims of the reaction, among others, in conjunction with Nicolas Bervier, Marshal Ney, and in October 1815 published a tractate entitled *Libre Défense des accusés* In 1827 he was again elected a member of the chamber of deputies and in 1830 actively supported the revolution At the end of 1832 he became president of the chamber, which office he held successively for eight years On Louis Philippe's abdication in 1848 Dupin introduced the young count of Paris into the chamber, and proposed him, in vain, as king, with the duchess of Orleans as regent In 1849 he was president of the committee of the Assembly on legislation After the coup d'état of Dec 2, 1851, he retained his office of *procureur-général*, until effect was given to the decrees confiscating the property of the house of Orleans In 1857 he was offered his old office by the emperor, and accepted it, explaining his acceptance by the words "I have always," he said, "belonged to France and

never to parties." He died on Nov. 8, 1865. Among Dupin's works, which are numerous, may be mentioned *Principes Juris Criminels*, 5 vols. (1806), *Mémoires et plaidoyers de 1806 au 1^{er} janvier 1830*, in 20 vols., and *Mémoires ou souvenirs du barreau*, in 4 vols. (1855-57). But his greatest work was his share in the codification of the laws of the empire, of which he had sole charge after the interruption of the work of the commission after 1815.

His brother, **FRANÇOIS PIERRE CHARLES DUPIN** (1784-1873), wrote several geometrical works.

DUPIN, LOUIS ELLIES (1657-1719), French ecclesiastical historian, was born at Paris on June 17, 1657, and educated at the college of Harcourt and the Sorbonne, receiving his B.D. (1680) and D.D. (1684). The first volume of his *Novellæ bibliotheca de auctoribus ecclesiasticis* appeared in 1686, but the liberty with which he treated the doctrines of the Fathers aroused the prejudice of ecclesiastics, including Jacques Bossuet, and, although he consented to a retraction, the book was suppressed in 1696. After passage of the bull *Unigenitus* he was exiled to Châteleraut as a Jansenist, but the sentence of banishment was repealed on a new retraction. His correspondence with William Wake, archbishop of Canterbury, with a view to a union of the English and Gallican Churches, threw further suspicion upon him. The same zeal for union induced him, during the residence of Peter the Great in France, and at that monarch's request, to draw up a plan for uniting the Greek and Roman Churches. He died at Paris on June 6, 1719. Besides his great work, Dupin wrote a *Bibliothèque universelle des historiens*, 2 vol. (1707), *L'Histoire de l'Eglise en abrégé* (1712), and *L'Histoire profane depuis son commencement jusqu'à présent*, 6 vol. (1714-16).

DUPLEIX, JOSEPH FRANÇOIS (1697-1763), governor general of the French establishment in India, the great rival of Robert Clive (q.v.), was born at Landrecies, Fr., on Jan. 1, 1697. His father, François Duplex, a wealthy farmer general, sent him on a voyage to India in 1715 on one of the French East India company's vessels. He made several voyages to America and India, and in 1721 was named a member of the superior council at Pondicherry. There, besides his official duties, he made large ventures on his own account and acquired a fortune. In 1731 he was made superintendent of French affairs in Chandernagore, which he administered with great success, and in 1742 he was appointed governor-general of all French establishments in India. He determined to acquire for France vast territories in India. The British took the alarm, but the danger to their settlements and power was partly averted by the bitter mutual jealousy between Duplex and La Bourdonnais, French governor of the Isle of Bourbon. When Madras capitulated to the French in 1746 Duplex opposed the restoration of the town to the British thus violating the treaty signed by La Bourdonnais. He then sent an expedition against Fort St. David (1747), which was defeated on its march by the nabab of Arcot, the ally of the British. Duplex succeeded in gaining over the nabab and again attempted the capture of Fort St. David, but unsuccessfully. A midnight attack on Cuddalore was repulsed with great loss. In 1748 Pondicherry was besieged by the British, but in the course of the operations news arrived of the peace of Aix-la-Chapelle. Duplex next entered into negotiations which had for their object the subjugation of southern India, and he sent a large body of troops to the aid of two claimants of the sovereignty of the Carnatic and the Deccan. The British were engaged on the side of their rivals. After temporary successes the scheme failed. Though Duplex was a great organizer, he did not possess Clive's genius for war. The conflicts between the French and the British in India continued till 1754, when the French government, anxious to make peace, sent a special commissioner, Charles Robert Godeheu, a director of the Compagnie des Indes, with orders to supersede Duplex and, if necessary, to arrest him. Duplex's work was ruined at a blow, and he was compelled to embark for France on Oct. 12, 1754. He had spent his private fortune in the prosecution of his public policy, the company refused to acknowledge the obligation, and the government would do nothing for a man whom they persisted in regarding as an ambitious and greedy adventurer. The greatest of French colonial governors died in obscurity and want on Nov. 10,

1763. In 1741 he had married Jeanne Albert (d. 1756), widow of one of the commissioners of the company, known to the Hindus as Joannâ Begum, who proved of great use to her husband in his negotiations with the native princes. Duplex defended his case against the company in his *Mémoire—contenant la compagnie des Indes avec les pièces justificatives* (1751), to which Godeheu replied in his *Lettre à M. Duplex* (1760).

See P. Cultiu, *Duplex* (Paris, 1901), A. Martin, *Duplex et l'Inde française*, 4 vol. (Paris, 1906-8).

DUPICATING MACHINES See OFFICE APPLIANCES

DUPONT, PIERRE (1821-1890), French song writer, the son of a blacksmith, was born at Lyons on April 23, 1821. He was brought up in the country by his godfather, a village priest, and apprenticed to a notary at Lyons. In 1839 he found his way to Paris and some of his poems were inserted in the *Gazette de France* and the *Quotidien*. Two years later he was saved from the conscription and enabled to publish his first volume, *Les Deux Anges*, through the exertions of a kinsman and of Pierre Lebrun Gounod's appreciation of his peasant song, "J'ai deux grands boeufs dans mon étable" (1846), settled his vocation as a songwriter. He had to engage Ernest Reyer to write down his airs. He sang his own songs, as they were composed, at the workmen's concerts in the Salle de la Fraternité du Faubourg Saint-Denis, the public performance of his famous *Le Pain* was forbidden, *Le Chant des ouvriers* was even more popular, and in 1851 he was condemned to seven years' exile. The sentence was cancelled and for a time Dupont renounced politics. He died at Lyons on July 24, 1890. His songs have appeared in various forms, *Chants et chansons* (3 vols., with music, 1852-1854), *Chants et poésies* (7th ed., 1862), etc. Among the best known are "Le Braconnier," "Le Tisserand," "La Vache blanche," and "La Chanson du blé."

DU PONT, SAMUEL FRANCIS (1803-1865), U.S. naval officer, was born in Bergen Point, N.J., Sept. 27, 1803. Educated in Philadelphia, Pa., young Du Pont was attracted to the naval service as a result of the exploits of U.S. sea-fighters during the War of 1812. He was appointed a midshipman in 1817, and his training was under Captain Charles Stewart in the ship-of-the-line "Franklin." He served on various naval vessels in South American and European waters, being promoted a lieutenant in 1826 and a commander in 1842. In command of the sloop of war "Cyane," on the Pacific coast at the outbreak of the Mexican War, Du Pont distinguished himself in a series of daring amphibious operations which cleared the enemy out of the Gulf of California. He participated in the capture of Mazatlán and other cities which drove the enemy from the Pacific coast of Mexico. For the next ten years Du Pont played an important part in the development of steam in the navy. In 1855 he was appointed a captain and, at the same time, brought congressional wrath upon himself as chairman of the naval efficiency board which found several hundred naval officers incompetent. As senior member of the commission of conference, Du Pont was instrumental in planning the naval strategy of the Civil War, and he carried out the first stages of that strategy, when, in the command of the south Atlantic blockading squadron, he stormed and took the Confederate forts at Fort Royal, S.C. (Nov. 7, 1861). Congressional thanks and a rear admiral's following followed the capture of forts by ships previously having been regarded as impracticable. Eighteen months later, in a similar attempt upon the defenses of Charleston, S.C., and using a battle line of monitors and an ironclad, Du Pont met with a severe reverse. He was relieved in July 1863. A dispute with Secretary of the Navy Welles as to the responsibility for this defeat continued until Du Pont's death in Philadelphia, on June 23, 1865. Du Pont circle and fountain in Washington, D.C., were named in his honor.

See H. A. Du Pont, *Rear Admiral Samuel Francis Du Pont* (1926), *Official Records of the Union and Confederate Navies in the War of the Rebellion*, 30 vol. (1894-1922). (W. B. Ck.)

DU PONT, THOMAS COLEMAN (1863-1930), American manufacturer and statesman, was born at Louisville, Ky., Dec. 11, 1863. He was educated at the Massachusetts Institute of Technology, and entered the Kentucky coal and iron mining industries in 1883. In 1900 he removed to Wilmington, Del.,

being president 1902-15 of the E I du Pont de Nemours Powder company. Appointed senator in July 1921 in place of Josiah O. Wolcott, who had resigned, he failed to secure election on the Republican ticket in 1922, but was successful in 1924. He built a concrete motor highway at a cost of \$4,000,000 in the State of Delaware, and made a gift of it to the State.

His cousin, PIERRE SAMUEL DU PONT (1870-1954), having graduated from the Massachusetts Institute of Technology in 1890, engaged in manufacturing at Wilmington. He became chairman of the board of the E I du Pont de Nemours Powder company and also chairman of the General Motors Corporation. The E I du Pont company, which originally confined its activities to the making of explosives, under his guidance engaged in the manufacture of artificial silk, motion-picture films, paints and varnishes.

DUPONT, an intracinct mining borough of Luzerne county Pa. U.S.A., half way between Scranton and Wilkes Barre, on the Lackawanna and Wyoming Valley railroad. The population in 1950 was 4,107 and it was 5,278 in 1940.

DUPONT DE L'ETANG, PIERRE ANTOINE, COUNT (1765-1840), French general, born at Chabanais on July 4, 1765, first saw active service as a member of Mallebois' legion in Holland, and in 1791 was on the staff of the Army of the North under Dillon. He rose rapidly, and in the campaign of 1800 he was chief of the staff to Berthier. After the battle of Marengo he defeated the Austrians at Pozzolo. In the campaign on the Danube in 1805, as the leader of one of Ney's divisions, he prevented the escape of the Austrians from Ulm, and so contributed to the subsequent capture of Mick and his whole army (see NAPOLEONIC CAMPAIGNS). At Friedland he won further fame. He entered Spain in 1808 at the head of a corps. After the occupation of Madrid Dupont, newly created count by Napoleon, was sent to subdue Andalusia but had to retire on the passes of the Sierra Morena. Pursued and cut off by the Spanish army under Castaños, his corps was defeated and capitulated (Baylen, July 19-23; see PENINSULAR WAR). His troops were for the most part raw levies, and ill luck contributed materially to the catastrophe, but Dupont was deprived of his rank and title, and imprisoned from 1812 to 1814. On April 3, 1814, his nomination as minister of war was confirmed by Louis XVIII but his portfolio was removed from him on Dec. 3, owing to his incompetence. Appointed commander of the 22nd military division, he lost his post at the return of Napoleon, but after Waterloo recovered it. After the Second Restoration he was a member of the *conseil privé* of Louis XVIII. From 1815 to 1830 he was deputy for the Charente. He lived in retirement from 1832 till his death in Paris on March 8, 1840.

Amongst the writings Dupont left are some poems, including *L'Art de la guerre* (1838), and verse translations from Horace (1836), and some military works.

See Lieut-Col. Tillet, *Le Général Dupont: une erreur historique* (1905).

DUPONT DE L'EURE, JACQUES CHARLES (1767-1855), French lawyer and statesman, was born at Neubourg, Eure, in Normandy, on Feb. 27, 1767. In 1789 he was an advocate at the parlement of Normandy. In 1798 he was a member of the Council of Five Hundred, and in 1813 he became a member of the Corps Législatif. During the Hundred Days he was vice president of the chamber of deputies, and when the allied armies entered Paris he was one of the commissioners to negotiate with the allied sovereigns. From 1817 till 1849 he was uninterruptedly a member of the chamber of deputies, acting consistently with the liberal opposition. For a few months in 1830 he held office as minister of justice, but resigned before the close of the year and resumed his place in the opposition. At the revolution of 1848 Dupont de l'Eure was made president of the provisional assembly as being its oldest member. He died at Rouge-Peniers, Eure, on Mar. 2, 1855. His fidelity to the cause of constitutional Liberalism won for him the name of the Aristides of the French tribune.

DU PONT DE NEMOURS, PIERRE SAMUEL (1739-1817), French economist and statesman, one of the founders of the school of "Physocrats," was born at Paris on Sept. 14, 1739.

He became intimate with François Quesnay, Turgot and other leaders of the school known as the "economists" and advocated their doctrine of free trade in his *Exportation et importation des grains* (1764). The Physiocratic school (*q.v.*) took its name from du Pont's treatise, *Physiocratie, ou constitution naturelle du gouvernement le plus avantageux au genre humain* (1768). An admirably clear expression of the doctrine is given in his *De l'origine et des progrès d'une science nouvelle* (1767). Du Pont aided Turgot during his brief period of office (1774-76). He was recalled from retirement by Vergennes in 1782 to negotiate with the English commissioner James Hutton, for recognition of the independence of the United States (1783), and to prepare a treaty of commerce with Great Britain (1786). Under Calonne he became councillor of state, and was appointed commissary general of commerce.

Du Pont was a member of the states-general, and then of the constituent assembly, of which he was elected president on Oct. 16, 1790. But after Aug. 10, 1792 when he took the side of the king, he was driven into hiding. He was eventually arrested and imprisoned in La Force (1794). The death of Robespierre saved him from the guillotine. As a member of the Council of Five Hundred, du Pont was a leader of the reaction. After the republican triumph on the 18th Fructidor (Sept. 4), 1797, his house was sacked by the mob, and in 1799 he emigrated to the United States.

Jefferson requested him to prepare a scheme of national education, which was published in 1800 under the title *Sur l'éducation nationale dans les Etats Unis d'Amérique*. Though the scheme was not carried out in the United States, several of its features have been adopted in the existing French code. On his return to France in 1802 he was elected to the *Institut*. In 1814 he was secretary to the provisional government, and on the restoration he was made a councillor of state. In 1815 he returned to the United States, and died at Eleutheran Mills near Wilmington, Del., on Aug. 6, 1817.

The powder mills founded by his son Eleuthère at Wilmington brought the family considerable wealth. Du Pont's grandson, Admiral Samuel Francis du Pont (1803-65), played a conspicuous part as a U.S. naval officer in the American Civil War.

See Schelle, *Du Pont de Nemours et l'école physiocratique* (1888).

DU PONT DE NEMOURS AND COMPANY, E. I., organized in 1802 as a gunpowder company, later developed into a world known chemical manufacturing corporation with (in 1951) 72 plants in 25 states of the United States. Among the products of the company are commercial explosives acids, tetra ethyl lead, sodium, synthetic ammonia, industrial alcohol, dyes, lacquers, paints pigments, coated fabrics, rayon, nylon "Orlon" acrylic fibre and other synthetic fibres, cellulose film, photographic film and plastics. Its commercial explosives have helped to build canals, railroads, highways and tunnels, and to extract coal, oil and minerals. Its dyes, nitrogen products, synthetic camphor, neoprene chemical rubber and nylon have contributed importantly to the nation's self sufficiency. Its military explosives have served the nation's wartime needs since 1802, but at the termination of hostilities it has always quickly returned to peacetime production. In peacetime, military explosives make up only a small fraction of 1% of the company's business. Headquarters are at Wilmington, Del., the site of the original powder plant, long since abandoned, built by Eleuthère Irénée du Pont de Nemours, its founder, who had learned to manufacture powder under the renowned French chemist Antoine Lavoisier.

(L. D. P.)

DU PONT HIGHWAY see COLEMAN DU PONT ROAD.

DUPONT, JAMES (1606-1679), English classical scholar, was born in Cambridge. In 1639 he was appointed regius professor of Greek there, in 1664 dean of Peterborough and in 1668 master of Magdalen college. Throughout the Civil War, in spite of the loss of his clerical offices and eventually of his professorship, Dupont continued his lectures. He is best known by his *Homers gnomologia* (1660), a collection of the aphorisms in the *Iliad* and *Odyssey*, illustrated by quotations from the Bible and classical literature. His other published works chiefly consist of translations (from the Bible and Prayer Book into Greek) and short original poems (*Horae subsecrae* or *Stromata* and *Sylvae*).

Duport did much to keep alive the study of classical literature in his day

The chief authority for the life of Duport is J. H. Monk's "Memoir" (1825), see also Sandys, *Hist. Class. Schol.* (1908), II, 349

DUPPLIN MOOR, scene of the battle of Dupplin, Aug. 9, 1332. This battle is of importance not only as the turning point in the Scottish Wars but as the birthplace of the tactics which gained the English victories later against France in the Hundred Years War (q.v.). The series of defeats suffered by Edward II in Scotland, and the mutual failure of Edward III, had led to the Peace of Northampton. As a consequence, the Scottish supporters of the Plantagenets were disinherited, but, headed by Edward Baliol and Henry de Beaumont, they organized an expedition to regain their fiefs. Edward III, bound by the treaty, not merely refused help but prohibited them from crossing the border. Not to be balked, they collected a small force of English archers and men at arms, hired ships, and, sailing from Ravenspur, landed at Kinghorn in Fife. Thence they marched on Perth but were met at the river Earn by a large Scottish army under the earl of Murr. Trying to discount their inferiority by the use of surprise, the "disinherited" crossed the river under cover of darkness and made an audacious night onslaught on the rear of the Scottish camp. But this only affected part of the enemy's bivouac, and at daybreak the main force moved out in battle order to swamp their puny adversary. The "disinherited" fell back to the slopes of Dupplin moor, and there the knights and men-at-arms dismounted to form a phalanx of spears, while the archers spread out in a dispersed line amid the heather on either flank. Only 40 men at arms were kept mounted as a reserve. The Scottish, all dismounted according to their custom, charged direct at the opposing men-at-arms, disregarding the archers. Once spears were locked the charge lost impetus and the archers, closing in from either side, poured a hail of arrows into the press, which grew ever denser until the close locked mass became help less to use their weapons. Held in front and galled on both flanks, those who could, broke away and fled, pursued by the "disinherited" horse, and these in the centre fell easy victims.

See J. E. Morris, *Eng. Historical Review* (1897), Oman, *History of the Art of War in the Middle Ages* (1924)

DU PRAT, ANTOINE (1463-1535), chancellor of France and cardinal, was born at Issoire on Jan. 17, 1463. He began life as a lawyer, and rose rapidly in the legal hierarchy owing to the influence of his cousin Antoine Bohier, cardinal archbishop of Bourges. In 1507 he became first president of the parlement of Paris. Louise of Savoy had employed him as her adviser in her affairs, and had made him tutor to her son. When Francis I ascended the throne he made Du Prat chancellor of France. During the regency of Louise of Savoy he, together with Florimond Robertet, was at the head of affairs. After the death of his wife in 1507 Du Prat had taken orders, he received the bishoprics of Valence, Die, Meaux and Albi, and the archbishopric of Sens (1525), in 1527 he became cardinal, and in 1530 papal legate. He was a determined adversary of the Reformation. He died at Nantouillet on July 9, 1535.

See the marquis Du Prat, *Vie d'Antoine Du Prat* (1851)

DUPRÉ GIOVANNI (1811-1882), Italian sculptor, born in

a more ideal conception of form contrasting with the naturalism of his early period. Among his later work we may mention a 'Pieta' in the cemetery of Siena, executed for the Bichi-Ruspoli family and the monument of Cavour in Turin. His realistic treatment of form here seems to conflict with the allegorical elements of the composition. Dupré also executed many portrait busts. He died in Florence on Jan. 10, 1882.

His autobiography *Pensieri sull'Arte e i Ricordi Autobiografici* (1882) was translated into English by Peruzzi.

DUPRÉ, JULES (1811-1893), French painter, and one of the chief members of the Barbizon group of romantic landscape painters, was born at Nantes, and died at L'Isle Adam, Oct. 6, 1891. If Corot stands for the lyric and Rousseau for the epic aspect of the poetry of nature, Dupré is the exponent of her tragic and dramatic aspects. He was the son of a porcelain manufacturer and started his career in his father's works, whence he went to his uncle's china factory at Sèvres. Dupré exhibited first at the Salon in 1831, and three years later was awarded a second class medal. In the same year he came to England, where he was deeply impressed by the genius of Constable. From him he learnt how to express movement in nature, and the district of Southampton and Plymouth, with its wide, unbroken expanses of water, sky and ground, gave him good opportunities for his special gifts. Late in life he changed his style, and gained appreciably in largeness of handling and arrived at greater simplicity in his colour harmonies. Among his best known works are the "Morning" and "Evening" at the Louvre, the early "Crossing the Bridge" in the Wallace collection, and the "River Scene" now in the Tate Gallery, London.

See Jules Claretie, *Peintres et sculpteurs contemporains* (2nd series, 1884).

DUPUIS, CHARLES FRANÇOIS (1742-1809), French author and politician, was born of poor parents at Trye-Chateau, near Gisors. He represented Seine-et-Oise in the Convention, was secretary to the Assembly in An III and a member of the Council of Five Hundred in An IV. After the 18th Brumaire he was a member of the Legislative Body, eventually becoming its president. In 1781 he had published a memoir on the origin of the signs of the zodiac, which he placed in Upper Egypt, and on the connection with the whole fabric of the mythology of the ancients. His chief work, *Origine de tous les cultes* (3 vols., 1795), developing his theories, aroused a bitter controversy, and was one of the factors which led Napoleon to send a scientific expedition to Upper Egypt. The *Origine* passed through many editions (modern ed. 1876), and the author himself published an abridged edition in 1798. Dupuis died on Sept. 29, 1809.

DUPUY, CHARLES ALEXANDRE (1851-1923), French statesman, born at Le Puy (Haute Loire) on Nov. 5, 1851. In 1885 he was elected to the chamber as an Opportunist Republican, and became minister of public instruction in Ribot's cabinet, in 1892. In April 1893 he formed a ministry himself, but resigned at the end of November, and on Dec. 5 was elected president of the chamber. During his first week of office the anarchist Vaillant, who had gained admission to the chamber, threw a bomb at the president, and M. Dupuy's collected bearing, and his historic words "Messieurs, la séance continue," gained him much credit. In May 1894 he again became premier and minister of the interior, and he was by President Carnot's side when the latter was assassinated at Lyons in June. His cabinet remained in office till January 1895, it was under it that Captain Dreyfus (q.v.) was arrested and condemned (Dec. 23, 1894). In November 1898, after Brisson had at last remitted the case to the judgment of the court of cassation, Dupuy formed a cabinet of Republican concentration. It was no sooner discovered that the judges were likely to decide in favour of Dreyfus than Dupuy proposed a law in the chamber transferring the decision to a full court of all the divisions of the court of cassation. This arbitrary act, though adopted by the chamber, was at once construed as a fresh attempt to maintain the judgment of the first court martial, but the whole court of cassation decided that there must be a new court-martial, and Dupuy at once resigned (June 1899). In June 1900 he was elected senator for the Haute-Saône. He died in 1923.

(1845, Arcades of the Uffizi, Florence) The mourning Dapppo (1857) is his most famous work of this period. His success was due to his lifelike and original interpretation of form at a time when Italian sculpture was deteriorating into a mannered imitation of Canova. A visit in 1856 to Naples and Rome, where he admired Canova's monument to Pius VI, influenced him towards 7-EE

DUPUY, PIERRE (1582-1651), French scholar, otherwise known as *Puteanus*, was born at Agen (Lot-et Garonne). In 1615 he was commissioned by Mathieu Mole, first president of the parliament of Paris, to catalogue the "Trésor des chartes." His inventory is preserved in the original and in copy in the Bibliothèque Nationale, and transcriptions are in the national archives in Paris, at the record office in London, and elsewhere. Dupuy and his brother then bought from Rigault the post of keeper of the king's library, and drew up a catalogue of the library. He was author of some important books, written from the Gallican standpoint, on the history of the relations of Church and State in the middle ages. Dupuy died in Paris on Dec. 14, 1651.

DUPUY DE LÔME, STANISLAS CHARLES HENRI LAURENT (1816-1885), French naval architect, the son of a retired naval officer, was born at Ploemeur, near Lorient, on Oct. 15, 1816. He entered the École Polytechnique in 1835, and in 1842 was sent to England to study and report on iron ship-building. Acting on his report, which was published in 1844, the Government built their first iron vessels under his supervision. He planned and built the steam line of battle ship "Napoleon" (1848-1852), and devised the method of altering sailing ships of the line into steamers, which was afterwards extensively practised in both France and England. He also showed the practicability of armouring the sides of a ship, and the frigate "Gloire" gave a very clear demonstration of his views. It was the beginning of a great change in the construction of ships. At the beginning of the Franco-German War Dupuy sat on the committee of defence, and during the siege of Paris planned a steerable balloon, for carrying out which he was given a credit of 40,000 fr., but the balloon was not ready till a few days before the capitulation. In 1877 he was elected a senator for life. He died in Paris on Feb. 1, 1885.

DUQUE DE ESTRADA, DIEGO (1589-1647), Spanish memoir writer, soldier and adventurer, was born at Toledo. He left a book of amazingly vivid memoirs, entitled *Comentarios de el Desempeño de si Mismo, prueba de todos estados, y elección del Mejor de ellos*—"The Commentaries of one who knew his own little worth, the touchstone of all the states of man, and the choice of the best."

The memoirs have been reprinted by Don Pascual de Gayangos in the *Memorial histórico español*, vol. XII (1860).

DUQUESNE, ABRAHAM, MARQUIS (1610-1688), French naval officer, was born at Dieppe in 1610. He spent his youth in the merchant service, and captured the island of Lerins from the Spaniards in May 1637. About the same time his father was killed in an engagement with the Spaniards, and the news raised his hatred of the national enemy to the pitch of a personal and bitter animosity. He distinguished himself in the engagement at Guetaria (1638), the expedition to Corunna (1639) and in battles at Tarragona (1641), Barcelona (1643) and the Cabo de Gata. Serving as a volunteer in the Swedish service in 1643, he defeated the Danish fleet near Gothenburg and thus raised the siege of the city. The Danes returned to the struggle with increased forces under the command of King Christian in person, but they were again defeated—their admiral being killed and his ship taken. On the conclusion of peace between Sweden and Denmark in 1645, Duquesne returned to France. The revolt at Bordeaux, supported as it was by material aid from Spain, gave him the opportunity of at once serving his country and gratifying his long cherished hatred of the Spaniards. In 1650 he fitted out at his own expense a squadron with which he blockaded the mouth of the Gironde, and compelled the city to surrender. Peace with Spain was concluded in 1659, and Duquesne was then occupied in suppressing piracy in the Mediterranean. On the revolt of Messina from Spain, he was sent to support the insurgents, and encountered the united fleets of Spain and Holland under the command of de Ruyter. After several battles, in which the advantage was generally on the side of the French, a decisive engagement took place near Catania (April 20, 1676), when the Dutch fleet was totally routed and de Ruyter mortally wounded. The greater part of the defeated fleet was

afterwards burned in the harbour of Palermo, where it had taken refuge, and the French thus secured the undisputed command of the Mediterranean. For this service Duquesne received a letter of thanks from Louis XIV., together with the title of marquis and the estate of Bouchot. His last achievements were the bombardment of Algiers (1682-83), to effect the deliverance of the Christian captives, and the bombardment of Genoa in 1684. He retired from service in 1684, on the ground of age and ill health. It is probable also that he foresaw the revocation of the Edict of Nantes, which took place in the following year. He died in Paris on Feb. 2, 1688.

See Jal, *Abraham Duquesne, et la marine de son temps* (1873).

DUQUESNE, a city of Allegheny county, Pa., U.S., on the Monongahela river, 12 mi. S.E. of Pittsburgh, served by the Pennsylvania railroad. The population was 17,612 in 1950 and was 20,693 in 1940 by the federal census. It is an important steel-manufacturing centre, with a total production in 1950 of about 1,323,000 net tons of pig iron and ferromanganese and 1,843,000 net tons of ingots. Rolled products of semifinished steel, concrete reinforcement bars and other bars, and tube rounds are also manufactured. Duquesne was settled in 1885, incorporated as a borough in 1891 and chartered as a city in 1917.

DU QUOIN, a city of Perry county, Ill., U.S., in the fertile agricultural and coal mining region southeast of St. Louis, on federal highway 51 and state highways 153 and 154 and the Illinois Central railroad. The population was 7,139 in 1950 and was 7,515 in 1940 by the federal census. It is a shipping point for coal, grain, livestock, fruit and the home of the Du Quoin state fair and Egyptian music camp. Its manufacturing industries include machine shops, a dairy and bottling and a meat packing plant. The largest strip coal mines in the country are there. The community of Old Du Quoin was settled in 1816, and the present city was laid out 5 mi. E.

DURALUMIN. An aluminum alloy discovered by A. Wilm and originally made at Duren in Germany. It possesses the valuable property of being greatly strengthened by heat treatment, as steel is hardened by quenching and tempering. In addition to 94% aluminum, 4% of copper and 1% of manganese, duralumin contains 1% of magnesium and owes its special qualities to the association of the last named component with the silicon always present in aluminum as an impurity. (For a brief explanation see *ALUMINUM Alloys of Aluminum*.) The original composition has been varied, manganese being sometimes eliminated and sometimes replaced by iron, nickel or chromium, but magnesium and silicon remain as essential constituents, while copper, which itself confers somewhat similar properties on aluminum, is also generally retained. Special trade names have been applied to some of these later alloys and the whole class is now frequently known as the "strong aluminum alloys."

In the normal state these alloys are soft and ductile and may be rolled into sheets and bars or drawn into tubes, angles, etc. Such work hardens them, as all metals, but leaves them like many aluminum alloys, unduly subject to corrosion. Annealing at about 400° C. removes this "work hardness," but if the alloys be heated to temperatures which vary with the alloy and its intended use from 450° C. to 550° C. and are then plunged into water, although at first softened and, therefore, still capable of being worked, hardening soon commences and continues for several days. By reheating at about 200° C. the hardening process can be hastened.

Heat-treated duralumin is comparatively resistant to corrosion. It is ductile (elongation 8% to 15%), will bear a load of 30,000 lb per square inch without permanent distortion and breaks under a load of 55,000-62,000 lb per square inch.

As the alloys are light (specific gravity = 2.85) their strength per unit of weight (specific tenacity) is high (9.3) compared with nickel steel (5.9) and nickel chrome steel (7.2). These properties make them particularly suitable for aircraft construction, for which they have been used to a very great extent. It may be said that the development of the rigid airship would have been impossible without duralumin, used throughout for the framework of these gigantic craft, while all-metal heavier-than-air machines also depend on these alloys. Connecting rods of duralumin find favour for internal-

combustion engines, while an alloy in which nickel replaces manganese (Y alloy) is used for the pistons of the large diesel engines of submarines, for which it is particularly suited, because it can be cast to shape and retains its strength at comparatively high temperatures.

Like aluminum and its other alloys, duralumin cannot be effectively soldered since joints so made corrode rapidly nor can it be welded without losing the special properties to which it owes its utility.

To all ordinary fabricating processes as spinning, pressing, riveting, machining, etc., duralumin lends itself perfectly.

For a full account of these alloys see R. J. Anderson *The Metallurgy of Aluminum and Aluminum Alloys* (1925), where an extensive bibliography will be found. (R. S.)

DURAN, a Jewish Provençal family of rabbis and scholars, of whom the following are the most important —
1. **PROFAT DURAN**, called also **EPHRAÏM**.

He was in 1391 compelled to profess Christianity, but remained devoted to Judaism. His chief works were grammatical and philosophical. In the former realm his most important contribution was the *Ma'aseh Ephod* (completed in 1403), in the latter, his commentary to the *Guide of the Perplexed* by Maimonides (q.v.).

2. **SEMON BEN ZEMAK DURAN** (1361–1441), rabbi of Algiers. He was one of the first of the medieval rabbis to be a salaried official of the synagogue. Before the 14th century the rabbinical post had been almost invariably honorary, and filled by men who derived their income from a profession, especially medicine. Duran wrote a systematic work on theology, *Magen Aboth*, but is chiefly famous for his numerous *Responsa* (known as *Tashbas*), published in 1738–39, which gives valuable information as to social and religious conditions of his day. (I. A.)

DURAN, AGUSTIN (1793–1862), Spanish scholar, was born at Madrid, where his father was court physician. He was sent to the seminary at Vergara. He studied philosophy and law at the University of Seville, and was admitted to the bar at Valladolid. He held a post in the education department at Madrid (1821–23), but was suspended because of his political opinions. In 1834 he became secretary of the board for the censorship of the press, and shortly afterward obtained a post in the national library at Madrid. The revolution of 1840 led to his dismissal, but he was reinstated in 1843, and in 1854 was appointed chief librarian, he retired, however, in the following year. In 1828 he published anonymously his *Discurso sobre el influjo que ha tenido la crítica moderna en la decadencia del teatro antiguo español*, which greatly influenced the younger dramatists of the day. He next endeavored to interest his fellow countrymen in their ancient, neglected ballads, and in the forgotten dramas of the 17th century. His *Romancero general* was published in five volumes (1828–32, later ed. 2 vol., 1849–51), *Talia española* (1834) is a reprint of old Spanish comedies. Durán's *Romancero general* is the fullest collection of the kind.

DURANCE (anc. *Drientia*), one of the principal rivers draining the French slope of the Alps towards the Mediterranean. Its total length from its source in the High Alps of Dauphiné to its junction with the Rhone, a little below Avignon, is 217½ miles. It is commonly said to take its origin in some small lakes a little south of the Mont Genève pass, but has two other head streams of much greater length and volume. These are the Claire, flowing in from the north, through the smiling Névache gien, at the head of which, not far from the foot of the Mont Thabor (10,440 ft.) it rises in some small lakes, on the east side of the Col des Rochilles, and the Gusané (flowing in from the north west and rising near the Col du Lautaret, 6,808 ft.). Between its junction with the Cerveyre and the Gyrondé the Durance passes through fine deeply-cut gorges. It then runs through a stony plain, where it frequently overflows and causes great damage, this being indeed the main characteristic of the Durance throughout its course. At the foot of the fortress of Mont Dauphin and some distance above the town of Embrun, it receives (left) the Guil, which flows through the Queyras valley from near the foot of Monte Viso. It becomes the boundary for a while between the

departments of the Hautes Alpes and of the Basses Alpes, and receives the considerable Ubaye river, flowing from near the foot of Monte Viso past Barcelonnette (left).

Flowing through the Basses-Alpes it is joined above Sisteron (right) by the wild torrent of the Buech, flowing from the desolate region of the Devoluy, the Bleone (left) (on which Digne, the capital of the department, is situated) and the Asse (left). The Verdon, flowing past the town of Castellane, joins it from the lower summits of the Maritime Alps. After passing through some narrow gorges near Sisteron the bed of the river becomes wide and liable to flood, the frequent overflows being kept within bounds by numerous dykes and embankments. These features are especially marked when the river, after leaving the Basses-Alpes, bends north west and, always serving as the boundary between the departments of Vaucluse (north) and of the Bouches-du-Rhône (south), passes Cavillon above its junction with the Rhone. The drainage area of the Durance is about 5,166 sq. m., while the height it descends is 6,550 ft., if reckoned from the lakes on the Mont Genève, or 7,850 ft. if we take those at the head of the Névache valley as the true source of the river.

DURAND, ASHER BROWN (1796–1886), American painter and engraver, was born at South Orange (N. J.), on Aug. 21, 1796. He worked with his father, a watchmaker, was apprenticed, in 1812, to an engraver named Peter Maverick, and his first work, the head of an old beggar after Waldo, attracted the attention of the artist Trumbull. Durand established his reputation by his engraving of Trumbull's "Declaration of Independence." After 1835, however, he devoted himself chiefly to portrait painting. He painted several of the presidents of the United States and many other men of political and social prominence.

In 1840 he visited Europe, where he studied the work of the old masters, after his return he devoted himself almost entirely to landscape. He died at South Orange on Sept. 17, 1886. He was one of the founders of the National Academy of Design in 1826, and was its president in 1845–61. Durand may be called the father of the Hudson River school. Although there was something hard and unsympathetic about his landscapes and unnecessary details and trivialities were over prominent, he was a well trained craftsman, and his work is marked by sincerity.

DURAND, GUILLAUME (DURANTI or DURANTIS) (c. 1230–1296), French canonist and liturgical writer, and bishop of Mende, was born at Puyssieux, near Beziers. He studied law at Bologna, and about 1264 was teaching canon law at Modena. Clement IV. called him to the pontifical court as a chaplain and auditor of the palace, and in 1274 he accompanied Gregory X. to the Council of Lyons, the constitutions of which he helped to draw up. Martin IV. made him vicar spiritual in 1281, then governor of Romagna and of the March of Ancona (1283). In the midst of the struggles between Guelphs and Ghibellines, Durand successfully defended the papal territories, both by diplomacy and by arms. Honorius IV. retained him in his offices, and although elected bishop of Mende in 1286, he remained in Italy until 1291. In 1295 he refused the archbishopric of Ravenna, and in 1296 retired to Rome, where he died on Nov. 1.

Durand's principal work is the *Speculum judicale*, which was drawn up in 1271, and revised in 1286 and 1291 (best ed. Turin, 1578). It is a general explanation of civil, criminal and canonical procedure, and also includes a survey of the subject of contracts. It is a remarkable synthesis of Roman and ecclesiastical law, distinguished by its clarity, its method, and especially its practical sense, in a field in which it was pioneer, and its reputation was as lasting in the courts as in the schools. His *Rationale divinarum officiorum*, on the origin and symbolic sense of the Christian liturgy, written before 1286, is one of the authorities on the Western liturgy (latest ed. Naples, 1866). The other important works of Durand comprise a *Repertorium juris canonici* (*Breviarium aureum*), a collection of citations from canonists on questions of controversy, a *Commentarius in sacrosanctum Lugdunense concilium* (ed. 1569), of especial value owing to the share of Durand in the elaboration of the constitutions of this council (1274), and inserted by Boniface VIII. in the *Sextus*.

Durand's nephew, also named **GUILLAUME DURAND** (d. 1330),

nd also a canonist, was rector of the university of Toulouse and succeeded his uncle as bishop of Mende. He wrote in 1311, in connection with the council of Vienne, *De modo celebrandi concilii et corruptelis in Ecclesia reformandis*.

On the elder Durand see V. Lefèvre in *Histoire littéraire de la France*, vol. xx, pp. 411-497 (1842); Schulte, *Geschichte der Quellen des canonischen Rechts* (1877); E. Male, *L'Art religieux au XIII^e siècle en France* (1898). On the nephew see B. Hauréau, in *Journal des savants* (1892).

DURAND, GUILLAUME (DURANDUS OF ST. POURSAIN) (d. 1332), French scholastic theologian known as *Doctor Resolutissimus*, was born at St. Pourçain, Auvergne. He entered the Dominican order at Clermont and in 1313 was made a doctor in Paris, where he taught till Pope John XXII called him to Avignon as master of the sacred palace, i.e., theological adviser and preacher. He subsequently became bishop of Limoux (1317), of Le Puy (1318) and of Meaux (1326). He composed a commentary on the *Sentences* of Peter Lombard (Paris, 1508, etc.), in which, breaking with the moderate realism of Aquinas, he anticipated the terminology of William of Occam. Singularity alone exists in things and is known immediately by the intellect. From this it follows that the active intellect which is supposed to abstract universals, is superfluous and the problem of individuation absurd. Durand also denied a distinction between essence and existence and opposed the realms of reason and faith. In the question of the beatific vision, arising out of opinions promulgated by John XXII (q.v.), he sided with Thomas Walleis, Armand de Bellocvis and the doctors of Paris against the pope, and composed his *De statu animarum sanctorum*. Mention should also be made of his *De jurisdictione ecclesiastica et de legibus* (Paris, 1506).

See B. Hauréau, *Histoire de la philosophie scolastique* (1880); C. Werner, *Die Scholastik des späten Mittelalters*, vol. II (1883); J. Koch, *Durandus de S. Porciano* OP (Münster, 1927).

DURANDO, GIACOMO (1807-1894), Italian general and statesman, was born at Mondovì in Piedmont. He was implicated in the revolutionary movements of 1831 and 1832. In 1848 he was one of those who asked King Charles Albert for the constitution. On the outbreak of the war with Austria he commanded the Lombard volunteers, and in the campaign of 1849 he was aide-de-camp to the king. He was elected member of the first Piedmontese parliament and was a strenuous supporter of Cavour, during the Crimean campaign he took General la Marmora's place as war minister. In 1855 he was nominated senator, lieutenant general in 1856, ambassador at Constantinople in 1859 and minister for foreign affairs in the Rattazzi cabinet two years later. He was president of the senate from 1884 to 1887, after which year he retired from the army.

His brother, GIOVANNI DURANDO (1804-1869), also spent his early life abroad. Returning to Italy on the outbreak of the revolution of 1848, he was appointed commander of a division of the pontifical forces and fought against the Austrians in Venetia until the fall of Vicenza, when he returned to Piedmont as major general. In the campaign of 1849 he commanded the first Piedmontese division, he subsequently served in the Crimea, in the war of 1859, and in that of 1866 as commander of the 1st army corps.

DURANGO, a city of southwestern Colorado, U.S., 6,525 ft above sea level, the county seat of La Plata county. It is on federal highways 160 and 350 and is served by the Denver and Rio Grande Western and the Rio Grande Southern railways. The population was 7,458 in 1930 and 5,887 in 1940 by the federal census.

Durango is the trading centre of a wide area, with livestock, fruit, oil, natural gas, mining and lumbering the main industries. Durango National forest (3,000,000 ac.) is 11 mi N. of the city, 60 mi W. is Mesa Verde National park, containing the most notable prehistoric cliff dwellings in the United States. At Hesperus (8 mi W.) is the Fort Lewis school of agriculture, a branch of the state agricultural college. The city was incorporated in 1880, four years after Colorado was admitted to statehood.

DURANGO, a state in north central Mexico, bounded north by Chihuahua, east by Coahuila, south by Nayarit, west by Sinaloa,

with an area of 47,679 sq mi. Pop. (1950) 629,502, including fewer than 600 Indians. On a high, semiarid plateau, Chihuahua is extremely mountainous in its westward districts where the Sierra Madre Occidental courses in a series of peaks between 7,000 and 10,000 ft high. Rainfall in the eastern sections is sparse and agriculture depends exclusively on irrigation, stock raising and minor forest industries occur in the west. Coursing eastward from the Sierra, the Nazas river is the largest of the state flowing for approximately 375 mi., when swollen by spring rains it is the main source of water that permits commercial crops of cotton, wheat, maize, tobacco, sugar cane, vegetables and fruits. Durango shares with Coahuila the famous Laguna cotton district, a large co-operative enterprise. The state is highly mineralized and mining has traditionally been a principal mainstay. Silver, gold, sulphur, tin, coal, cinnabar and other valuable deposits exist, only partially known. A colossal helmet shaped hill 700 ft high of nearly pure iron, known as Cerro de Mercado, rises 2 mi. from the capital, Durango city. The hill is estimated to contain between 300,000 and 600,000 tons of haematite in various stages of oxidation, forced out by ancient volcanic action. It supports the iron and steel works near by. The Candelaria mine (argenteite) is famous for its prodigious output and purity of ore. Other mining districts are Mapimi, a great arid depression 130 mi. NNE of Durango city, Cuernavaca, Nombre de Dios (first Spanish settlement, c. 1555), Papasquaro, and San Juan del Rio. Expensive and inadequate transportation has hampered development of mineral resources. National Railways of Mexico lines traverse the state northeast to southwest, and another line crosses its eastern parts. In 1951 construction began on a direct rail connection from Durango city to the Pacific port of Mazatlán. The state is also crossed by two branches of the Pan American paved highway and has air routes. Originally explored by Francisco de Ibarra (1562-63), Durango shared the colonial history of Chihuahua as major parts of the realm of Nueva Viscaya, the two became sovereign and separate states in 1823. As frontier zones, they were plagued by Indian uprisings until late in the 19th century. Principal places in Durango, with their 1940 populations, include the only city and state capital, Durango (33,412), Guanaxacé (2,512), El Oro (1,860), San Juan de Guadalupe, San Dumas, and Villa Lerdo. The latter is a suburb of Torreón, Coahuila. (Hd C.)

DURANGO, also called VICTORIA DE DURANGO, a city of Mexico, capital of the state of Durango, 574 mi NW of Mexico City, in lat. 24° 25' N, long. 105° 55' W. Pop. (1940) 33,412, (est. 1950) 61,000. Durango lies on the main trunk highway from the federal capital to the United States border at Ciudad Juárez, El Paso, Tex., and is served by National Railways of Mexico, in 1951 construction began on a rail link to the Pacific port of Mazatlán. At an altitude of 6,314 ft the city dominates the picturesque and fertile Guadiana valley formed by eastern spurs of the Sierra Madre. Its climate is mild and healthful, and the city is provided with abundant water supply, thermal springs are found near by. An outstanding feature is the Cerro de Mercado north of the city, it is a solid hill of iron that represents one of the world's largest deposits. Durango is an important commercial and mining centre with diversified local industries, that include reduction works, cotton and woollen mills, glass works, iron

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San Francisco and the Kansas, Oklahoma and Gulf railways. Pop. (1950) 10,521. Oklahoma Southern State college and Oklahoma Presbyterian college are located in Durant. There is a large state fish hatchery.

DURANTE, FRANCESCO (1684-1755), Italian composer, was born at Frattamaggiore, in the kingdom of Naples, on March 15, 1684. At an early age he entered the Conservatorio dei poveri di Gesù Cristo, at Naples, where he received lessons from Gaetano Greco, later he became a pupil of Alessandro Scarlatti at the Conservatorio di Sant' Onofrio. He is also supposed to have studied under Pasquini and Pironi in Rome, but no documentary proof of this statement can be given. He is said to have succeeded Scarlatti in 1725 at Sant' Onofrio, and to have remained there until 1742, when he succeeded Porpora as head of the Conservatorio di Santa Maria di Loreto, also at Naples. This post he held for 13 years, till his death on Aug. 13, 1755, at Naples. His fame as a teacher was all but unrivalled, and Jommelli, Paisiello, Pergolesi, Piccini and Vinci were among his pupils. A complete collection of Durante's works, consisting all but exclusively of sacred compositions, was presented by Selvaggi, a Neapolitan lover of art, to the Paris library. The imperial library of Vienna also preserves a valuable collection of Durante's manuscripts. Two requiems, several masses (one of which, a most original work, is the *Pastoral Mass* for four voices) and the *Lamentations* of the prophet Jeremiah are among his most important settings.

DURAO, JOSÉ DE SANTA RITA (c. 1737-1784), Brazilian poet, was born in the parish of Cata Preta, near the boundary of Minas Geraes, Brazil, probably in 1737, though some authorities place his birth within the years 1718-22. He received his early education at the Jesuit college in Rio de Janeiro, and in 1756 obtained the degree of doctor of theology from the historic University of Coimbra, Portugal. Two years later he entered the Gratián convent of the order of St. Augustine. Famous already as a preacher, he offended his superiors by his liberality of thought, and particularly by his openly expressed regard for the proscribed Jesuits. In consequence he was forced to leave the country. He was detained in Spain as a spy in 1765, but was released in the following year, and then went to Rome, where he became acquainted with Alfieri, Fidenmonte, Casti and other literary men of the time. In 1778 he returned to Portugal to accept the chair of theology at the University of Coimbra, and at the opening of the university for the year delivered an address in Latin, *De sapientia*, which marked him as one of the foremost intellectuals of his day. He soon retired, however, to the Gratián convent, and became its prior. In 1781 he published in Lisbon his great epic *Coramuru poema épico do descobrimento da Bahia*, a poetic treatment in ten cantos of the discovery of Bahia (southern Brazil), by Diogo Alvarez. This is one of the masterpieces of Brazilian literature, and is remarkable especially for the beauty of its descriptions of South American scenery and Indian life. Failure of the poem to command instant recognition embittered its author, and led him to burn nearly all his other works. A French translation of the *Coramuru* appeared in Paris in 1839. He died in Lisbon on Jan. 24, 1784.

See Adolfo de Varnhagen, *Epocas Brasileiras* (1845), Pereira da Silva, *Os Varões illustres do Brasil* (1858), Wolf, *Le Brésil littéraire* (Berlin, 1863), Sotero dos Reis, *Curso de literatura Portuguesa e Brasileira*, vol. iv (Maranhão, 1868), José Veríssimo, *Estudos de literatura Brasileira, segunda serie* (1901), Ronald de Carvalho, *Pequena Historia da Literatura Brasileira* (1922), and Isaac Goldberg, *Brazilian Literature* (1922). (W B F)

DURATION AND TIME are commonly used as synonymous terms. In recent philosophy, however, great stress has been laid on the need of differentiating between them in order to avoid certain confusions. The difference has been expressed most clearly by Bergson, who, however, has only revived and elaborated the distinction drawn already by Spinoza (see Letter XIII in A Wolf, *The Correspondence of Spinoza*, p. 119). Time is commonly conceived abstractly and is thought of as composed of discrete instants or moments which follow one another in a uniform manner. For the purposes of science such an abstraction is often necessary. But real time, time as it actually passes, as it is actually experienced and lived in the world of changing events is not composed of such instants which replace one another. It is duration, that is a continuous change in which "the past gnaws into the future and swells as it advances" (H. Bergson, *Creative*

Evolution, p. 5). When time is conceived as a succession of discrete parts it is incomprehensible how any period of time, say an hour, can ever elapse, seeing that it involves the sequence of an infinity of parts. Hence Zeno's paradox of Achilles and the tortoise. But real time is only apprehended in intuition, and is continuous duration. The abstract concept of time, as commonly used in science, is the result of an attempt to assimilate it to space, or at least to measure it by means of certain correlated positions in space. Such is the view of Bergson, whose views may be summarized as follows. When science speaks of time it really refers to the motion of a body M on its trajectory. This motion is taken to represent time, and, by definition, is assumed to be uniform. Let M_1, M_2, M_3 be points which divide the path of the moving body, M, into equal parts from its starting point Mo onwards. Then it will be said that 1, 2, 3, units of time have elapsed when M is at M_1, M_2, M_3 . Hence to consider the state of the universe at a certain time, say t, is simply to consider its state when M will be at the position Mt. No attention is paid to the actual flow of time, much less to its effect, on consciousness. For only points or positions are taken into account. And all that is considered in connection with all other parts of the universe is their positions on their several paths. With each virtual position of M (M_1, M_2, M_3 , ...) there is correlated a virtual position of all other moving bodies. But these correspondences in position are *simultaneous* which take no account of the flow of time, the continuous transitions from position to position in unbroken sequence. If real time could be measured by feeling, independently of physical events, then the sequence of physical events would continue to be expressed by the same equations, however much their actual tempo might be varied as judged independently by our duration-feeling. Science, as a matter of fact, has no symbols to express real succession or duration. See H. Bergson, *Time and Free Will* (1910), see also the article SPACE-TIME. (A Wo)

DURAZZO (DYRRËS), a seaport of Albania. Pop. (1930) 8,739, of whom 70% were Mohammedans, 25% Orthodox, and 5% Roman Catholics. Most of the merchant class are of Vlach origin. Durazzo is the seat of a Roman Catholic archbishop and a Greek metropolitan. It is built on the slope of Mt. Durazzo and stretches down into a picturesque valley, but is surrounded by marshes, dotted with lakes, and the water supply, from wells, is far from satisfactory. The old crenellated walls are dilapidated, plane trees grow on the gigantic ruins of the old Byzantine citadel, and the harbour, commodious and safe when used by the Venetian galleys, is gradually becoming silted up, sandbanks rendering the approach difficult. The only features worthy of notice are the quay with its rows of cannon, and the viaduct, 750 ft. long, which crosses the marsh to the road to Tirana. The chief exports are olive oil, wheat, oats, barley, skins, tobacco, sumach and sheep. Salt is obtained by evaporation, and there are brick kilns in the district, while the making of the national costumes is an important industry.

Epidamnus, the ancient name of Durazzo, was founded by a joint colony of Corcyreans and Corinthians towards the close of the 7th century B.C., and from its admirable position and the fertility of the surrounding country, soon rose into considerable importance, and played a part in bringing about the Peloponnesian War (431-404 B.C.). In 312 B.C. the city was seized by the Illyrian king Glaucias, and shortly after it passed to the Romans, who changed its name to Dyrrachium, and it again rose to importance. It was a favourite point of debarkation for the Roman armies, the great military road known as the Via Egnatia led from Dyrrachium to Thessalonica (Salonica), and another highway passed southwards to Buthrotum and Ambracia. Broad swamps rendered the city almost impregnable, and in 48 B.C. Pompey made his last successful resistance to Caesar here. After the battle of Actium in 31 B.C. Augustus made over Dyrrachium to a colony of his veterans, it became a *civitas libera*, and reached the summit of its prosperity at the end of the 4th century when it was made the capital of Epirus Nova.

Its bishopric, created about A.D. 58, was raised to an archbishopric in 449. In 481 the city was besieged by Theodoric the

Goth, and during the 10th and 11th centuries was frequently attacked by the Bulgarians. In 1081 it was stormed by Robert Guiscard, the Norman, and in 1185 it fell into the hands of King William of Sicily, was surrendered to Venice in 1202, and in 1268 came into the possession of Charles of Anjou. In 1273 it was destroyed by an earthquake, but soon recovered from the disaster, and became an independent duchy under John of Anjou (1294-1304), and afterwards under Philip of Otranto. In 1333 it was annexed to Achaia, in 1336 to Serbia, and in 1394 to Venice. The Turks captured it in 1501, and held it till 1913. In that year Essad Pasha set up a government of his own in Durazzo, but in 1914 Prince William of Wied landed as King of Albania, and Essad fled to Italy. His partisans, however, attacked the town, and three months later Prince William abandoned the country. At Kavrya, near Durazzo, an Albanian American school of agriculture was founded in 1925 for the promotion of better methods of cultivation and cattle raising.

Durazzo was a main point of disembarkation for the Italian troops invading Albania in 1939. During the Greek-Italian war of 1940-41 it was subjected to heavy air raids by the British. British warships also shelled the port from the Adriatic, disrupting Italian supplies to its armies facing the Greeks.

D'URBAN, SIR BENJAMIN (1777-1849), British general and colonial administrator, entered the British army in 1793. In 1794 he took part in operations in Holland and Westphalia. In 1795 he served under Sir Ralph Abercromby in San Domingo. He spent the years 1800-05 at the Royal Military college, and then served in Hanover under Lord Cathcart. In Nov. 1807 he went to Dublin as assistant-quartermaster general, being transferred successively to Limerick and the Curragh. He joined the army in the Peninsula in 1808 and acted as quartermaster general to General (afterwards Viscount) Beresford in the reorganization of the Portuguese army. He served throughout the Peninsular War, being present at Busaco, Albuera, Badajoz, Salamanca, Vittoria, the Pyrenees, the Nivelle, the Nive and Toulouse. He was made a K.C.B. in 1815. He remained in Portugal until 1816. In 1819 he became major general and in 1837 lieutenant general. From 1829 he was colonel of the 51st Foot.

Sir Benjamin began his career as colonial administrator in 1820 as governor of Antigua. In 1822 he was transferred to Demerara and Essequibo, then in a disturbed condition owing to a rising among the slaves consequent on the emancipation movement in Great Britain. In 1823 he returned to the amalgamation of British Guiana, and of Dutch D'Urban was first governor. The 10 years of his governorship in Cape Colony (1834-38) were of great importance in the history of South Africa. They witnessed the abolition of slavery, the establishment of a legislative council and municipal councils in Cape Colony, the marriage of Kaffirs and the beginning of the Great Trek. The firmness and justice of his administration won the cordial support of the British and Dutch colonists. The eastern part of 1833 was occupied in dealing with an uproarious mission of the eastern borders of the colony of Xosa-Kaffirs. To protect the inhabitants of the eastern province Sir Benjamin extended the boundary of the colony to the Kei river and erected military posts in the district, allowing the Xosa to remain under British supervision. But Lord Glenelg, secretary for the colonies in the second Melbourne administration, adopted the view that the Kaffirs had been the victims of systematic murder. In a despatch dated Dec. 26, 1835, he instructed D'Urban to give up the newly annexed territories. At the same time Sir Andrew Smith, Bart. (1792-1864), was appointed lieutenant governor for the eastern provinces of the colony to carry out the policy of the home Government, in which the Kaffirs were to be treated as being on terms of full equality with Europeans. One result of the new policy was to recreate a state of anarchy, bordering on anarchy, in the eastern province, and this condition was one of the causes of the Great Trek of the Dutch farmers which began in 1836. In various despatches D'Urban justified his position, characterizing the trek as due to "insecurity of life and property occasioned by the recent measures, inadequate compensation for the loss of the slaves, and despair of obtaining recompense for the

rumorous losses by the Kaffir invasion" (See SOUTH AFRICA, UNION OF, and CAPE PROVINCE.) D'Urban was relieved of his office (May 1, 1837), but remained governor until the arrival of his successor, Sir George Napier, in Jan. 1838.

During his governorship Sir Benjamin helped the British settlers at Port Natal, who in 1835 named their town D'Urban (now written Durban) in his honour, but his suggestion that the district should be occupied as a British possession was vetoed by Lord Glenelg. D'Urban remained in South Africa until April 1846. In 1840 he was made a G.C.B., and in 1842 declined a high military appointment in India offered him by Sir Robert Peel. In Jan. 1847 he took up command of the troops in Canada, and held it at the time of his death at Montreal on May 25, 1849.

DURBAN, a seaport on the coast of Natal, Union of South Africa, situated in 29° 52' S., 31° 1' E., just south of the Umgeni river. It is 6,992 nautical miles from London by the West Coast route, and 7,785 via Suez. Owing to its low latitude and proximity to the Mozambique current, its climate is humid and sub-tropical. The mean annual temperature is about 70°, and the temperature ranges, both daily and annual, are comparatively small. The monthly means for July and January are 64.6° and 76.6°, the mean minimum for July being 52.3° and the mean maximum for January 84.5°. Rains mostly fall in the summer months, October to March inclusive, the annual rainfall is just over 40 inches. The dry season, however, is not so marked here as it is further inland, the six winter months receiving 29% of the total rainfall. The average number of rainy days is between 110 and 118. The relative humidity is high, making the climate rather enervating, a fact that is probably reflected by the large number of junksies, drawn by Zulus, which ply for hire in the streets. The health of the town is good, though malaria is liable to occur in the summer, and in 1926-27 there was a serious epidemic of dengue fever.

Durban is the largest urban centre in Natal, and is exceeded in the union only by Johannesburg and Capetown. In 1936 the population consisted of 95,033 Europeans (104,976 in 1941), 68,658 natives, 88,226 Asiatics and 7,649 "coloured" (mixed), making a total of 259,606. The town is built near the shores of what is originally a shallow lagoon, 8 sq. mi. in extent, cut off from the sea by a line of ancient partially consolidated sand dunes. The northern end of this barrier, known as the Bluff, 195 ft. high, overlooks the narrow entrance to the lagoon. On the northern side of the entrance is a low sandy spit, called the Point. The main business part of the city is laid out on a low lying sandy tract on the north and northwestern side of the bay (i.e., the lagoon). In West Africa almost all of the principal shops, the theatre, and, at the western end, a large technical college, near which is a colossal statue of the late Louis Botha in the dress of a Boer general, erected by citizens of Durban. About the middle of West street is a rectangular area occupied by gardens and a large war memorial. Along the West street side of this open space is the general post office, while on the opposite, southern side, is a hotel and an imposing block of insurance offices. The western flank is occupied by shops, and on the eastern side is a block of buildings containing the town hall, municipal offices, public library and art gallery. The town hall has an assembly room, which is capable of accommodating 3,000 people, and which is fitted with a fine organ. The art gallery has some good pictures by modern British painters. The border of the lagoon is laid out as an esplanade, and is known as the Victoria embankment. It forms a picturesque walk, lined with palms. About the middle is an equestrian statue of Dick King, commemorating his famous nine days ride to Grahamstown (600 mi.) to obtain relief when Durban was besieged by the Boers in 1842.

The Harbour—The area about the Point is occupied by harbour works, loading sheds, etc. Here also is a memorial to Vasco da Gama. Owing to the presence of sandbanks it was originally difficult for any but smaller craft to enter the lagoon. The entrance has, however, been greatly improved. A wall has been constructed from the end of the Bluff for about 2,000 ft. out to sea. Nearly parallel with this the North pier was carried out to the same distance from the Point. The narrow entrance thus formed is kept

free from sand by the tidal scour and by dredging. The depth at LOW ST is about 37 ft, and the average rise of a spring tide is 4 ft 11 inches.

Along the lagoon side of the Point are the sheds and wharves, of which there are about 3 mi. The depth alongside ranges from 23 to 34 ft. For coaling purposes electrically driven belt and bucket transporter appliances have been installed at the Bluff, capable of coaling five ships simultaneously. Oil depôts exist near by.

For repairs there is a floating dock capable of lifting 8,500 tons, and a patent slip capable of lifting craft up to 150 tons. At the southwestern end of the bay, near Congella, is a graving dock, 1,150 ft long and 110 ft broad. The depth of the entrance channel is 32 ft.

Not far away is the largest grain elevator in South Africa, with a storage capacity of 42,000 tons.

Extensive harbour developments, which expanded the capacity of the port, were completed during World War II. A large marine airport was opened in April 1940.

Homes and Recreation—Behind the business section rises a sharp ridge, the Berea, which runs in a more or less northerly direction until it meets the Umgeni river, where the Dwyka conglomerate, of which it is formed, is quarried for road metalling and harbour works. The Berea is the favourite residential quarter, and building sites are, therefore, dear. Most of the houses stand in their own grounds, surrounded by trees and shrubs, flowers and lawns. The streets are lined with the beautiful flamboyant tree, which is strictly restricted to the coastal strip of Natal. The general appearance of this quarter, and the views out to sea are very pleasing. A bridge was constructed across the mouth of the Umgeni.

On some of its other sides the town is hemmed in by a zone of Indian settlements, with squalid huts, untidy surroundings and sanitary conditions which could not be regarded as being satisfactory. On the sea front, north of the harbour, and stretching in the direction of the Umgeni, is a large esplanade, with its accompaniment of hotels, bathing conveniences, bandstands, etc. Near its northern end is a capacious concert hall, built in 1924. Between this and the river is an area of open beach and sand dunes. A part of the latter is occupied by the country club and its golf links and tennis courts. Durban is one of the most important seaside holiday resorts in South Africa. Many people from the high country inland come down during the winter for relaxation, and to escape the severe frosts. During July important race meetings are held here.

Public Services—The town is well supplied with public services. It has a good water supply, obtained from a large reservoir on the Umhlanga river, a water-borne sewage, electric light and a good tram service. The botanical gardens on the lower slopes of the Berea contain a fine collection of plants, more tropical in character than those in most other parts of South Africa. There are several other open spaces, such as Albert park, between West street and the bay, Mitchell park, Bulwer park, etc. Opportunities for sport are provided by a race course, near the centre of the town, polo and football grounds and golf links. Near the Port Natal University of Natal, Durban, is the University of Natal, Durban, which was founded in 1917.

Industry—The town is well supplied with public services. It has a good water supply, obtained from a large reservoir on the Umhlanga river, a water-borne sewage, electric light and a good tram service. The botanical gardens on the lower slopes of the Berea contain a fine collection of plants, more tropical in character than those in most other parts of South Africa. There are several other open spaces, such as Albert park, between West street and the bay, Mitchell park, Bulwer park, etc. Opportunities for sport are provided by a race course, near the centre of the town, polo and football grounds and golf links. Near the Port Natal University of Natal, Durban, is the University of Natal, Durban, which was founded in 1917.

exports are maize from the high veld, coal for bunking and export from the Natal coalfields, wattle bark from the midlands of Natal, and wool. It is also the chief focus of the sugar industry which occupies most of the coastal belt of Natal. Durban is second only to Capetown as a shipping centre in the union. In 1939, 1,699 vessels entered the harbour, with a total tonnage of 6,750,390, and in 1938-39, 6,566 passengers landed or embarked at Durban. The port played a very important part on the supply route to the middle east and India during World War II. Durban is also the centre of the whaling activities on this coast. The season lasts from May to November, and a whaling station has been established on the seaward side of the Bluff. The oil is used by local soap factories. The establishment of industries in the town is favoured by the plentiful supplies of coal, water, electricity and local labour that are available, and by the facilities for importing and exporting raw material and finished products. Land is being reclaimed at the southwestern end of the bay, and is quickly taken up for industrial development. Among the industries already established are those dealing with the production of soap, matches, jams and preserves, biscuits, furniture, etc.

See G. Russell, *History of Old Durban (to 1860)* (Durban, 1899); *Fifty Years of Municipal History*, compiled for the Corporation by the town clerk, 1904, *South Africa Year Book* (R. U. S. H. F.).

DURBAR, a term in India for a court or levee, from the Persian *darbar*. A *darbar* may be either a council for administering affairs of state, or a purely ceremonial gathering. In the former sense the native rulers of India in the past received visitors and conducted business in *darbar*. A *darbar* is the executive council of a native state. In the latter sense the word has come to be applied to great ceremonial gatherings like Lord Lytton's *darbar* for the proclamation of the queen empress in India in 1877, or the Delhi *darbar* of 1911.

DUREN, a town in Rhineland Prussia, Germany, on the right bank of the Roer, 19 mi. E. from Aix-la-Chapelle on the main line of railway to Cologne. Pop. (1939) 45,441. The Gothic St. Anna church is said to contain a portion of the head of the saint, to the shrine of which frequent pilgrimages are made. There are several high grade schools, and, in the town hall, a collection of antiquities. It is the seat of considerable manufactures, notably cloth, paper, flax spinning, carpet, artificial wool, sugar, beer and spirits, iron wares, needles, machinery, glass.

Duren derives its name from the *dura* or *duria*, assemblies held by the Carolingians in the 8th century. It received civic rights early in the 13th century. Hypothecated by the emperor Frederick II to Count William of Julich, it became incorporated with the duchy of that name, and with it passed to Prussia in 1816.

DURENE (1,2,4,5-tetramethylbenzene) $C_6H_2(CH_3)_4$, a hydrocarbon occurring in the light oils of coal tar and prepared by the action of methyl iodide on bromopropene or 4,6-dibromonitrobenzene, in presence of sodium, or by the action of methyl chloride on toluene, in presence of anhydrous aluminum chloride. It crystallizes in plates, having a camphorlike smell, melting at 79-80°C and it boils at 189-191°C.

DURER, ALBRECHT (1471-1528), German painter, engraver, and architect, was born at Nuremberg on May 21, 1471. His father, Albrecht Durer the elder, born at Gyula, Hungary, in 1427, was a goldsmith by trade, and settled soon after the middle of the 15th century in Nuremberg. He served as assistant under a goldsmith of the city, Hieronymus Holper, and in 1468 he had his master's daughter Barbara, the bridegroom being 40 years of age. He had 18 children, of whom Albrecht was the second. Durer painted the portrait of his father (who died in 1502) twice, in 1490 and again in 1497. The portrait of these is in the Uffizi at Florence, of the latter, four in the National Gallery, London (formerly in the Ashburton Northampton collection) having the best claim to authenticity.

The young Albrecht was his father's favourite son, and was apprenticed at the age of fifteen and a half to the principal painter of the town, Michael Wolgemut. Wolgemut furnishes a complete type of the German painter of that age. There were

produced in the workshop of Wolgemut a great number of woodcuts for book illustration. We cannot with certainty identify any of these as being by the prentice hand of the young Dürer. Authentic drawings done by him in boyhood, however, exist, including one in silver point of his own likeness at the age of 13 in the Albertina at Vienna, and others of two or three years later in the print room at Berlin, at the British Museum and at Bremen.

At the end of his apprenticeship in 1490 he entered upon the usual course of travels—the *II. oder Jahr*—of a German youth. It had at one time been his father's intention to apprentice him to Martin Schongauer of Colmar. But after travelling two years in various parts of Germany, the young Dürer arrived at Colmar in 1492, only to find that Schongauer had died the previous year. He was received kindly by three brothers of the deceased master established there, and afterwards, still in 1492, by a fourth brother at Basle. Under them he evidently had some practice both in metal engraving and in furnishing designs for the woodcutter. There is in the museum at Basle a wood block of St. Jerome executed by him and elaborately signed on the back with his name. This was used in an edition of Jerome's letters printed in the same city in 1492. In the early part of 1494 he was working at Strasbourg, and returned to his home at Nuremberg immediately after Whitsuntide in that year. Of works certainly executed by him during his years of travel there are extant, besides the Basle wood-block, only a much injured portrait of himself, dated 1493 and originally painted on vellum but since transferred to canvas (this is the portrait of the Felix Goldschmidt collection), a miniature painting on vellum at Vienna (a small figure of the Child Christ), and some half a dozen drawings, of which the most important are the characteristic pen portrait of himself at Erlangen, with a Holy Family on the reverse, much in the manner of Schongauer, another Holy Family in nearly the same style at Berlin, a study from the female nude in the Bonnat collection, a man and woman on horseback in Berlin, a man on horseback, and an executioner about to behead a young man, at the British Museum, etc. These drawings all show Dürer intent above all things on the sternly accurate delineation of ungeneralized individual forms by means of strongly accented outline and shadings curved, somewhat like the shadings of Martin Schongauer's engravings, so as to follow their modellings and roundness.

Within a few weeks of his return (July 7, 1494) Dürer was married, according to an arrangement apparently made between the parents during his absence, to Agnes Frey, the daughter of a well-to-do merchant of the city. By the autumn of the same year he must have made an excursion of some months to Italy. The evidences of this travel consist of (1) some fine drawings, three of them dated 1494 and others undated, but plainly of the same time, in which Dürer has copied, or rather boldly translated into his own Gothic and German style, two famous engravings by Mantegna, a number of the "Tarocchi" prints of single figures which pass erroneously under that master's name, and one by yet another minor master of the North-Italian school, with another drawing dated 1495 and plainly copied from a lost original by Antonio Pollaiuolo, and yet another of an infant Christ copied in 1495 from Lorenzo di Credi, (2) several landscape drawings done in the passes of Tirol and the Trentino, (3) two or three drawings of the costumes of Venetian courtesans, one of which is used in his great woodcut Apocalypse series of 1498, (4) a general preoccupation from this date with the problems of the female nude, treated in a manner for which Italy only could have set him the example, and (5) the clear implication contained in a letter written from Venice in 1506 that he had been there already 11 years before. Some time in 1495 Dürer must have returned from this first Italian journey to his home in Nuremberg, where he seems to have lived for the next ten years.

The hour when Dürer, the typical artist of the German nation, attained maturity was one of the most pregnant in the history of his race. It was the crisis, in northern Europe, of the transition between the middle ages and our own. The art of printing had been invented in good time to help and hasten the new movement of men's minds. Nor was it by the diffusion of written ideas only

that the new art supplied the means of popular enlightenment. Along with word printing, or indeed in advance of it, there had sprung into use another kind of printing, picture printing, or what is commonly called engraving. Just as books were the means of multiplying, cheapening and disseminating ideas, so engravings on copper or wood were the means of multiplying, cheapening and disseminating images which gave vividness to the ideas, or served, for those ignorant of letters, in their stead. The genius of Albrecht Dürer cannot be rightly estimated without taking into account the position which the arts of engraving on metal and on wood thus held in the culture of this time. He was indeed professionally and in the first place a painter, but throughout his career a great, and on the whole the most successful, part of his industry was devoted to drawing on the block for the woodcutter or engraving with his own hand on copper. Nuremberg was a favourable home for the growth and exercise of his powers. Of the free imperial cities of central Germany, none had a greater historic fame or a more settled and patriotic government. Nuremberg had imported before the close of the 15th century a fair share of the new learning of Italy, and numbered among her citizens distinguished humanists like Hartmann Schedel, Sebald Schreyer, Willibald Pirckheimer and Conrad Celtes. From associates like these Dürer could imbibe the spirit of Renaissance culture and research, but the external aspects and artistic traditions which surrounded him were purely Gothic, and he had to work out for himself the style and form language fit to express what was in him. During the first seven or eight years of his settled life in his native city from 1495, he betrays a conflict of artistic tendencies as well as no small sense of spiritual strain and strife. His finest work in this period was that which he provided for the woodcutter. After some half dozen miscellaneous single prints—"Samson and the Lion," the "Annunciation," the "Ten Thousand Martyrs," the "Knight and Men-at-arms," the "Men's Bath," etc.—he undertook, and by 1498 completed, his famous series of 15 great designs for the Apocalypse. Founding himself to some extent on traditional motives, Dürer conceived and carried out a set of designs in which the qualities of the German late Gothic style, its rugged strength and restless vehemence, its love of gnarled forms, writhing actions and agitated lines, are fused by the fire of the young master's spirit into vital combination with something of the majestic power and classic severity which he had seen and admired in the works of Mantegna. Of a little later date, and of almost as fine a quality, were the first seven of a large series of woodcuts known as the "Great Passion", and a little later again (probably after 1500), a series of 11 subjects of the Holy Family and of saints singly or in groups then, towards 1504-05, came the first 17 of a set illustrating the life of the Virgin, neither these nor the "Great Passion" were published till several years later.

In copper engraving Dürer was at the same time diligently training himself to develop the methods practised by Martin Schongauer and earlier masters into one suitable for his own self-expression. He contented himself for the most part with Madonnas, single figures of scripture or of the saints, some nude mythologies founded upon the impressions received in Italy, and groups, sometimes bordering on the satirical, of humble folk and peasants. In the earliest of the Madonnas, the "Virgin with the Dragon fly" (1495-96), Dürer has thrown something of his own rugged energy into a design of the traditional Schongauer type. In examples of a few years later, like the "Virgin with the Monkey," the design of Mother and Child clearly betrays the influence of Italy and specifically of Lorenzo di Credi. On the other hand, he treats the subjects of the "Prodigal Son" and "St. Jerome in the Wilderness" in an almost purely northern spirit. In the nudes of the next four or five years, which included a "St. Sebastian," the so-called "Four Witches" (1497), the "Dream" or "Temptation," the "Rape of Anyonore," and the "Jealousy" or "Great Hercules," Venetian, Paduan and Florentine memories are found, in the treatment of the human form. In these early engravings the highly wrought landscape backgrounds, whenever they occur, are generally the most satisfying feature. This feature reaches a climax of beauty and

elaboration in the large print of "St. Eustace and the Stag," while the figures and animals remain still somewhat cramped and immature. In the first three or four years of the 16th century we find Dürer in his graver work still contending with the problems of the nude, but now with added power, though by varying methods. The "Nemess," belonging probably to 1503, is a marvelously wrought piece of quite unflinching realism in the rendering of a common type of mate, muscular, unshapely German womanhood. The conception and attributes of the figure are taken, as has lately been recognized, from a description in the "Manto" of Poltium, the goddess, to whose shoulders are appended a pair of huge wings, stands like Fortune on a revolving ball, holding the emblems of the cup and bundle, and below her feet is spread a rich landscape of hill and valley. In the "Adam and Eve" of 1504 we find Dürer treating the human form in an entirely opposite manner, constructing it, that is, on principles of abstract geometrical proportion. The Venetian painter etcher, Jacopo de' Barbari, whom Dürer had already, it would seem, met in Venice in 1494-95, and by the example of whose engravings he had already been much influenced, came to settle for a while in Nuremberg in 1500. He was conversant to some extent with the new sciences of perspective, anatomy and proportion, which had been making their way for years past in Italy, and from him it is likely that Dürer received the impulse to similar studies and speculations. At any rate a whole series of extant drawings enables us to trace the German gradually working out his own ideas of a canon of human proportion in the composition of his famous engraving of "Adam and Eve" (1504), which at first, as a drawing in the British Museum proves, had been intended to be an Apollo and Diana conceived on lines somewhat similar to one of Barbari's. Two or three other technical masterpieces of the engraver's art, the "Coat-of-Arms with the Skull," the "Nativity," with its exquisite background of ruined buildings, the "Little Horse" and the "Great Horse," belong to 1505.

The pictures of this earlier Nuremberg period are not many in number and not very admirable. Among the earliest seem to be two examples of a method practised in Italy especially by the school of Mantegna, but almost without precedent in Germany, that of tempera painting on linen. One of these is the portrait of Frederick the Wise of Saxony, formerly in the Hamilton collection and now at Berlin, the second, much disfigured by restoration, is the Dresden altar piece with a Madonna and Child in the middle and St. Anthony and St. Sebastian in the wings. A mythology reminiscent of Italy is the "Hercules and the Stymphalian Birds" in the Germanic museum at Nuremberg, founded directly upon the "Hercules and Centaur Nessus" of Pollaiuolo, now at New Haven, Conn., U.S.A. Of portraits, besides that of his father already mentioned as done in 1497, there is his own of 1498 at Madrid. Two totally dissimilar portraits of young women, both existing in duplicate examples, for each of which has been claimed the name Furlbergin, that is, a member of the Furlerger family at Nuremberg, belong to nearly the same time. Other panel portraits of the period are three small ones of members of the Tucher family at Wemmar and Cassel, and the striking, restlessly elaborated half-length of Oswald Krel at Munich. In some devotional pictures of the time Dürer seems to have been much helped by pupils, as in the two different compositions of the Maries weeping over the body of Christ preserved respectively at Munich and Nuremberg. Two examples of high value are the Paumgartner altar piece at Munich, with its romantically attractive composition of the Nativity with angels and donors in the central panel and the fine armed figures of St. George and St. Eustace on the wings, and the "Adoration of the Magi" in the Uffizi at Florence.

In the autumn of 1505 Dürer journeyed for a second time to Venice, and stayed there until the spring of 1507. One of the motives for this journey was the prospect of a commission for an important picture from the German community settled at Venice, who had caused an exchange and warehouse—the *Fondaco de' Tedeschi*—to be built on the Grand canal, and who were then desirous of dedicating a picture in the church of St. Bartholomew. The picture painted by Dürer on this commission

was the "Adoration of the Virgin," better known as the "Teast of Rose Garlands"; it was subsequently acquired by the emperor Rudolf II., and carried as a thing beyond price upon men's shoulders to Vienna, it now exists in a greatly injured state in the State museum in Prague. Of all Dürer's works, it is the one in which he most deliberately rivaled the combined splendour and playfulness of certain phases of Italian art. A similar festal intention in design and colouring, with similar mastery in passages and even less sense of harmonious relations in the whole, is apparent in a second important picture painted by Dürer at Venice, "The Virgin and Child with the Goldfinch," formerly in the collection of Lord Lothian and now at Berlin. A "Christ disputing with the Doctors" of the same period, in the Barberini gallery at Rome, is recorded to have cost the painter only five days' labour. The most satisfying of Dürer's paintings done in Venice are the admirable portrait of a young man at Hampton Court (the same sitter reappears in the "Teast of Rose Garlands"), and two small pieces, one the head of a brown Italian girl modelled and painted with real beauty and simplicity formerly in the collection of Mr. Reginald Cholmondeley and now at Berlin, and the small and very striking little "Christ Crucified" with the figure relieved against the night sky, which is preserved in the Dresden gallery and has served as model and inspiration to numberless later treatments of the theme. An interesting, rather fantastic, portrait of a blonde girl wearing a wide cap, now in the Berlin museum, is dated 1507 and may have been done in the early months of that year at Venice. A portrait of a Venetian woman, discovered in 1914 at Vienna, belongs to this period, and possibly also the famous portrait of himself at Munich bearing a false signature and date, 1500. In the latter the artist modified his own lineaments according to a preconceived scheme of facial proportion, so that it must be taken as an ideal rather than a literal presentation of him.

From the spring of 1507 until the summer of 1520, Dürer was again a settled resident in his native town. Except the brilliant existences of Raphael at Rome and of Rubens at Antwerp and Madrid, the annals of art present the spectacle of few more honoured or more fortunate careers. His reputation had spread all over Europe. He was on terms of friendship or friendly communication with all the first masters of the age, and Raphael held himself honoured in exchanging drawings with Dürer. In his own country, all orders of men, from the emperor Maximilian down, delighted to honour him, and he was the familiar companion of chosen spirits among the statesmen, humanists and reformers of the new age. His temper and life seem to have been remarkably free from all that was jarring, jealous and fretful, unless, indeed, we are to accept as true the account of his wife's character which represents her as an incorrigible shrew and skinflint. The name of Agnes Dürer was for centuries used to point a moral, and among the unworthy wives of great men the wife of Dürer became almost as notorious as the wife of Socrates. It is to be noted that neither in Dürer's early correspondence with his intimate friend, Willibald Pirckheimer, nor anywhere in his journals, does he use any expression of tenderness or affection for his wife, only speaking of her as his house-mate and of her help in the sale of his prints, etc. But it is far to remember in her defence that Pirckheimer, when he denounced her in the letter which forms the basis of these imputations, was old, gouty and peevish, and that the immediate occasion of his outbreak against his friend's widow was a fit of anger because she had not let him have a pair of antlers out of the property left by Dürer. After her husband's death Agnes Dürer behaved with generosity to his brothers.

The 13 or 14 years of Dürer's life between his return from Venice and his journey to the Netherlands (spring 1507–mid-summer 1520) may be divided according to the classes of work with which he was principally occupied. The first five years, 1507–11, are pre-eminently the painting years of his life. In them he produced what have been accounted his four capital works in painting, besides several others of minor importance. The first is the "Adam and Eve" dated 1507, two versions of

which exist: one in Florence at the Pitti palace, the other, which is generally allowed to be the original, at Madrid. To 1508 belongs the life-sized "Virgin with the Ius," a piece remarkable for the fine romantic invention of its background, but plainly showing the hand of an assistant perhaps Hans Baldung, in its execution the best version in the National gallery, at London, an inferior one in the Rudolphinum at Prague. In 1508 Durer returned to a subject which he had already treated in an early woodcut, the "Massacre of the Ten Thousand Martyrs of Nicomedia." The picture, painted for the elector Frederick of Saxony, is now in the Imperial gallery at Vienna. In 1509 followed the "Assumption of the Virgin" with the Apostles gathered about her tomb, a rich altar-piece with figures of saints and portraits of the donor and his wife in the folding wings, executed by Jacob Heller, a merchant of Frankfurt, in 1509. This altar-piece was afterwards replaced at Frankfurt (all except the portraits of the donors, which remained behind) by a copy, while the original was transported to Munich, where it perished by fire in 1674. In 1511 was completed another famous painting, multitudinous in the number of its figures though of very moderate dimensions, the "Adoration of the Trinity by all the Saints" now at Vienna.

In the meantime Durer had added a few to the number of his line engravings and had completed the two woodcut series of the "Great Passion," begun about 1498-99, and the "Life of the Virgin." In 1511 these two works were brought out for the first time, and the Apocalypse series in a second edition, and for the next three years, 1511-14, engraving both on wood and copper, but especially the latter, took the first place among Durer's activities. Besides such fine single woodcuts as the "Mass of St. Gregory," the "St. Christopher," the "St. Jerome," and two Holy Families of 1511, Durer published in the same year the most numerous and popularly conceived of all his woodcut series, that known from the dimensions of its 37 subjects as the "Little Passion" on wood, and in the next year, 1512, a set of 15 small copper-engravings on the same theme, the "Little Passion" on copper. Both of these must represent the labour of several preceding years: one or two of the "Little Passion" plates, dating back as far as 1507, prove that this series at least had been as long as five years in his mind. In thus repeating over and over on wood and copper nearly the same incidents of the Passion, or again in rehandling them in yet another medium, as in the highly finished series of drawings known as the "Green Passion" in the Albertina at Vienna, Durer shows an inexhaustible variety of dramatic and graphic invention, and is never betrayed into repeating an identical action or motive.

In 1513 and 1514 appeared the three most famous of Durer's works in copper-engraving, "The Knight and Death" (or simply "The Knight," as he himself calls it, 1513), the "Melancholia" and the "St. Jerome in his Study" (both 1514). These are the masterpieces of the greatest mind which ever expressed itself in this form of art. The idea at the bottom of the "Knight and Death" seems to be a combination of the Christian knight of Erasmus's *Enchiridion militis Christiani* with the type, traditional in mediaeval imagery, of the pilgrim on his way through the world. The "Melancholia," numbered "1," as though intended to be the first of a series, with its brooding winged genius sitting dejectedly amidst a litter of scientific instruments and symbols, is hard to interpret in detail, but impossible not to recognize in general terms as an embodiment of the spirit of intellectual research (the student's "temperament" was supposed to be one with the melancholic), resting sadly from its labours in a mood of lassitude and defeat. Comparatively cheerful beside these two is the remaining subject of the student saint reading in his chamber, with his dog and domestic hen resting near him, and a marvellous play of varied surface and chequered light on the floor and ceiling of his apartment and on all the objects which it contains. Besides these three masterpieces of line-engraving, the same years, 1512-15, found Durer occupied with his most important experiments in etching, both in dry-point ("The Holy Family and Saints" and the "St. Jerome in the Wilderness") and with the acid bath. At the same time he was

more taken up than ever, as is proved by the contents of a sketchbook at Dresden, with mathematical and anatomical studies on the proportions and structure of the human frame. A quite different kind of study, that of the postures of wrestlers in action, is illustrated by a little-known series of drawings, still of the same period, at Vienna. Almost the only well authenticated painting of the time is a "Virgin and Child" in the Imperial museum at Vienna. The portraits of the emperors Charles the Great and Sigismund (1512), in their present state at any rate, can hardly be recognized as being by the master's hand. An interval of five years separates the Vienna "Madonna" from the two fine heads of the apostles Philip and James in the Uffizi at Florence, the pair of boys' heads printed in tempera on linen in the Bibliothèque Nationale at Paris, the "Madonna with the Pink" at Augsburg, and the portrait of Wolgemut at Munich all of 1516. Among engravings of the same time are three Madonnas, the apostles Thomas and Paul, a bagpiper and two peasants dancing, and three or four experiments in etching on plates of iron and zinc. In wood engraving his energies were almost entirely given to his share in the great decorative schemes commanded by the emperor Maximilian in his own honour, namely, the Triumphal Gate and the Triumphal March or Procession. A third and smaller commemorative design, the Triumphal Car, originally designed to form part of the second but in the end issued separately, was entirely Durer's own work. A far more successful effort of his genius is to be found in the marginal decorations done by him in pen for the emperor's prayer-book. This unequalled treasure of German art and invention has been broken up, the part executed by Durer being preserved at Munich, the later sheets, which were decorated by other hands, having been transported to Besançon. Durer's designs, drawn with the pen in pale lilac, pink and green, show an inexhaustible richness of invention and an easy freedom and playfulness of hand beyond what could be surmised from the sternness of those studies which he made direct from life and nature.

All these undertakings for his imperial friend and patron ceased with the emperor's death in 1519. A portrait drawing by the master done at Augsburg a few months previously, one of his finest works, served him as the basis both of a commemorative picture and a woodcut. In line engravings we have four more Madonnas, two St. Christophers, one or two more peasant subjects, the well known St. Anthony with the view of Nuremberg in the background, and the smaller of the two portraits of the cardinal elector of Mainz, and in wood-engraving several fine heraldic pieces, including the arms of Nuremberg.

In the summer of 1520 he set out for the Netherlands, together with his wife and her maid, in order to be present at the coronation of the young emperor Charles V, and if possible to conciliate the good graces of the all-powerful regent, Margaret. He journeyed by the Rhine, Cologne, and thence by road to Antwerp, where he was handsomely received, and lived in whatever society was most distinguished, including that of Erasmus of Rotterdam. Besides his written notes, interesting traces of his travels exist in the shape of the scattered leaves of a sketchbook filled with delicate drawings in silver point, chiefly views of places and studies of portrait and costume. Several of his finest portrait-drawings in chalk or charcoal, including those of his brother artists Lucas Van Leyden and Bernard Van Orley, as well as one of two fine portrait paintings of men belong to the period of this journey. So does a magnificent drawing of a head of a nonagenarian with a flowing beard who sat to him at Antwerp, together with a picture from the same head in the character of St. Jerome, the drawing is now at Vienna, the picture at Lisbon. Besides going to Aachen for the coronation, he made excursions down the Rhine from Cologne to Nimwegen, and back overland by Hertogenbosch, to Brussels, to Bruges and Ghent, and to Zealand with the object of seeing a natural curiosity, a whale reported ashore. The diary contains a passionate outburst of sympathetic indignation at the supposed kidnapping of Luther by foul play on his return from the diet of Worms. Without being, properly speaking, a reformer, Durer in his art and his thoughts was the incarnation of those qualities

of the German character and conscience which resulted in the Reformation, and personally, with the fathers of the Reformation he lived in the warmest sympathy.

On July 12, 1527, Dürer reached home again. Drawings of this and the immediately following years prove that on his return his mind was full of schemes for religious pictures. There exist fine drawings for a "Lamentation over the body of Christ," an "Adoration of the Kings," and a "March to Calvary," of the last named composition, besides the beautiful and elaborate pen and ink drawing at Florence, three still more highly wrought versions in green monochrome exist, whether any of them are certainly by the artist's own hand is matter of debate. But no religious paintings on the grand scale, corresponding to these drawings of 1521-24, were ever carried out. The artist allowed much of his time and thoughts to be absorbed in the preparation of his theoretical works on geometry and perspective, proportion and fortification. Like Leonardo, but with much less than Leonardo's genius for scientific speculation and divination, Dürer was a confirmed reasoner and theorist on the laws of nature and natural appearances. The consequence was that in the last and ripest years of his life he produced as an artist comparatively little. In painting there is the famous portrait of Hieronymus Holzschuber at Berlin. This and the Antwerp head of Jerome are perhaps the most striking examples of Dürer's power of forcing into subordination to a general impression such a multiplicity of insistent detail as would have smothered any weaker conception than his. To the same period belong a "Madonna and Child" at Florence, and finally, still in the year 1526, the two famous panels at Munich embodying the only one of the great religious conceptions of the master's later years which he lived to finish. These are the two pairs of saints, St. John with St. Peter in front and St. Paul with St. Mark in the background. The John and Paul are conceived and executed really in the great style, with a commanding nobility and force alike in the character of the heads, the attitudes, and the sweep of draperies, they represent the highest achievement of early German art in painting. In copper engraving Dürer's work during the same years was confined entirely to portraits, those of the cardinal elector of Mainz ("The Great Cardinal"), Frederick the Wise, elector of Saxony, Willibald Pirckheimer, Melanchthon and Erasmus. To the tale of his woodcuts, besides a few illustrations to his book on measurements (that is, geometry and perspective), and on fortification, he added only one Holy Family and one portrait, that of his friend Eoban Hesse. Of his theoretical books he succeeded in getting only two finished and produced during his lifetime, that on geometry and perspective or measurements—to use his own title—which was published at Nuremberg in 1525, and that on fortification, published in 1527, the work on human proportions was brought out shortly after his death in 1528. His labours, whether artistic or theoretic, had for some time been carried on in the face of failing health. In the canals of the Low Countries he had caught a fever, of which he never shook off the effects. We have the evidence of this in his own written words, as well as in a sketch which he drew in his own hand, the seat of his suffering to some physician, and again in a portrait engraved on wood just after his death, from a drawing made no doubt not long before in this portrait we see his shoulders already bent, the features somewhat gaunt, the old pride of the abundant locks shown away. The end came suddenly on the night of April 6, 1528. An appropriate *Requiescat* is contained in the words of Luther, in a letter written to their common friend Eoban Hesse—"As for Dürer, assuredly affection bids us mourn for one who was the best of men, yet you may well hold him happy that he has made so good an end, and that Christ has taken him from the midst of this time of trouble and from greater troubles in store, lest he, that deserved to behold nothing but the best, should be compelled to behold the worst. Therefore may he rest in peace with his fathers. Amen."

The principal exact paintings of Dürer, with the places where they are to be found, have been mentioned above. Of his drawings, which for students are the most vitally interesting part of his works, the richest collections are in the Albertina at

Vienna, the Berlin museum and the British Museum. The Louvre also possesses some good examples, and many others are dispersed in various public collections, as in the Musée Bonnat at Bayonne, at Munich, Hamburg, Bremen, Frankfurt, Dresden, Basle, Milan, Florence and Oxford, as well as in private hands.

The principal editions of Dürer's theoretical writings are: *Geometry and Perspective—Underweisung der Messung mit dem Zirckel und Richtschyl, in Linien, Ebenen und ganzen Corporen* (Nuremberg, 1525, 1533, 1538). A Latin translation of the same, with a long title (Paris, Wechel, 1532) and another ed. in 1535. Again in Latin, with the title *Institutionum geometricarum libri quatuor* (Arnhem, 1605).

Fortification—Eltche Underricht zu Befestigung der Stett, Schloss und Flecken (Nuremberg, 1527), and other editions in 1530, 1538 and 1603 (Arnhem). A Latin translation with the title *De urbis arce, castelle, munitis et condendis* (Paris, Wechel, 1537).

Human Proportion—Hermenen und begriffen vuer Bucher vuer menschlicher Proportion (Nuremberg, 1528, and Arnhem, 1603). Latin translation *De symetra partium in rectis formis humanorum corporum libri in latinum conuersi, de varietate figurarum, etc.* (Arnhem, 1528, 1532 and 1534), (Paris, 1535, 1537, 1557). French translation (Paris, 1557, Arnhem, 1613, 1614). Italian translation (Venice, 1501, 1594), Portuguese translation (Lisbon, 1590), Dutch translation (Arnhem, 1622, 1662).

The private literary remains of Dürer, his diary, letters, etc., were published most completely in Lange and Fubus's *Dürers schriftlicher Nachlass* (Halle, 1902), W. M. Conway's *Literary Remains of A. Dürer* (London, 1889) contains extensive transcripts from the MSS in the British Museum.

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See also the *Verbrücker der Berlin und Vienna museums, Repertorium für Kunstwissenschaft, Zeitschrift für bildende Kunst*, etc., Prof. H. W. Singer's *Versuch einer Dürer-Bibliographie* (Strasbourg, 1903), A. Jellinek's *Internationale Bibliographie der Kunstwissenschaft* (Berlin), an edition de luxe of Dr. Willm. Kurtz's *Complete Woodcuts of Albrecht Dürer* (Intro by Campbell Dodgson) was published in 1927. (S C X)

DURESS, in law, constraint or compulsion. Duress may be of two kinds. It may consist of personal restraint or actual violence or imprisonment, or it may be by threats (*per minas*), as where a person is compelled to act by acts of threats of immediate death or grievous bodily harm (See **COERCION, CONTRACT**).

D'URFEY, THOMAS (1653-1723), better known as Tom D'Urfey, English song writer and dramatist, belonged to a Huguenot family settled at Esher. Honoré d'Urfé, the author of *Astrée*, was his uncle. His first play, *The Siege of Memphis*, or *the Ambitious Queen*, a bombastic rhymed tragedy, was produced at the Theatre Royal in 1676. He was much more successful with his comedies, which had brisk, complicated plots carried out in lively dialogue. He had a light touch for fitting words on current topics to popular airs, moreover, many of his songs were set to music by his friends Dr. John Blow, Henry Purcell and Thomas Farmer. Many of these songs were introduced into his plays. Addison in the *Guardian* (No. 67) relates that he remembered to have seen Charles II. leaning on Tom D'Urfey's shoulder and humming a song with him. Even William III. liked to hear him sing his songs, and as a strong Tory he was sure of the favour of Princess Anne, who is said to have given Tom fifty guineas for a song on the Electress Sophia, the next heir in succession to the crown. "The crown's far too weighty, for shoulders of eighty," said D'Urfey, with an indirect compliment to the princess, "So Providence kept her away,—poor old Dowager Sophy." He was poor in his old age, but his gaiety and invincible good humour had made him friends in the craft, and by the influence of Addison his *Fond Husband*, or *The Plotting Sisters* was revived for D'Urfey's benefit at Drury Lane on June 15, 1713. He died on Feb. 26, 1723.

Collections of his songs with the music appeared during his lifetime, the most complete being the 1719-20 edition (4 vols.) of *Wit and Mirth*, or *Falls to Purge Melancholly*. The best known of the twenty-two volumes of his which were really found their way to the stage were *Love for Money*, *The Boarding School* (Theatre Royal, 1691), *The Marriage Hatred* (1692), and *The Comical History of Don Quixote*, in three parts (1694, 1694 and 1696), which earned the especial censure of Jeremy Collier. In his burlesque opera, *Wonders in the Sun or the Kingdom of the Birds* (1706, music by G. B. Draghi), the actors were dressed as parrots, crows, etc.

DURFORT, a family distinguished in French and English history and taking its name from a feudal lordship situated at the village of Durfort, in south western France, formerly in the province of Guenne, now in the department of Tain et Garonne, 18 m north west of Montauban. The pedigree of the family is only clearly traceable to Arnuld de Durfort (fl. 1305), who acquired the fief of Duras by his marriage with a niece of Pope Clement V. His descendant Gaillard de Durfort, having embraced the side of the king of England, went to London in 1455, and was made governor of Calais and a knight of the Garter.

The greatness of the family dates from the 17th century. Guy Aldonce (1605-65), marquis de Duras and comte de Rozan, had, by his wife Elizabeth de la Tour d'Auvergne, sister of Marshal Turenne, six sons, three of whom played a distinguished part. The eldest, Jacques Henri (1651-1704) was governor of Franche Comte in 1694 and a marshal of France. The second, Guy Aldonce (1650-1707), comte de Lorges and duc de Quinault (known as the duc de Lorges), became a marshal of France in 1676, commanded the army in Germany from 1690 to 1695, and captured Heidelberg in 1693. The sixth son, Louis (1640?-1709), marquis de Blanqufort, came to England in the suite of James, duke of York, in 1663, and was naturalized in the same year. On Jan. 19, 1677-78, he was raised to the English peerage as Baron Duras of Holdenby, his title being derived from an estate in Northamptonshire bought from the duke of York. In 1676 he married Mary, daughter and elder co-heiress of Sir George Sondes, created in that year Baron Throwley, Viscount Sondes and earl of Eversham. On the death of his father-in-law (April 16, 1677), Duras succeeded by his titles under a special remainder. He was appointed by Charles II successively to the command of the third and second troops of Horse Guards, was sent abroad on several important diplomatic missions, and became master of the horse (1679) and lord chamberlain to the queen (1680). In 1684 he was appointed a lord of the bed-chamber, and was present at the king's deathbed reconciliation with the Roman Church. Under James II Eversham became a member of the privy council, and in 1685 was given the chief command against the rebels under Monmouth, in which he mainly distinguished himself by his civility to the vanquished. He was rewarded with a baronetcy of the Garter and the colonelcy of the first troop of Life Guards. In 1686 he was appointed to the command of the first regiment of the King's Life Guards on Blackheath to contain the people. On James II's flight he succeeded in making his peace with William on the condition of the duke's doctor, to which he was then received the membership of the Royal Hospital of St. Catherine near the Isle of Wight (1698). He died without issue on April 8, 1709. (See G. E. C. [Johns], *Cont. Hist. Peerage*, and *Brit. Biog. Dict.*)

Jean Durand (1688-1770), duc de Duras, son of Jacques
 Jean, who was married to France the son of Louis XIV (1715-1793), duc de Duras took part in all the wars of Louis XV
 and was made a marshal of France in 1775. His grandfather Armand
 de Bretagne Malo (1717-1838), duc de Duras, is mainly known as
 the husband of Claire Louise Rose Bonne de Coetempren de
 Kersaint (1778-1838), daughter of Armand Guy Simon de
 Coetempren Kersaint (qv), who, as duchesse de Duras, pre-
 sided over a celebrated salon and wrote several novels once widely
 read.

The family of Durfort is represented in France now by the branch of Durfort Civrac, dating from the 16th century

DURGA, one of the many cult-titles of Devi "the Goddess," in Hindu mythology. Durga first appears in the Epics, as a name of Umā, wife of Śiva (*q.v.*), and she may have been originally worshipped by savage aborigines. She is also a manifestation of

Kālī (*qv*), and the hook swinging rite of self devotion is done in her honour. One of her principal festivals, as a war goddess, is the Durga puja (see DASHRA). Durga is pictured, in spite of her fierce nature, with a gentle face.

DURHAM, OHN GEORGE LAMBTON, 1ST EARL OF (1792-1840), English statesman, son of William Henry Lambton of Lambton Castle, Durham, was born in London on April 12, 1792. His mother was Anne Barbara Vilhers, daughter of the 4th earl of Jersey. Lambton succeeded to large estates when he was five years old. In 1805 he went to Eton, and in 1809 obtained a commission in the 10th Hussars. In 1812, while still a minor, he made a run away match with Henrietta, natural daughter of Lord Cholmondeley, whom he married at Gretna Green, she died in 1815. In 1813 he was elected to the House of Commons as member for the county of Durham in the Whig interests.

In 1816 he married Louisa Elizabeth, eldest daughter of Lord Grey, and as early as 1818 he was taken into the political confidence of his father-in-law and other Whig leaders. But Lambton belonged to the avowedly Radical wing of the party, with whose aims Grey had little sympathy, and when he gave notice of resolution in 1819 in favour of shortening the duration of parliaments, and of a wide extension of the franchise, he found himself discountenanced. He warmly espoused the cause of Queen Caroline. In April he made his first great speech in the House of Commons on parliamentary reform, when he proposed a scheme for the extension of the suffrage to all holders of property, the division of the country into electoral districts and the disfranchisement of 1000 boroughs. He was now one of the recognized leaders of the advanced Liberals, forming a connecting link between the aristocratic Whig leaders and the Liberals of the great towns. His opposition to any compromise on the question of Catholic emancipation led (1825) to his first conflict with Brougham, with whom he had been on terms of close friendship. While supporting the candidature of his brother in law, Lord Howick, for Northumberland in the elections of 1826, Lambton fought a duel with T. W. Beaumont, the Tory candidate, but without bloodshed on either side. Lambton supported the ministry of Canning, and after Canning's death that of Lord Goderich, on whose advice he was raised to the peerage in 1828 with the title of Baron Durham. Lord Durham was on terms of friendship with Prince Leopold of Saxe-Coburg, who, after he became king of the Belgians as Leopold I., continued to correspond with Durham as a trusted confidant, the same confidential relations also existed between Durham and Leopold's sister, the duchess of Kent, and her daughter, afterwards Queen Victoria.

On 12 November 1830 Durham entered the Grey cabinet as lord privy seal. To ardent reformers in the country the presence in the cabinet of "Radical Jack" was a pledge that thoroughgoing reform would not be shirked by the Whigs, now in office for the first time for 20 years. Lord Grey gave him the task of preparing a scheme to serve as the basis of the proposed legislation. He was chairman of the famous committee of four, which met at his house in Cleveland Row and drew up the scheme submitted by the government to parliament. It was Durham who selected Lord John Russell, not then in the cabinet, to introduce the bill in the House of Commons. When the deadlock between the two Houses occurred over the second Reform Bill (1832), he pressed on the prime minister the necessity for a creation of peers to overcome the resistance of the House of Lords.

After the passing of the Reform Act, Durham was sent on a difficult diplomatic mission to Russia. On his return he resigned office in March 1833, ostensibly for reasons of health, but in reality owing to his disagreement with the government's Irish policy as conducted by Lord Stanley, in the same month he was created Earl of Durham and Viscount Lambton. His advanced opinions gradually alienated the more moderate of his late colleagues, such as Melbourne and Palmerston, and even Lord Grey often found his son in law intractable and self-assertive, but the growing hostility of Brougham was mainly due to Durham's undoubted popularity in the country, where he was regarded by many, including J. S. Mill, as Grey's probable successor in the leadership of the Liberal party. At the great banquet given to

Lord Grey at Edinburgh in Sept. 1834 Brougham made a venomous attack on Durham, repeated shortly afterwards at Salisbury, and anonymously in the *Edinburgh Review*. But the strength of Durham's position in the country was shown when a concourse of more than a hundred thousand persons assembled to hear him speak at Glasgow Green in October. Durham however found no place in the Melbourne administration, partly because of his difficult temper, and partly on account of his radicalism.

In 1837 Durham accepted the post of governor general and lord high commissioner in Canada, with the almost dictatorial powers conferred on him by an act passed in Feb. 1838, by which the constitution of Lower Canada was suspended for two years. Having secured the services of Charles Buller (q.v.) as first secretary, and having appointed Thomas Turton and Edward Gibbon Wakefield (q.v.) to be his unofficial assistants, Durham arrived at Quebec on May 28, 1838. Papineau's rebellion had been quelled, but the French Canadians were sullen, the attitude of the United States equivocal, and the general situation dangerous, especially in the Lower Province where government was practically in abeyance. Durham at once issued a conciliatory proclamation. He dismissed his predecessor's executive council and created a new and unprejudiced one. On June 28, the day of Queen Victoria's coronation, he issued a proclamation of amnesty, from which eight persons only were excepted, these were to be transferred from Montreal to Bermuda, where they were to be imprisoned without trial. Papineau and 15 other fugitives were forbidden on pain of death to return to Canada.

These proceedings were violently attacked in England by Brougham. Of the ministers Lord John Russell alone defended the public servant to whom they had promised "the most unflinching support", and the prime minister and the colonial secretary, who had signified their "entire approval," now disavowed the ordinance, and earned an Act of Indemnity the terms of which were insulting to Durham. The latter immediately resigned, but before returning to England he put himself in the wrong by attempting a public justification of his actions. He laid his memorable "Report on the Affairs of British North America," before parliament on Jan. 31, 1839. This report, one of the greatest state papers in the English language, laid down the principles, then unrecognized, which have guided British colonial policy ever since. It was not written or composed by Charles Buller, as Brougham was the first to suggest, and the credit for the statesmanship it exhibits is Lord Durham's alone, though he warmly acknowledged the assistance he had derived from Buller, Wakefield and others in preparing the materials on which it was based. With regard to the future government of British North America, Durham had at first inclined towards a federation of all the colonies on that continent, but as a more immediately practical policy he advised the legislative union of Upper and Lower Canada. He further urged the creation of an executive council responsible to the colonial legislature, he advised state aided emigration on the broadest possible scale, and the formation of an intercolonial railway for the development of the whole country. Meantime Durham, who almost alone among the statesmen of his time saw the importance of imperial expansion, interested himself in the emigration schemes of Gibbon Wakefield (q.v.), he became chairman of the New Zealand Company, and was thus concerned in the enterprise which forestalled France in asserting sovereignty over the islands of New Zealand in Sept. 1839. He died at Cowes on July 28, 1840, just five days after the royal assent had been given to the bill giving effect to his project for uniting Upper and Lower Canada.

Lord Durham filled a larger place in the eyes of his contemporaries than many statesmen who have been better remembered. He was in his lifetime regarded as a great popular leader, and his accession to supreme political power was for some years considered probable by many, his opinions were, however, too extreme to command the confidence of any considerable party in parliament before 1840. That Brougham hated him and Melbourne feared him, is a tribute to his abilities, and in the first Reform Act, of which he was the chief author, and in the famous *Report* on the principles of colonial policy, he left an indelible mark on

English history. His personal defects of character did much to mar the success of a career, which, it must be remembered, terminated at the age of 48. He was impatient, hot-tempered, hypersensitive to criticism, vain and prone to take offence at fancied slights, but he was also generous and unvindictive, and while personally ambitious his care for the public interest was genuine and untiring.

By his first wife Durham had three daughters, by his second, who was a lady of the bedchamber to Queen Victoria but resigned on her husband's return from Canada, he had two sons and three daughters, the eldest son, Charles William, the "Master Lambton" of Sir Thomas Lawrence's celebrated picture, died in 1831, the second, George Frederick d'Arcy (1828-1879), succeeded his father as 2nd earl of Durham. The latter's son, John George Lambton (1855-1928), became 3rd earl in 1879.

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DURHAM, a county of England bounded north by Northumberland, east by the North sea, south by Yorkshire, and west by Westmorland and Cumberland. Area 1,014.7 sq. mi. The Derwent, a tributary of the Tyne, forms part of the northern boundary with Northumberland, while the Tees in the south forms almost the whole of the boundary with Westmorland and Yorkshire. The county is divided into a highland west and a lowland east. No clearly marked contour separates these regions but geologically the Permian scarp, forming the right bank of the middle Wear and continuing north-north-eastwards to just south of Tynemouth is a suitable dividing line. West of this the Carboniferous limestone series prevails, a succession of thick beds of limestone with intervening sandstones and shales. This series forms the high ground of the north Pennines which are the backbone of the western section of the county. It is, however, broken by intrusive dykes and sills of basalt, especially in the Tees valley above Middleton, one of these, the Great Whin Sill, extends 20 miles. The Cockfield dyke and Little Whin Sill are similar intrusions of basalt. Millstone Grit caps many of the higher points in the west as at Muggleswick and Walsingham commons. On these plateaux, Bolts Law reaches 1,778 ft. and Fatherly hill 1,504 feet. The outcrop of the Millstone Grit broadens eastward until it is covered by the Durham coalfield which occupies the centre of the county from Newcastle and South Shields to Barnard Castle. There are some small Silurian outcrops near Cronkley on the Tees, once famous for its slate pencils. South and east of the Permian Scarp the newer rocks are exposed and dip eastwards or south eastwards. The Permian magnesian limestone reaches from the Tees to South Shields in a broad tract and occupies the coast between that town and Hartlepool. The south-eastern corner of the county is low lying with Triassic and Jurassic material—red marls and sandstones with beds of gypsum and rock salt.

The drainage system as represented by the major streams, the Wear, Derwent and Tees, bears a curious relation to the geology. When flowing over the older rock of the west they follow a general north west to south-east line, well marked in the Upper Wear and Tees, but, once they enter the newer rocks, the general direction of the drainage runs almost at right angles south west to north east. Of additional interest is the final section of the Wear from Chester-le-Street to the sea. In pre-glacial times the south west to north section of the middle course continued and the Wear was a tributary of the Tyne entering it just to the west of Gateshead. The blocking of its former lower course by glacial debris caused it to turn at Chester-le-Street to the eastward and it cut through the low Permian scarp and found the sea at its present mouth at Sunderland. Between the Wear and lower Tees is the strange valley of the Skerne. This river flows on Permian rock in an

opposite direction to the general trend of the larger rivers and enters the Tees just as it changes its course (near Darlington) from the upper north-west to south-east section on the older rocks (where it takes advantage of important fault lines) to its lower course on newer rocks in a broad open valley with wide stretches of sand near the coast.

Glacial deposits containing derived material from the Cheviots and Pennines obscure the older rocks. There are evidences from sunk meanders in the middle courses of the Wear and Tees, raised beaches, and submerged forests off the coast at West Hartlepool and other points of post-glacial earth movements. Except in the western moorlands only a few scraps of the county have been left in their natural state. The ballast hills at Shields, Jarrow and Hartlepool, have many foreign plants elsewhere unknown in England. Stockton was almost the last retreat in England of the native black rat. Peatbog remains testify to the former abundance of deer, wild ox and boar, which appear to have existed in the reign of Henry VIII., records of red deer are found in the 18th century.

Early Settlement—Evidence of early man is scarce. It would seem that the area was but sparsely populated at least until Saxon times. Copt hill, Houghton-le-Spring, has a barrow which shows a series of burials, the earliest of which may be of Neolithic date. Finds of the Bronze age are more numerous, yet from their characteristic distribution along the river valleys, especially those of the Tyne and Wear, it may be taken that the Bronze age invaders were more "birds of passage" than settlers. The Bronze hoard at Heathery Burn Cave has yielded important finds. Evidence of the Iron age is very scanty—a fine late Iron age sword, at Barnston, near Sadberge being its only representative.

History—In Roman and Romano British times, county Durham was an outpost and the main concern of the Romans was for the safety of communication to the frontier walls. Through the county ran the great north road, from outside York via Cataractum to Vindua at the bend of the Wear and thence northward to the Tyne at Corstopium. Chester-le-Street and South Shields were Roman stations. The post-Roman centuries saw the county overrun by northern raiders until the Saxon settlement and the establishment of the kingdom of Northumbria. The church sites at Monk Wearmouth (Sunderland), Jarrow, Escomb, near Bishop Auckland, and numerous sculptured crosses (as those at Aycliffe) are of the Anglo-Saxon period.

In the 6th century Northumbria was divided into Bernicia and Deira, separated by the Tees, the latter including the district afterwards known as Durham. The post-Norman palatinate grew around a grant of land originally made by Egrifith to St. Cuthbert on his election to the see of Lindisfarne in 685. On the transference of the see to Chester-le-Street in the 9th century, Guthred the Dane endowed it with the whole district between the Tyne and the Wear, stretching west as far as Watling street, a grant confirmed by Alfred, the endowment was again enriched at the establishment of the see at Durham in 995. The ravages of the Danes caused much disruption in this area in the 9th century when the Tees formed the northern boundary of the Danelaw. Durham continued, however, to form part of the earldom of Northumbria, and it was not until after the purchase of the earldom by Bishop Walcher in 1075 that the bishops began to exercise regal rights in their territory. The term palatinate is applied to the bishop in 1293. At the time of the Conquest the bishop's possessions included nearly all the district between the Tees and the Tyne, except Sadberge, and also the outlying districts of Bedlingtonshire, Northamshire, Islandshire and Crayke, together with Hexhamshire, the city of Carlisle, and part of Teviotdale. Henry I deprived the bishopric of the last three but made over to it three villis of the earldom of Northumberland. The wapen take of Sadberge was purchased by Bishop Pudsey in 1189, but continued independent in administration. The division into the four wards of Chester-le-Street, Darlington, Dasington and Stockton existed in the 13th century. The diocese was divided into the archdeaconries of Durham and Northumberland.

The palatinate was administered by a steward with a sheriff, coroners, chamberlain and chancellor. The palatinate assembly

represented the whole county and dealt chiefly with fiscal questions. The bishop's council, consisting of the clergy, the sheriff and the barons, regulated judicial affairs. The prior of Durham had his own court. The repeated efforts of the crown to check the powers of the palatinate bishops culminated in 1536 in the Act of Resumption, which deprived the bishop of much of his judicial power. In 1596 further restrictions were imposed and in 1646 the palatinate was abolished. It was revived, however, after the Restoration, and continued with much the same power until the Act of 1836, which finally vested the palatinate jurisdiction in the crown. The most important palatinate barons of the 12th century were the Hiltons, the Bulmers, the Conyers, the Hansards and the Lumleys. The Nevilles owned large estates in the county, which they ruled from Raby castle. Owing to its isolated position the palatinate took little part in the great rebellions of the Norman and Plantagenet period. On the outbreak of the Civil War Durham inclined to support the cause of parliament, and in 1640 harboured the Scottish army. In 1642 the earl of Newcastle organized the western counties for the king, but in 1644 the palatinate was again overrun by the Scottish army, and after Marston Moor fell entirely into the hands of the parliament.

Agriculture—Agriculture centres in the river valleys. East of the line from Barnard Castle to Consett the hills are covered with a dry loam, whose fertility varies with its depth. West of the line the hills are in great part waste moorland. About 581% of the total area of 645,739 ac. was under cultivation in 1939 and of this two thirds was in permanent pasture, including 137,485 ac. of rough pasture. Cereals, with 33,854 ac., were the main crop, with wheat (20,652 ac.) and barley (5,997 ac.) coming next. Potatoes and turnips and swedes, with 24,156 ac. almost equally divided, were prominent among the green crops. Cattle are imported. The sheep are esteemed, particularly the Teesdale and Wensdale breeds. The National Trust owned only 284 ac. in Durham in 1904.

Industrial Activities—The coal-field has two sections, that west of Durham on the Pennine plateau where early mining occurred, and that east of the Wear. In the former region the coal measures outcrop on the valley sides and the mines are shallow. In the latter the coal is beneath the Permian rocks and the mines deep but productive. Little mining is done now west of Durham as the mines are shallow and the habitations consequently scattered, but east of the Wear large quantities of coal are raised, which can easily be transported to the coast for exportation. Here the big industrial towns are gathered. The Frosterley marble has been quarried for many centuries near Stanhope, and excellent slate is quarried at several places. Fire-clay is obtained in various parts of Durham, and exported in considerable quantity. The industrial districts may be taken to be almost wholly east of a line from Darlington through Bishop Auckland to Consett. The manufacture of machines, appliances, locomotives, trams and tools is important, and the ship-building yards on the Tyne are second only to those on the Clyde, building is carried on also at Sunderland, the Hartlepoons and Stockton-on-Tees. The use of the waste gases from the iron foundries gives an impetus to the manufacture of chemicals, glass and bottles and earthenware. The heavy chemical industry has developed on Tees-side. Local iron ore was formerly used, but now vast quantities are imported. The Tyne and the Tees mouth are the main areas. Much timber is imported from Scandinavia. There is a large production of salt gypsum and a tidal manure on the Tees mouth. The sea fisheries of Sunderland and Hartlepool are valuable.

The decline in shipping and the contraction of foreign markets (especially for coal), combined with the cessation of intensive wartime activity, led to widespread unemployment and poverty in the industrial sections of the Tyne-side in the decades between World Wars I and II. Unemployment in June 1931 reached a peak of about 34% of the insured population, and relief from public funds was annually more than double the amount per capita expended in the country as a whole. Complete recovery from this condition was almost impossible and was made the more difficult by the deteriorated financial position of the local industries and the water-logged condition of many mines in the southwest of the county. When, therefore, under the Act of 1934 almost all Durham became a "special area," the commission's attention was primarily directed toward the attraction of new industries to the area. A development board for the northeast as a whole was formed, along with local development councils. Derelict sites were cleared, public works were undertaken by the local authorities with the aid of government grants and a trading estate of 700 ac. was established in 1936 at Gateshead, within two m. of Newcastle, for light industries, while facilities were created to provide capital to potentially successful small businesses. In addition, land settlement schemes were promoted. The success of these measures led to an expansion of the commissioner's powers under the 1937 act, so that further sites were cleared and new factories set up outside trading estate areas.

The I.N.E.R. main line runs northward through Darlington, Dur-

ham and Gateshead, and there are branches through the mining and industrial districts. The company also owns some docks. From Stockton to Darlington run the railway engineered by George Stephenson and opened in 1825. Its main object was to transport coal to the coast for exportation.

Administration and Population.—The area of the administrative county is 973.7 sq mi., with a population (est. 1938) of 884,000. Wartime movements, caused mainly by evacuation, led to a decline of 6% in the county population between Sept. 1939 and Feb. 1941. The county boroughs are Darlington, Gateshead, South Shields, Sunderland and West Hartlepool. Municipal boroughs are the city of Durham, Hartlepool, Jarrow and Stockton-on-Tees. There are 22 urban districts. Durham is in the northeastern circuit, and assizes are held at Durham. There are two courts of quarter sessions and the county is divided into 25 petty sessional divisions. It is in the diocese of Durham, excepting part of one parish in that of York, and contains 168 civil parishes. The bishop strongly opposed in 1614 a bill for securing representation to the county and city of Durham and the borough of Barnard Castle. The county was first summoned to return members to parliament in 1254. After 1928 it returned one member for each of 11 divisions. The five county boroughs and Stockton-on-Tees also return one member each, except Sunderland, which returns two.

See W. Hutchinson, *History and Antiquities of the County Palatine of Durham* (3 vols., Newcastle, 1785-1794), R. Surtees, *History and Antiquities of the County Palatine of Durham* (4 vols., 1816-40), B. Bartlett, *The Bishopric of Durham, Collection of Legends, Songs, Ballads of Durham* (1834), J. Rame, *History and Antiquities of North Durham* (1852), Perry and Heiman, *Illustrations of the Mediaeval Antiquities of the County of Durham* (1867), G. T. Lapsley, *The County Palatine of Durham* (New York, 1900), *Victoria County History, Durham*. See also the Surtees Society's *Publications and Transactions of the Architectural Society of Durham and Northumberland, Reports of Investigations into Industrial Conditions in Certain Depressed Areas* (1934), *Reports of Commissioner for the Special Areas* (1935-38).

DURHAM, a city, and county town of Durham, England, in the Durham parliamentary division, 256 mi. NW from London, on the LNER. Pop. (est. 1938) 19,370. Area 6.3 sq mi. The nucleus of the site is a narrow, rocky peninsula formed by a sharp bend of the river Wear, on which stands the cathedral and castle. Though the mediaeval city grew around this site there are indications of earlier settlement, particularly on Maiden hill, where there is a Romano-British encampment. On the projecting rock rising some 70 ft above the river the monks of Lindisfarne found, in 995, a resting place for the body of St. Cuthbert, which they had removed from its tomb in fear of Viking raids. The naturally strong position selected was possibly artificially fortified also, thereby laying the foundations of one of the few examples in Britain of a mediaeval fortress city. In 1928 it was reported that Durham castle was in danger of collapse from moving foundations. A national appeal for £150,000 "to save the castle from falling into the river" was made, and the restoration was successfully completed.

On the peninsula, which was called Dunholm (softened in Norman times to Duresme, whence Durham), a church was built by Bishop Ealdhun and the site was removed thither from Chester-le-Street in 995. In 1093 Ealdhun's church was rebuilt by Bishop Saint Calais, who changed the early establishment into a Benedictine abbey. The grand Norman building in which his designs were carried out remains, with numerous additions. The cathedral library, formerly the dormitory and refectory of the abbey, contains a number of printed books and MSS. and the relics found in St. Cuthbert's grave.

In 1072 Earl Waltheof erected the castle to the north of the cathedral, but Ranulph Flambard was the designer of the Norman fortifications as they can be traced today. Of this there remains a beautiful crypt chapel. Other interesting portions are the Norman gallery, with its fine arcades, Bishop Hatfield's Hall of c. 1350, a reconstruction of the previous Norman one by Bishop Pudsey, and the Black Staircase of fine woodwork of the 17th century.

The church of St. Mary le Bow in the North Bailey is a 17th century building on a very ancient site, while that of St. Mary le Less possesses slight traces of Norman work. Of other churches in Durham, the site of St. Oswald is apparently pre-Norman, and the building contains Norman work of Bishop Pudsey, also some fine early 15th century woodwork. St. Mar-

garet's and St. Giles's churches show work of the same period while the latter has earlier portions.

The remarkable meander of the Wear served as a natural defense and replaced, in parts, the usual mediaeval town wall. Three of the present bridges across the river are old, that of Elvet having been built 1153-95. *Tramwellgate* was rebuilt in the early 15th century. Outside the city on the Wear is the priory of Finchale (1196), of which there are considerable remains of Early English and later styles, but in the main Decorated. The earliest charter, dated 1179 or 1180, is a grant of exemption from toll market and hearth. Before that time, however, the monks had a little borough at Elvet, which is divided from Durham by the Wear and afterward became part of the city. In 1183 the city was at farm and rendered 60 marks. The bishop of Durham, among other privileges, claimed a mint in the city, which record in Boldon Book rendered ten marks yearly until its value was reduced by that established by Henry II at Newcastle, and it was temporarily abolished by the same king.

The palatinate of Durham in the middle ages was a great border ecclesiastical state occupying the extent of the present county, with many outlying portions, and the cathedral functioned as "half church of God, half castle against the Scots." In the neighbourhood of the city is Neville's Cross, of which little remains. A battle was fought there in 1346 resulting in the defeat of the Scots. With the Reformation came the rise of other city buildings. A grammar school was founded by Henry VIII in place of the monastic school. The town hall, a 16th century building, was reconstructed in 1851. The city possesses a guild hall and shire hall together with other county buildings. Four miles west of the city is the great Roman Catholic college of St. Cuthbert, Ushaw, the representative of the old college at Douai.

Durham was at first governed by a bailiff appointed by the bishop, but in 1505 Bishop Pilkington ordained that the government should consist, in addition to the bailiff, of one alderman and twelve assistants, the latter to continue in office for life and the former to be chosen every year from among their number. This form of government was replaced in 1602, under the charter of Bishop Matthew, by that of a mayor, 12 aldermen and 24 burgesses, the aldermen and burgesses forming a common council and electing a mayor every year from among the aldermen. This was confirmed by James I, but in 1684 the corporation were obliged to resign their charters to Bishop Crew, who granted them a new one, probably reserving to himself a right of veto on the election of the mayor and aldermen. At the time of the Revolution, however, Bishop Matthew's charter was revived and continued to be the governing charter of the city until 1770, when, owing to dissensions as to the election of the common council, the number of aldermen was reduced to four and the charter became void. No mayor or aldermen were elected for 10 years, but in 1780 Bishop Egerton, on the petition of the burgesses, granted them a new charter, which was practically a confirmation of that of 1602 and remained in force until the Municipal Reform act of 1835. Being within the county palatine, the city of Durham sent no members to parliament, until, after several attempts beginning in 1614, it was enabled by an act of 1673 to return two members, which it did until 1885, when the number was reduced to one. It was disfranchised in 1918.

The University.—Prior Richard de Holon (1200-1308) erected a hall in Oxford for students from Durham. In 1380 Bishop Hatfield refounded this hall as Durham college, which became Trinity college (see OXFORD) on a new foundation (1555). Henry VIII had the unfulfilled intention of founding a college in Durham, and a similar attempt failed during the Commonwealth. In 1831 the scheme for a college was projected by the chapter, an act of 1832 specified the foundation as a university, which was opened in 1833. In 1837 the university received its charter from William IV. Instruction in civil engineering and mining was established as early as 1837. In 1871 the university and the North of England Institute of Mining and Mechanical Engineers co-operated to found a college at Newcastle-upon-Tyne, which was incorporated with the university in 1874. The College of Medicine at Newcastle has been connected with Dur-

ham university since 1852. In 1895 women were admitted to degrees. In 1889 music degrees were instituted, and a professor ship was founded in 1897.

In 1908 the university was reconstituted to consist of the Durham and the Newcastle divisions. The latter had the college of medicine and Armstrong college, while the Durham colleges, University college, Hatfield college, St Chad's college, St John's college, St Mary's college (women) and three residential colleges are controlled by the former. The university was later reorganized along lines suggested by a royal commission appointed in 1934, so that, although it still consisted of two divisions known as Durham colleges and King's college, Newcastle, the senate received greatly increased powers over the university as a whole.

Industries—The corporation of Durham claim their fair and market rights under Bishop Hugh de Puiset's charter of 1179, confirmed in 1565, as a weekly market and three yearly fairs. There is also a fourth fair. In 1610 the bishop recovered the markets and fairs, which he afterward leased to the corporation for a rent of £20 yearly until they were purchased from the ecclesiastical commissioners in 1860. Durham has never been noted for any particular trade, and the attempts to introduce the manufacture of cloth and wool in the 17th and 18th centuries were failures. The manufacture of carpets was begun in 1814.

The uplands have many collieries and ironworking and smelting is important. Durham is no longer one of the great cities of the north, but has become a small market town for the industrial population.

DURHAM, a city of North Carolina, U.S., 25 mi W of Raleigh, the county seat of Durham county. It is on federal highways 15, 70, 264 and 501, and is served by the Durham and Southern, the Norfolk and Western, the Norfolk Southern, the Seaboard Air Line and the Southern railways. Pop. (1950) 70,307, (1940) 50,195 by the federal census. It is the seat of Duke university (q.v.), and is one of the leading tobacco markets and tobacco manufacturing centres of the country. Durham became a nationally known medical centre with the establishment of the Duke clinic.

In the city of Durham there are large cotton mills, hosiery mills and various other manufacturing industries. The assessed valuation of property in 1950 was \$250,000,000 and bank deposits in 1949 amounted to \$1,221,779,000. The North Carolina College at Durham (Negro), Lincoln hospital (one of the finest in the country for Negroes) and the largest Negro life insurance company in the country are situated there. The tobacco industry of Durham was founded soon after the Civil War by W. T. Blackwell (1839-1904) and Washington Duke (1820-1905). The city was incorporated in 1869, became the county seat of the newly constituted county in 1881, and in 1921 adopted a council manager form of government. In the Bennett house near the city, Gen. J. E. Johnston on April 26, 1865, surrendered to Gen. William T. Sherman.

DURIAN, the fruit of *Durio zibethinus*, a tree of the family Bombacaceae, which attains a height of 70 or 80 ft., has oblong, tapering leaves, rounded at the base, and yellowish green flowers, and bears a general resemblance to the elm. The durian is cultivated in Sumatra, Java, Celebes and the Moluccas and northward as far as Mindanao in the Philippines, also in the Malay peninsula, in Tenasserim, on the Bay of Bengal, to 14° N lat., and in Siam to the 13th and 14th parallels. The fruit is spherical and 6 to 8 in. in diameter, approaching the size of a large coconut, it has a hard external husk or shell, and is completely armed with strong pyramidal tubercles, meeting one another at the base and terminating in sharp, thorny points. On dividing the fruit at the joints of the carpels, where the spines arch a little, it is found to contain five oval compartments, each filled with a cream coloured, glutinous pulp, in which are embedded from one to five seeds about the size of chestnuts. The pulp and the seeds, which latter are eaten roasted, are the edible parts of the fruit. With regard to the taste of the pulp, A. R. Wallace (*The Malay Archipelago* [1872]) remarks, "A rich butter like custard, highly flavoured with almonds, gives the best idea of it, but intermingled with it come wafts of flavour that call to mind cream cheese, onion-sauce, brown sherry

and other incongruities, it is neither acid, nor sweet, nor juicy, yet one feels the want of none of these qualities, for it is perfect as it is." The fruit, especially when not fresh from the tree, has an exceedingly offensive smell, which has been compared to that of rotten onions or of putrid animal matter.

DURIS, of Samos Greek historian, according to his own account a descendant of Alcibiades, was born about 340 B.C. He must have passed his early years in exile, since from 352 to 324 Samos was occupied by Athenian cleruchs, who had expelled the original inhabitants. He was a pupil of Theophrastus of Eresus, whom he met at Athens. When quite young he won a prize at the Olympic games, a statue by Hippis was set up to commemorate his victory (Pausanias, vi, 13, 5). He was for some time despot of Samos. Duris was the author of a history (*Historiae*) from the battle of Leuctra (371) down to the death of Lysimachus (281), and a life of Agathocles of Syracuse (both used by Diodorus), the annals (*apoi*) of Samos, arranged according to the lists of the priests of Hera, and treatises on literary and artistic subjects. Plutarch (*Pericles*, 28) expresses doubt as to his trustworthiness, Dionysius Halicarnassensis (*De compos. verborum*, 4) criticizes his style and Photius (*cod.*, 176) the arrangement of his work.

See Fragments in C. W. Müller, *Fr. Hist. Graec.*, ii, 446, where the passage of Pausanias referred to above and the date of Duris' victory at Olympia are discussed.

DURKHEIM, EMILE (1858-1917), French sociologist and philosopher, came of a rabbinical Alsatian family. His study of law, philosophy and social science, first in France and later in Germany, led to acceptance of the chair of sociology founded for him at Bordeaux in 1887, five years later he was called to Paris to teach sociology and pedagogy. Like Auguste Comte, whose successor he was, Durkheim studied society as a natural phenomenon to be treated as the physical scientists treat their subject matter. His books on the division of labour, suicide and primitive religion combine a bold and well considered theoretical analysis with monographic empirical material. A notable contribution is his concept of collective representation, the effect upon the individual of a synthesis of the reactions which the consciousness of individuals in society exercise on each other. With this concept he developed the view that society, to remain stable, must have a common value system. Durkheim's chief publications are *De la division du travail social* (1893), *Les Règles de la méthode sociologique* (1894), *Le Suicide* (1897), *Les Formes élémentaires de la vie religieuse* (1912, Eng. trans., 1915).

In 1897 Durkheim founded *L'Année sociologique*, which he edited annually.

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DURKHEIM, a town in the Bavarian Palatinate, Germany, near the foot of the Hardt mountains, and at the entrance of the valley of the Isenach, 15 mi NW of Spire on the railway Monheim Neustadt. Population 7,770. The town hall occupies the site of the castle of the princes of Leiningen Hartenburg. It is well known as a health resort for the grape cure and for the baths of the brine springs of Philipshalle which produce marketable salt. There is a brisk trade in wine. As a dependency of the Benedictine abbey of Limburg, built and endowed by Conrad II, Durkheim or Thurnheim came under the counts of Leiningen, who in the 14th century made it the seat of a fortress. It was often damaged in wars but was rebuilt after the French invasion of 1689. The ruins of the Benedictine abbey of Limburg lie about 1 mi SW of the town, and in the neighbourhood rises the Kastanienberg, with ancient fortification of the Heidenmauer or Heathen's wall.

DURLACH, a town in the Land of Baden, Germany, 2½ mi by rail from Karlsruhe, with which it is connected by canal, on the left bank of the Pfalz at the foot of the vineyard covered Thurnberg. Pop. (1933) 18,658. It possesses a castle (1565), now a bar racks, and an ancient town hall. It has manufactures of brushes, chemicals, machinery, gloves, leather, tobacco, beer, vinegar and chicory, and considerable trade in market produce.

Durlach was bestowed by the emperor Frederick II on the margrave Hermann V of Zahringen as an allodial possession, but afterwards came into the hands of Rudolph of Habsburg. It was chosen as his residence by the margrave Charles II in 1565, and retained this distinction till the foundation of Karlsruhe in 1715, though it was almost totally destroyed by the French in 1688.

DUROC, GÉRAUD CHRISTOPHE MICHEL, DUC DE FRUHL (1772-1813), French general, was born at Pont a Mousson (Meurthe et Moselle) on Oct. 25, 1772. He was gazetted second lieutenant (artillery) in the 4th regiment in 1793, and advanced steadily in the service. Captain Duroc became aide de camp to Napoleon in 1796, and distinguished himself at Isonzo, Brenta and Gradisca in the Italian campaigns of 1796-97. He served in Egypt, and was seriously wounded at Aboukir. His devotion to Napoleon was rewarded by complete confidence. He became first aide de camp (1798), general of brigade (1800) and governor of the Tuileries. After the battle of Marengo he was sent on missions to Vienna, St. Petersburg, Stockholm and Copenhagen. As grand marshal of the Tuileries he was responsible for the measures taken to secure Napoleon's personal safety whether in France or on his campaigns, and he directed the minutest details of the imperial household. After Austerlitz, where he commanded the grenadiers in the absence of General Oudinot, he was employed in negotiations with Frederick William of Prussia, with the elector of Saxony (December 1806), in the incorporation of certain states in the Confederation of the Rhine, and in the conclusion of the armistice of Znaim (July 1808). In 1808 he was created duke of Frühl, and after the Russian campaign he became senator (1813). He was in attendance on Napoleon at the battle of Bautzen (May 20-21, 1813) in Saxony, when he was mortally wounded, and died in a farmhouse near the battlefield on May 23.

The chief source for Duroc's biography is the *Moniteur* (May 31, 1797, Oct. 24, 1798, May 30, 1813, etc.).

DURRA, see KAFIR.

DURUY, JEAN VICTOR (1811-1894), French historian and statesman, was born in Paris. He studied under Michelet at the École Normale Supérieure, and taught at the Collège Henri IV at Paris for over a quarter of a century. Already known as a historian by his *Histoire des Romains et des peuples soumis à leur domination* (2 vols., 1843-44), he was appointed minister of education in 1863.

Among his measures may be cited his organization of higher education ("enseignement spécial"), his foundation of the "conférences publiques," which later became universal throughout France, and of a course of secondary education for girls by lay teachers, and his introduction of modern history and modern languages into the curriculum both of the *lycées* and of the colleges. He greatly improved the state of primary education in France and proposed to make it compulsory and gratuitous, but was not supported in this project by the emperor. In 1884 he was elected to the Academy. He died on Nov. 25, 1894.

Duruy's fame rests mainly on the revised edition of his Roman history, which appeared in a greatly enlarged form in 7 vol. under the title of *Histoire des Romains depuis les temps les plus reculés jusqu'à la mort de Théodose* (1879-85), Eng. trans. by W. J. Clarke, 6 vol., 1883-86. He also wrote *Histoire des Grecs* (3 vol., 1886-91, Eng. trans., 4 vol., 1892), *His toire de France de 1453 à 1815* (1886, new enlarged ed. 1891), and other works on French history.

A memoir by Ernest Lavisse appeared in 1895 under the title of *Un Ministre Victor Duruy*. See also the notice by Jules Simon (1895) and S. Monod, *Portraits et souvenirs* (1897).

DURYEA, an anthracite mining borough of Luzerne county, Pa., U.S.A., on the Susquehanna river and the Lackawanna railroad, 8 mi. S.W. of Scranton. The population in 1950 was 6,676 and 8,275 in 1940.

The borough, originally called Babel because the first inhabitants came from so many different countries and spoke so many different languages, was called Duryea after Abram Duryea, who began working coal mines in that region in the middle of the 19th century.

DU RYER, PIERRE (c. 1606-1658), French dramatist, was born in Paris. His masterpiece, *Scivole*, probably dates from 1644 (the date generally given is 1646). *Alceste* (1637) was so popular that the abbé d'Aubignac knew it by heart. Among du Ryer's other works may be mentioned *Saul* (printed 1642) and a comedy *Les Vendanges de Suèves* (printed 1633, probably played 1633).

See H. C. Lancaster, *Pierre Du Ryer Dramatist* (1913).

DUSART (DU SART), CORNELIS, the younger (1660-1704), Dutch painter and engraver. He was born at Haarlem on April 24, 1660, and became one of the most distinguished pupils of Adriaen van Ostade, following his master closely both as regards style and subject matter. His engravings are much sought after. He died at Haarlem on Oct. 1, 1704.

DUSE, ELEONORA (1859-1914), Italian actress, belonged to a family of actors from Chioggia, near Venice. Her grandfather, Luigi Duse, a celebrated actor of Goldoni plays, created the 18th century Venetian masque of Giacomoni, round which a whole dialect repertory turned. Born on a tour in Lombardy on Oct. 3, 1859, Eleonora Duse was carried to her christening at Vigevano in a gilt theatrical property box, some Austrian soldiers presented arms, thinking it was a reliquary. She acted the part of Cosette in *Les Misérables* at the age of four in a booth at Chioggia. At Verona she played Juliet when just 14, and drew public attention by her love of flowers and the use she made of them in her art. The incident is always referred to as "the device of the roses" (*la trovata delle rose*).

About this time her mother, to whom she was passionately attached, died, and thrown on her own resources, often in dire poverty, she passed from one travelling company to another, eventually reaching fame through sheer hard work, no less than by genius and the exceptional beauty of her speaking voice. She acted in *Alcibiades* of Felice Cavallotti, in *Orfeo* of Alfieri, and took the part of Shakespeare's Ophelia with success. She gained wider recognition in 1878 when, one night at Naples, she was called upon suddenly to take the leading part in *Les Fourchambaults* by Augier. In the following year, after securing a real triumph in the part of Zola's *Thérèse Raquin*, Cesare Rossi engaged her for his famous company as *prima donna* and she added *La Princesse de Bagdad* to her repertory. A memorable year was 1882: she saw Sarah Bernhardt act at Turin in *La Dame aux Camélias* of Dumas fils, and felt inspired to give her own interpretation of Marguerite Gautier—"fille galante, extrêmement distinguée," a character which both actresses idealized. The Frenchwoman, less realistic and temperamental, possessed a more subtle style, but, in certain scenes, the passionate, almost volcanic, powers of the Duse admitted of no rival. The greatest triumph, perhaps, in her career was gained in this part, and she was induced to act it in Paris in 1897, when the Parisians were taken by storm, Sarah Bernhardt leading the applause. She also acted in *Frou Frou* and *La Femme de Claude*. Her *Magda*, in the opinion of Sudermann the author, was never surpassed. In the character of Mirandolina (*La Locandiera* of Goldoni) she also showed a remarkable gift for light comedy. She created the character of Santuzza in *La Cavalleria Rusticana*, given for the first time in 1884, and such was her success that Verga said the part belonged as much to her as to him. Her acting during all this period was characterized by realism devoid of any excess, hers was the highest kind of romantic realism which had passed through the flame of intense feeling. Coquelin the elder said of her: "No one draws from humanity as she does, she is passionately beautiful and great." Her own words still further help to explain her vivid and varied personality: "How I have loved life!" she wrote to a friend, and again: "There are a thousand women within me, and each one makes me suffer in turn."

Eleonora Duse was a woman of wide culture, her intellectual life had been greatly influenced early in life through a close friendship with Arrigo Boito, the composer, whose sound criticism proved of considerable value to her art. The books she steeped herself in included the writings of Pascal, Keats, and Thomas à Kempis, *The Letters of St. Catherine of Siena*, *The Confessions of St. Augustine* and *L'Action* by Maurice Blondel.

Northern Europe and certain Mediterranean ports. The famous Academy of Painting founded by the elector Charles Theodore in 1767 was reorganized by King Frederick William III in 1822. Among the celebrities of the town are Johann Georg and Frederick Heinrich Jacobi, Heinrich Heine and Peter von Cornelius, and Louise Dumont, who founded a theatre. Large international industrial exhibitions were held at Düsseldorf in 1880, 1902 and 1937. In order to facilitate better city planning in regard to streets, traffic and parks several adjacent towns and suburbs (Benrath, Garath, Uerdenbach, Kassewerth, Lohausen and Lützenberg) were incorporated into Düsseldorf on Aug. 1, 1929. During World War II the city suffered severely from frequent British bombing attacks.

See H. Ferber *Historische Wanderung durch die alte Stadt Düsseldorf* (Düsseldorf, 1889-90), Wilden, *Grundlagen und Trübräume der Wirtschaft in Düsseldorf* (1923), H. Stolz, *Düsseldorf* (1925).

DUST Dust is earth or other solid matter in a fine state of subdivision, so that the particles are light enough to be easily raised and carried as a cloud by the wind. The presence of dust in the atmosphere is obvious on the most casual inspection. Particles of dust, varying from the motes in the sunbeam to big flakes of soot, are readily visible to the naked eye. The origin of the dust is varied in character. Smoke from domestic and factory chimneys contains particles of carbon (soot), as well as small particles of ashes and drops of liquid tar. These particles are carried by the wind, and even spread upward through considerable heights by the turbulent or eddy motion of air (see *Meteorology: The Tertiary Circulations*).

Over the deserts coarse dust is raised from the ground by wind storms, and can be carried for thousands of miles by the wind. The "red rain" which has been observed in Europe from time to time is due to the washing down of desert dust which has originated in tropical deserts. A notable example of "red rain" occurring on Feb. 21 and 22, 1903, is described in the *Quarterly Journal Roy. Met. Soc.*, xxx, 1904 p. 57, where it is shown that the dust must have travelled from north west Africa round the western edge of an anticyclone over southern Europe. The amount of dust which fell in England during the two days in question was estimated at about ten million tons. The *harmattan*, a dry easterly wind which blows off the west coast of Africa between Cape Verde and Cape Lopez, carries with it quantities of dust, causing thick haze for a distance up to 15 m from the shore. Enormous quantities of volcanic dust are poured into the atmosphere by the eruption of volcanoes. The eruption of Krakatoa near Java in 1883 produced, among many effects, a vast cloud of small particles which is said to have taken two years to settle down completely. The dust from Krakatoa produced the most extraordinary colours in the sky. Even in the British Isles sunsets of unusually gorgeous colours were observed. Meteoric matter disintegrating in the air is another source of atmospheric dust. A phenomenal dust storm visited the United States in May 1934. Rising from the parched soil of the Western plains, where drifts as deep as six inches often covered the highways, a vast cloud of dust moved slowly eastward, hung for a time in yellow haze over the cities along the coast and finally was precipitated in the Atlantic Ocean.

The particles of dust or soot, from whatever source they originate, are distributed over a wide area by the wind. Granted a sufficient wind velocity, the smoke from the largest city will be distributed over such a wide area, and through so great a volume of air, that it cannot acquire a sufficient density to be troublesome. But when the wind falls below a certain limit, it ceases to be an effective distributor. Another factor of importance in connection with the concentration of smoke is the turbulence in the atmosphere, which scatters the smoke through a greater range of height than it would otherwise attain. When there is an increase of temperature with height (i.e., an inversion) instead of the normal decrease, turbulence is suppressed, since inversions of temperature at the ground are usually associated with light winds, they generally give smoke fogs in large towns.

The rate of settlement of spherical particles of dust through a still atmosphere is given approximately by the formula,

$$V = \text{density} \times R^2 \times 12 \times 10^5$$

where V is the velocity in centimetres per second and R is the radius of the particle in centimetres. Thus a particle of unit density and of diameter 1 micron will fall through still air at a rate of about 0.003 centimetres per second, which is equivalent to a fall of 30 metres (100 ft) in 278 hours, during which time a wind of 10 m.p.h. would carry it 2,780 miles. It is thus readily seen that smoke particles can travel over immense distances under favourable conditions. A drop of water of diameter 10 microns would fall with a velocity of 3 cm/sec or roughly 10 metres in one hour.

The first investigations of the amount of dust in the atmosphere were those of John Aitken in 1880. Aitken succeeded in showing that water drops will not form, even in supersaturated air, in the complete absence of solid nuclei upon which the molecules of water can collect. It was but a step further, to utilize this idea to count the number of condensation nuclei in a given volume of air. Aitken's method consisted in placing the air under examination in an airtight receiver and saturating it with water vapour. It was then caused to expand adiabatically until condensation was produced, the drops being collected on a reticule and counted by the aid of a short focussed lens. Certain precautions were necessary in carrying out this procedure. It was found that if more than 500 nuclei were present in each cubic centimetre of air, they would not all form water drops. In such cases it was necessary first to dilute the air with air which had been carefully filtered, subsequently allowing for the dilution in computing the number of particles per second. Aitken's method was applied in thousands of tests in different parts of the world, and in no case was the air found to be completely free of nuclei. The numbers of particles per c.c. in cities such as London and Paris were often found to exceed 100,000. Fridlander used Aitken's dust counter on a voyage across the Atlantic and never found values below 2,000 per c.c. but in crossing the Pacific and Indian oceans he found values as low as about 250 per c.c. But we can safely conclude that air, no matter where it is sampled, contains an ample supply of particles capable of acting as condensation nuclei. The instrument which Aitken devised for counting the particles suspended in air was called a "dust counter," but subsequent research has shown that the particles which Aitken counted were not dust in the ordinary sense of the word, but what are known as hygroscopic nuclei.

The only effective nuclei are particles of certain hygroscopic salts, in particular the chlorides of sodium and magnesium derived from salt spray, and sulphates. Ordinary dust, except such particles as may be hygroscopic, will not act as nuclei for condensation, and particles of soot, being of a larry nature, tend to repel water rather than to attract it. The hygroscopic nuclei are so small as to be in general invisible in the field of a high-power microscope, but on account of their hygroscopic properties they are capable of producing water drops in air whose humidity falls short of saturation. Thus particles of common salt will produce condensation when the relative humidity is only 75%, and are thus capable of producing fogs at times when the conditions do not otherwise seem favourable for their formation.

It was first suggested by Wigand (A. Wigand, *Meteor. Zeitschrift* 30 p. 10 Jan. 1913) that the particles counted by Aitken's dust counter were not dust in the ordinary sense of the word. Wigand compared the figures obtained by Aitken's method in air which was artificially made dusty and found that the number of condensation nuclei per c.c. was not dependent on the amount of dust introduced into the atmosphere. This is confirmed by Owen's observations. A recent investigation by Boylan (*Proc. Roy. Irish Acad.* vol. 37A NO 6, 1926) shows very definitely that the dust and nuclei are different, and that ordinary dust particles will not act as nuclei for condensation.

The horizontal visibility of objects on the earth's surface depends upon the degree of pollution of the atmosphere. Poor visibility is due to the obscuration of the atmosphere by water-drops or by solid particles. The condition known as haze is due to the presence in the atmosphere of small solid particles, whose diameter is about 5 micron (0.005 mm), together with varying quantities

of water drops. In a series of observations of haze by Owens it was found that in some cases no water drops were present, while in other cases large numbers of water drops were found. The distinction is largely a question of relative humidity, since haze is probably always a mixture of insoluble particles and hygroscopic nuclei. If the relative humidity is low, the haze effect is almost entirely due to small solid particles of dust whose diameter is of the order of $\frac{1}{2}$ micron, but if the humidity increases sufficiently, condensation takes place on the hygroscopic nuclei, and the haze changes into a true mist. Similarly fog may be divided into two classes—smoke fogs and water fogs. The diameter of the solid particles in a smoke fog vary from $\frac{1}{2}$ micron up to several microns, while the diameter of water drops in a water fog vary from 5 to 20 microns. The fine smoke particles which produce the dust horizon frequently seen in the British isles have diameters of about 0.8 micron, while the Indian dust horizon consists of blown sand of similar size.

The most troublesome aspect of atmospheric dust is provided by the smoke produced in great cities. The problem of pollution produced by smoke has been the study of a special Advisory Committee on Atmospheric Pollution. The work of this committee has been summarized by Sir Napier Shaw and Dr. J. S. Owens in *The Smoke Problem of Great Cities*. Smoke as it issues from the chimney consists of particles of soot of varying sizes as well as acid products of combustion, small particles of ash, and small drops of tar. The larger aggregations of soot fall in the near neighbourhood of their source, while the smaller particles of dust rather less than one micron are carried to considerable distances. Shaw and Owens describe a variety of methods for the detection and measurement of the quantities of different forms of pollution in the atmosphere, and the reader is referred to their treatise for fuller details of these methods. Of particular interest, however, is the jet dust counter devised by Dr. J. S. Owens, depending upon the principle that when air containing dust and a sufficient quantity of water vapour has its pressure suddenly reduced, there is a fall of temperature and a condensation of moisture into water drops.

It is not clear how the ordinary dust particles become attached to their share of water, but it appears probable that the particles which are hygroscopic become nuclei of condensation and that the condensed water captures the dust. When the dust-bearing water drops are brought into contact with a glass surface they adhere to it. In the Owens dust counter the dusty air is drawn through a slit as a fine ribbon shaped jet, and impinges on a coverglass placed at a millimetre from the slit. The air is first passed through a damping chamber in which it acquires sufficient moisture to produce condensation. The lowering of pressure by which the air is drawn through the jet is sufficient to produce condensation in the air striking the coverglass. As the velocity falls off, the pressure and temperature rise, and the water drops evaporate from the coverglass, leaving the dust deposited. By a careful adjustment of the amount of air drawn through the jet, a record is obtained on which the dust particles can be examined and counted by means of a microscope with $\frac{1}{2}$ inch oil immersion objective.

The results derived by the use of the Owens dust-counter show a wide variation in the number and nature of the particles in the atmosphere. For example, in a dense fog on Jan. 22, 1922, there were 21,750 particles per cubic centimetre. The average diameter of the particles was 0.85 microns, but a large proportion had diameters twice as great as the average. Some white mist results were obtained from a fog on Oct. 26, 1921, but in this case there were numerous small spherical particles of diameters up to 0.85 microns. A slight haze in dry sunny weather yielded 200 to 200 particles per cubic centimetre, of sizes from 0.3 microns up to 1.7 microns. Further, it was found that when the damping chamber of the Owens dust counter was slightly warmed, and a large quantity of air drawn through the jet, the condensed water flowed out sideways in streams, and on evaporation left the soluble matter crystallized in the dried-up stream beds. The crystals could then be examined microscopically and microchemically. The deposit on the coverglass frequently showed needle shaped and rhomboid crystals, sometimes with a tarry deposit. Most of the records

obtained showed a number of transparent spherical particles, occasionally accounting for as much as 50% of the total number of particles counted. When very small these particles appear opaque, but when the diameter exceeds about 0.75 micron they show a bright centre. The spherical particles are insoluble in water, xylol, and cedarwood oil.

Perhaps the most remarkable fact brought out by the observations mentioned above is the remarkable uniformity as to the size of the particles. Shaw and Owens in the book referred to (p. 185) give a comparison between numbers of particles counted by the jet dust counter, and the total impurity present in the atmosphere, showing a remarkably close proportionality. The number of particles counted should therefore give a measure of the degree of obscenity of the atmosphere. These numbers bear no relationship to the numbers of particles obtained in the Aitken dust counter, since the latter may give extremely high values in apparently clear air.

The fact that the particles measured by the Owens dust counter differ from those observed by Aitken is also confirmed by the observations made by Owens while crossing the Atlantic. No dust was to be recognized in any of the records, though some showed numbers of crystals, some of which were not hygroscopic, and were only sparingly soluble in water. Aitken, on the other hand, never found less than about 2,000 particles in one cubic centimetre of air over the Atlantic.

Optical Effects.—The scattering of light by small obstacles was exhaustively studied by the late Lord Rayleigh, who showed that true scattering only takes place when the diameter of the obscuring particles is smaller than the wave length of the incident light. Rayleigh showed also that the coefficient of scattering was inversely proportional to the fourth power of the wave length, so that light in the blue end of the spectrum is scattered more than light in the red end of the spectrum. Thus a cloud of tobacco smoke (consisting of small liquid particles of about 2 microns in diameter) or a smoke haze in the atmosphere will appear blue by scattered light, while the sun appears red when viewed through a thick smoke fog, but white when viewed through a country fog consisting of water drops. Water drops are too large to produce true scattering, their effect being of the nature of diffraction and reflection which is almost equally effective for all wave lengths. Hence water drops appear white, whether viewed by scattered or direct solar radiation.

During the first two or three years after the eruption of Krakatoa a reddish brown corona was often observed around the sun. It had an angular radius of 22° to 23° , and was 10° to 12° wide. Pernter explained this phenomenon, which was known as Bishop's ring, as a result of diffraction of sunlight by small dust particles, and assuming the particles to be spherical he found their diameter to be 1.85 microns. It is of interest to combine this figure with Stokes's formula for the rate of fall of particles. We find their rate of fall should be 0.02 cm/sec or 10 km in a time between one or two years.

Another aspect of the optical effects of dust in the atmosphere upon sunlight relates to the loss of ultra-violet rays which is directly produced by dust and smoke pollution. In the *Times* of Dec. 22, 1924, Professor Leonard Hill gave a comparison of the relative amounts of ultra-violet light at different places in the British isles, showing the lowest values in the centre of London. In view of the importance of ultra violet rays to human health, the results are highly suggestive.

It has been frequently suggested that a smoke fog such as a London fog might be penetrated by the longer infra-red rays. On theoretical grounds we should expect that infra-red rays of wave length large by comparison with the mean diameter of the smoke particles (0.8 micron), should show some degree of penetration. In Wood's *Physical Optics* (3rd Edition p. 416), there is a statement that a film of smoke which was absolutely opaque to light was transparent to infra red rays of wave length 100 microns. This result in itself is not suggestive of any practical solution of penetration, since there still remain the problems of finding not only suitable sources for such radiation but also a means of rendering visible the rays which have penetrated the fog.

The problem is a long way from solution, and no definite observations of the penetration of fogs by infra red rays of different wavelength appear to have been published.

Country fogs composed of drops of water whose diameter is of the order of 10 microns, show no appreciable selective effect in the transmission of light, and there is no obvious reason for supposing that infra red rays would penetrate such fogs.

F Entwistle (*Jour Ry Aer Soc* vol xxxi, p 374, 1928) reproduces two interesting photographs by C J P Cave, of a landscape—the one photograph taken in the usual way without a screen, and the second with a red screen, which cuts out all the blue light. The first shows a light fog, while in the second only slight traces of the fog are visible.

Volcanism.—In *Physics of the Air*, W J Humphreys has discussed in considerable detail the effect of clouds of volcanic dust on solar and terrestrial radiation. He finds that these clouds have an inverse green house effect, in that they would obstruct the inward passage of solar radiation more than the outward passage of terrestrial radiation. For since solar radiation at its point of maximum intensity has a wave length of a little less than half a micron, it would be reflected rather than scattered by the dust particles whose diameter is of the order of 2 microns. Terrestrial radiation, on the other hand, has a wave length of about 12 microns at the point of maximum intensity, and should therefore be scattered by the dust particles in accordance with Rayleigh's law. On this basis Humphreys evaluates the coefficients of attenuation of solar and terrestrial radiation by volcanic dust, and concludes that a shell of volcanic dust is some thirty times more effective in shutting out solar radiation than it is in keeping in terrestrial radiation. Humphreys' computation is admittedly a rough approximation only. It assumes that all the dust is uniformly of the size of the particles which give Bishop's ring by diffraction. This we know to be incorrect. The wonderfully coloured sunsets produced by Krakatoa did indicate a scattering of solar rays by dust particles of a diameter considerably less than 2 microns. Such dust would scatter both direct solar and terrestrial radiation, in proportion to the inverse fourth power of their wavelengths. This would increase the ratio of 30:1 given above.

Humphreys develops in considerable detail the theory that the emission of large quantities of volcanic dust into the atmosphere can produce large variations of climate, of a sufficient magnitude to account for ice ages. It is clearly established that after the eruption of Krakatoa in 1883 there were marked changes in the pyrheliometric measurements of solar radiation (Arcrowski, *Annals New York Acad Sci* 26, 1915, p 149, and Kimball, *Monthly Weather Review*, 46, 1918, p 355). The theory, known as the volcanism theory, has by no means met with general acceptance, though there is some evidence, especially in eastern Australia, of the association of glaciation with volcanic activity, which appears to bear out the theory. In any case, volcanic dust may well have been a deciding factor in starting glaciation when other factors were also favourable. For further details the reader is referred to Humphreys' *Physics of the Air*, and to works on climatology.

BIBLIOGRAPHY.—See works mentioned in text and the following: *The Collected Papers of John Aitken* (Cambridge Univ Press), J S Owens, "Condensation of Water from the Air upon Hygroscopic Nuclei," *Proc Roy Soc A* vol 110, p 738 (D Brv).

DUST STORMS. See DUST

DUTCH AUCTION. A form of auction in which the property for sale is put up at a certain figure, and if not bid for at that price, offered successively at lower prices until a bid is obtained. The starting price is assumed to be higher than the seller hopes to get. (See AUCTIONS AND AUCTIONEERS.)

DUTCH EAST INDIA COMPANY, THE (*Oostindische Vereenigde Maatschappij*), a body founded by a charter from the Netherlands states general on March 20, 1602. It had a double purpose: first to regulate and protect the already considerable trade carried on by the Dutch in the Indian ocean, and then to help in prosecuting the long war of independence against Spain and Portugal. Before the union between Portugal and Spain in 1580-81, the Dutch had been the chief carriers of eastern produce from Lisbon to northern Europe. When they were shut out from the Portuguese trade by the Spanish king they were driven to sail to

the East in order to make good their loss. Unsuccessful attempts were made to find a route to the East by the north of Europe and Asia which would have been free from interference from the Spaniards and Portuguese. It was only when these failed that the Dutch decided to intrude on the already well known route by the Cape of Good Hope, and to fight their way to the Spice islands of the Malay archipelago. A first expedition, commanded by Cornelius Houtman, a merchant long resident at Lisbon, sailed on April 2, 1595. It was provided with an itinerary or book of sailing instructions drawn up by Jan Huyghen van Linschoten,¹ a Dutchman who had visited Goa. The voyage was marked by many disasters and losses, but the survivors, who reached the Texel on their return on Aug 20, 1597, brought back some valuable cargo and a treaty made with the sultan of Bantam in Java.

These results were sufficient to encourage a great outburst of commercial adventure. Companies described as "Van Ferne"—that is, of the distant seas—were formed, and by 1602 from 60 to 70 Dutch vessels had sailed to Hindustan and the Indian archipelago. On those distant seas the traders could neither be controlled nor protected by their native government. They fought among themselves as well as with the natives and the Portuguese, and their competition sent up prices in the eastern markets and brought them down at home. Largely at the suggestion of Jan van Oldenbarnevelt, and in full accordance with the economic principles of the time, the states general decided to combine the existing separate companies into one united Dutch East India Company, which could discharge the functions of a government in those remote seas, prosecute the war with Spain and Portugal, and regulate the trade. A capital estimated variously at a little above and a little under 6,500,000 florins, was raised by national subscription in shares of 3,000 florins. The independence of the states which constituted the United Netherlands was recognized by the creation of local boards at Amsterdam, in Zealand, at Delft and Rotterdam, Hoorn and Enkhuizen. The boards directed the trade of their own districts, and were responsible to one another, but not for one another as towards the public. A general directorate of 60 members was chosen by the local boards. Amsterdam was represented by 20 directors, Zealand by 12, Delft and Rotterdam by 14, and Hoorn and Enkhuizen also by 14. The real governing authority was the "Collegium," or board of control of 17 members, of whom 16 were chosen from the general directorate in proportion to the share which each local branch had contributed to the capital or joint stock. Amsterdam, which subscribed a half, had eight representatives, Zealand, which found a quarter, had four, Delft and Rotterdam, Hoorn and Enkhuizen had two respectively, since each of the pairs had subscribed an eighth. The 17th member was nominated in succession by the other members of the United Netherlands. A committee of ten was established at The Hague to transact the business of the company with the states general. The "collegium" of 17 nominated the governors-general who were appointed after 1608. The charter, which was granted for 21 years, conferred great powers on the company. It was endowed with a monopoly of the trade with the East Indies, was allowed to import free from all custom dues, though required to pay 2% on exports, and charged with a rent to the states. It was authorized to maintain armed forces by sea and land, to erect forts and plant colonies, to make war or peace, to arrange treaties in the name of the stadtholder, and to coin money. It had full administrative, judicial and legislative authority over the whole of the sphere of operations, which extended from the west of the Straits of Magellan westward to the Cape of Good Hope. Its headquarters were early fixed at Batavia in Java. Only the main

¹Linschoten was born at Haarlem in or about 1563. He started his travels at the age of 16 and, after some years in Spain, went with the Portuguese East India fleet to Goa, returning in 1589. In 1594 and 1595 he took part in the Dutch Arctic voyages, and in 1598 settled at Batavia where he died on Feb. 8, 1611. His *Notitie des sijnverreijns* (1595-98) is a compilation based partly on his own experiences, partly on those of other travellers with whom he came in contact. It was translated into English and German in 1598, two Latin versions appeared in 1599 and a French translation in 1610. The English version was reprinted for the Hakluyt Society in 1885. Large selections, with an Introduction are published in C Raymond Beazley's *Voyages and Travels*, vol. 1 (English Garner, 1903).

dates of its progress can be mentioned here. By 1619 it had founded its capital in Batavia in Java on the ruins of the native town of Jacatra. It expelled the Portuguese from Ceylon between 1638 and 1658, and from Malacca in 1641. Its establishment at the Cape of Good Hope, which was its only colony in the strict sense, began in 1652. A treaty with the native princes established its power in Sumatra in 1667. The flourishing age of the company dates from 1605 and lasted till the closing years of the century. When at the summit of its prosperity in 1669 it possessed 150 trading ships, 40 ships of war, 10,000 soldiers, and paid a dividend of 40%. In the last years of the 17th century its fortunes began to decline. Its decadence was the result of a variety of causes. The rigid monopoly it enforced whenever it had the power provoked the anger of rivals. When Pieter Both, the first governor general, was sent out in 1608, his instructions from the board of control were to see that Holland had the entire monopoly of the trade with the East Indies, and that no other nation had any share whatever. The pursuit of this policy led the company into violent hostility with the English, who were also opening a trade with the east. Between 1613 and 1633 the Dutch drove the English from the Spice Islands and the Malay archipelago almost entirely. The English were reduced to a precarious footing at Bantam in Java. One incident of this conflict, the torture and judicial murder of the English factors at Amboyna in 1623, caused bitter hostility in England. The success of the company in the Malay archipelago was counterbalanced by losses elsewhere. It had in all eight governments Amboyna, Banda, Ternate, Macassar, Malacca, Ceylon, Cape of Good Hope and Java. Commissioners were placed in charge of its factories or trading posts in Bengal, on the Coromandel coast, at Surat and at Gambroon (or Bunder Abbas) in the Persian gulf, and in Siam. Its trade was divided into the "grand trade" between Europe and the east, which was conducted in convoys sailing from and returning to Amsterdam, and the "Indies to Indies" or coasting trade between its possessions and native ports.

The rivalry and hostilities of the French and English gradually drove the Dutch from the mainland of Asia and from Ceylon. The company suffered severely in the War of American Independence. But it extended and strengthened its hold on the great islands of the Malay archipelago. The increase of its political and military burdens destroyed its profits. In the early 18th century it was already embarrassed, and was bankrupt when it was dissolved in 1798, though its credit remained unshaken, largely, if its enemies are to be believed, because it concealed the truth and published false accounts. In the later stages of its history its revenue was no longer derived from trade, but from forced contributions levied on its subjects. The immediate causes of its destruction were the conquest of Holland by the French revolutionary armies, the fall of the government of the stadtholder and the establishment of the Batavian republic in 1798.

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DUTCH LANGUAGE. Dutch is spoken in Europe by about 15,000,000 people spread over the kingdom of the Netherlands, the northern half of Belgium and the northern part of the French département of the Nord. Outside the continent of Europe it is spoken in Indonesia by the Dutch who live there, in Dutch Guiana and the Dutch Antilles.

Cape Dutch (Afrikaans), spoken in the Union of South Africa, has developed into an independent language, its resemblance to Dutch, however, is very great for although its grammar has been considerably simplified, its vocabulary has for the greater part remained the same as that of High Dutch.

In the United States of America there are about 250,000 peo-

ple whose mother tongue is Dutch, and in Canada the number is estimated at 125,000. In Ceylon, where Dutch was used in the 18th century as a church and government language, it is almost extinct, only a few Dutch words now remain.

At an early date the language of the Netherlands occupied an independent position among the Low German dialects spoken along the coasts of the North sea and Baltic from Dunkirk to Poland. At first it was chiefly the language of western Flanders (with the world market Bruges), which was dominant, but in the course of the 15th century Brabant came more to the fore. Antwerp at the height of its prosperity was a metropolis of about 100,000 inhabitants. In the course of the 16th century, the centre of Dutch culture moved to the northern Netherlands, especially to Holland. During the Eighty Years' War (1568-1648) the province of Holland formed the centre of the resistance against Spanish rule. The northern provinces rallied round Holland and, when free from the Spanish yoke, rose to great prosperity in the 17th century. The southern provinces remained in Spanish possession and fell into decay. French threatened to supersede the original language. The development of the language in the north was aided by the exodus to Holland of refugees from the provinces occupied by the Spanish. In the language of Holland this southern Dutch influence is distinctly noticeable. In the 16th century the inhabitants of Holland pronounced the words *byten* (to bite), *vijs* (five), *huus* (house), *mus* (mouse), etc., still monophthongal. From the middle of the 16th century the southern Dutch diphthongization spread more and more and has now become general in the educated language of north and south, though the monophthongs still survive in numerous dialects. There still exists considerable difference between the colloquial and the written language of Holland. The more dignified, formal, official terms are originally southern Dutch, whereas colloquial speech has preserved the original linguistic forms. It is also because of this old southern influence that the written language of the north differs comparatively little from that of the south and the authorized version of the Bible, the *Statenbijbel* (executed at Dordrecht 1626-35), was written in a language coloured by certain southern characteristics.

The history of the Netherlands is distinctly reflected in the spread of the Dutch language and its dialects. The original language of the Belgian provinces West Flanders, East Flanders, Antwerp, Brabant and Limburg and of French Flanders is still characterized by a wealth of dialects as in the middle ages. The dialects of all these districts are generally grouped together under the name Flemish. In these Flemish districts the dialect is spoken by preference, although the written language is taught in the schools. By the side of it French has taken a prominent place from the time of the middle ages. In Brussels the language of the greater part of educated people is still chiefly French, although the position of the Flemish speaking intellectuals has become much stronger in the capital as well as all over Flanders. To an important extent the battle against the Frenchification of Flanders has been won. Before the law French and Flemish now have equal legal recognition.

The state of affairs in Holland is less complex. The name "Holland," which originally only referred to the present provinces of North and South Holland, is now also used at home and abroad to designate the whole kingdom of the Netherlands. As a consequence of the expansion of the province of Holland in the 16th and 17th centuries, the language of this province was gradually adopted as the language of daily intercourse by all the provinces grouped round Holland. Provincial dialects are still spoken, a peculiar position being occupied by Frisian in the province of Friesland, which is separated from the Dutch dialects proper by a sharp linguistic boundary line. The other dialects cannot be sharply differentiated. If we move eastward from the centre of culture, Amsterdam, an increasing "eastern" colour can be remarked in the dialects, as they merge imperceptibly into those of the Low German group, where, in the adjoining German districts, numerous Dutch influences are found.

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DUTCH LITERATURE The oldest literary writings to be found in Netherlands or Dutch are the works of Heinrich von Veldeke, who lived near Maastricht in Limburg at the end of the 12th century. He wrote a life of St. Servatius the patron saint of the town, after a Latin original, and an *Enchiridion* (Aeneid) after the French *Roman d'Enéide*. He also wrote love songs which, like his *Enchiridion*, were translated into German and exercised a very considerable influence upon German poetry. But his influence on Middle Dutch literature was less considerable, although it is probable that the mystical poets of the Netherlands, and in particular the poetess Hadewych, borrowed from him.

The Influence of France—The great efflorescence of Dutch literature occurred in the middle of the 13th century in Flanders and Brabant. Most of the works written there were translations from the French. This applies in particular to the romances of chivalry. The French originals of these romances came into existence at different periods, but their translations into Dutch belong more or less to one period. Among others there exist in Middle Dutch fragments of a translation of the *Chanson de Roland*, of a *Willem van Oringen*, a *Renout van Montalboen*, *De Loremeien*, *Aiol*, etc. All these are "Frankish" romances. To this section also belongs *Carel ende Elegast*. It is almost certain that there was a French original of this remarkable work, but so far it has not been discovered.

In the section of Celtic romances there exists one, or rather a double romance by Jacob van Maerlant: the *Historie van den Grail* ("History of the Grail") and *Merlins Boek*. It is a translation, as regards the beginning, a rather abbreviated and free adaptation of the *Joseph d'Armathie* and the *Merlin* of Robert de Borron. These adaptations date from approximately 1261. In 1326 Lodewijk van Velthem added to this the translation of a much more extensive work called *Koning Artur's Boek* after *Le Livre du Roi Artur*. Maerlant also adapted a romance of Torel, while books about the adventures of Lancelot, Perceval and the death of Arthur have also come down to us.

Under the name *Roman van Lancelot* we possess a vast work of compilation in which a number of British stories have been put together, and which also contains the original Dutch romance of *Moriaen*. And there is the *Fergut*, which tells how a peasant lad was turned by love into a perfect knight.

The most important of the eastern romances is the adaptation of *Floris ende Blancefloer* by Diederik van Assenede. It is the story of the love of two children who are brought up together, one a heathen prince, the other the daughter of a Christian count. Another eastern romance is that of *Partenopous en Melior*, which describes the love of a young man for a mysterious beauty who proves to be the daughter of the emperor of Constantinople.

Religious Literature—Religious poetry occupies a prominent place in Middle Dutch literature. There exists among other poems a *Leven ons Heren* ("Life of Our Lord"), compiled from various sources, written between 1260 and 1270. Various lives of saints were also narrated in verse. We have a life of St. Lutgarde by Willem van Aflighem, and fragments of several other lives of saints.

The ecstatic mystical songs of the nun Hadewych, who also wrote visions and letters, are the most important, from the aesthetic point of view, of the 13th century religious poems. The 14th century saw the decay of the romance of chivalry, while, on the other hand, religious literature acquired still greater importance. From that period also date a few lives of saints which, however, have no great literary value. More importance must be ascribed to the poem about Theophilus and to the beautiful legend of *Beatus*, which are poetic versions of *Exemplum* (models or examples) displaying the favours which the Virgin Mary is able

to obtain for those who serve her. The really significant literary literature of the period is the mystic prose, notably that of Jan van Leeuwen the good look of Groenendael and even more important, that of Jan van Ruysbroek prior of the monastery of Groenendael near Brussels (1293-1381). His principal work is *Die Christus den geesteliken brulocht*. In all these works the relations between God and the soul which love Him are described, and the ways in which one can turn to Him.

Maerlant's Significance—There further exists an interesting and original literature of the third estate in the middle age. Jacob van Maerlant is its first and principal representative. We have seen that he also produced romances of chivalry. In addition he wrote religious poetry. He was a Fleming by birth. His special significance lies in the fact that he translated the writing of the new bourgeoisie for useful reading. So he wrote the *Rijmbijbel* which is an adaptation of the *Historia Scolastica* of Petrus Comestor. With this work and with his *Sint Franciscus' Leven* he had entered a new field. Five lyric poems, which were partly translated but also very probably original in parts, belong to this section of his work. He wrote didactic poetry in the same very skilful strophic arrangement. There are two dialogues between Jacob (who represents Maerlant himself) and Martijn, about society and the church about the relations between social classes, love, God, sin and similar subjects. But there are also works on a larger scale and of more scientific content, written to instruct the bourgeoisie. His *Hemelryche der Hemelrycheit* ("Secret of Secrets") is a guide for princes. *Der Natueren Bloem* ("The Flower of Nature") is a moralizing handbook of natural history. These works are adaptations of Latin models. For us Maerlant is principally a source of information about his time rather than an artist. Nevertheless he proved himself a real poet. His original contributions in the sphere of didactic poetry found many imitators during the 14th century, among whom Boendale deserves special notice.

The mediaeval bestiary is represented by *Esopet*, a volume of fables after a Latin original (*Romanulus*). But of much greater importance is *Van den Vos Rinaldo*, one of the masterpieces of Dutch literature. It was a free translation from the French branch of the Reynard romance, *Le Plaid*, by one Aernout, in date about 1250, while a certain Willem (who in the opinion of some literary historians must be considered the sole author of the Reynard), completed this adaptation with a piece about equal in length which described how Reynard succeeded in escaping the gallows by a series of extremely clever though false accusations, made at the court of King Nobl. The whole Dutch Reynard is a beautiful work, full of the most delicate popular humour and psychology.

Mediaeval Drama—Among what remains of the drama of the middle ages there are a number of religious plays and a quantity of very interesting secular plays, from which the religious element, however, is usually not lacking. The *Abel Spelen*, 16, serious secular plays, which have come down to us are *Esmerol*, *Gloriant* and *Lancelot van Denemarken*. Each *Abel Spel* was followed by a farce (*Sotturne*). Six *Sotturmen* are still known dating from the 13th century. They are pleasant pictures of daily life.

The mystery plays date from the 13th century. Seven such plays had been written about the seven joys of the Virgin, one of them being performed in each of seven successive years. There are still extant *Die Erste Byschap van Maria*, and *Die Sevente Byschap van Maria*. There also exists *Tspel van de Vroede ende van de Dwase Maegden*, in which the wise and foolish virgins bear the names of different virtues and sins. This takes us far upon the way to allegory. Other plays, dating probably from a later period in the 13th century, are the two miracle plays *Van den Heylighen Sacramente van der Nieuwaervaert* by Smeken, and *Mariken van Neumegeen*. The second, like the *Rinaldo* and a few of the mystical songs of the nun Hadewych and of Sister Bertke, a hermit of Utrecht, is one of the jewels of mediaeval Dutch literature. The later middle ages were characterized by the production of a considerable number of greatly varied popular songs, many of which are very beautiful.

Chambers of Rhetoric—The 16th century was, in the prov-

ances of the Netherlands, the centre of the *Kluchtjes* is a name which is a popular rendering of rhetoricians or members of the chambers of rhetoric. These chambers were of much more in vogue than they are today. They were societies of laughter which had to practice literature by recitations, the recital of performance, and even by poetic composition. In this domain also the southern Netherlands gave the lead. In the north the oldest chamber, the Bloemcken J. S. of Middelburg, dates from 1450. A highly placed person in the city acted as patron. The real leader of the club was the factor, who often wrote the plays himself and produced them. These chambers really had a great significance in social history. If they diffused notions about poetry and its technique among the masses, they were also instrumental in spreading new ideas of every kind. They did not, however, produce anything of real artistic value.

In 1548 Matthias de Castelein compiled the *Const van Rhetoeriken*. It was an *ars poetica* for rhetoricians and placed the emphasis on the technique of poetry. The importance attached by the chambers of rhetoric to difficult forms and complicated rhyme arrangements gradually increased. Still real sentiment is expressed in three volumes of *Kluchtjes* by the Antwerp schoolmasters, Anna Blyps, who proved her self ever militant servant of the old church in the battle against the dominant Lutheran doctrine. Most of the extant works by rhetoricians are allegorical plays, so called *moralities* or *spelen van spreken*. The morality *Electieve*, written at the end of the 15th century, is unmistakably related to the English *Everyman*. It has not been decisively established which of the two is of earlier date. The medieval time also persisted by the rhetoricians it is usually called *Exbattiment*. There is a collection of 16th century plays which form the archives of the former chamber of rhetoric of Harlem called *Troonmoet blycken*. This collection contains several such *Exbattiments*. The principal poet of this genre is Cornelius Escaerdt of Beugens (1485-1556). To *Exbattiment* as well as to allegory the mind, important and fine contributions.

The Early Renaissance.—The effect of the Renaissance was noticeable. In this connection it is unnecessary to say much about the world famous Desiderius Erasmus of Rotterdam because he wrote exclusively in Latin. A few quite remarkable writers who belonged to the early Renaissance used the national language. The Brabant Jan van der Noot, who admired and translated the work of Pierre de Ronsard, and Carel van Mander, who also wrote an important book on painting (*Het Schilderboeck*). There was also Jan van Hout, secretary to the town of Leyden. These men differ altogether from the rhetoricians who adorned their style with mythological names. They have communed with the pure spirit of the Renaissance through the poets of the French Pléiade. Greater, however, was the effect of the Reformation, a movement which touched and agitated the whole of the population. The political and religious struggle against Spain is reflected in the so called *Gezondheids*, which tried to spur people on to action. Philip van Marinx van St. Aldegonde (1533-98) wrote the *Bun corf der Heilige Roomsche Kerke*, perhaps the bitterest satire ever written against the Catholic Church, which called forth a number of replies. The poet D. V. Coornhert (1522-90) occupied a peculiar neutral position between the warring factions, which duly persecuted him each in its turn. His principal work is the *Zedekunst, dus is Wellevenskunst*.

Meanwhile in Amsterdam the chamber of rhetoric De Eglanter was flourishing as a centre of literary culture. Its motto was "In liefde bloeyende" (i.e., "flourishing in love"). During the latter part of the 16th century and the beginning of the 17th one of the principal members of this chamber was the humanist Hendrik Laurenszoon Spieghel (1549-1611) whose principal work was the *Heitspiegel*, a rather elaborately composed poem, which expounded a doctrine not unlike that of Coornhert. Another important member was Roemer Visser, who wrote familiar and comical little rhymes (*Brabbeling*) and also wrote little mottoes in prose to accompany printed pictures (*Smneppoppen*).

The Golden Century.—The chamber De Eglanter also made great efforts to refine the national language, to polish it and to free it from French bastard words. In 1584 it published a *Twee-*

spreek van de Nederduitsche letterkunst, a Renaissance grammar with an important preface by Coornhert. A factor of the greatest significance in the development of the civilization and culture of the Netherlands was the emigration of Calvinists from the southern Netherlands.

The principal poets and prose writers of the golden century are Jakob Cats (1577-1666), Pieter Corneliszoon Hooft (1581-1647), Gerbrand Adriaanszoon Brederode (1585-1618), Joost van den Vondel (1587-1679), and Constantijn Huygens (1596-1687).

Jakob Cats, born at Brouwershaven, studied at Leyden and at Orléans. He became advocate of the town of Middelburg (1603), made a fortune by reclaiming land from the sea, successively occupied the position of pensionary of Middelburg (1621) and of Dordrecht (1623). From 1636 to 1651 he was pensionary of Holland after which he retired to his country house Zorghvliet near The Hague. His work is worthy but easy to understand, and during the whole of the 17th and 18th centuries it was read by the people and had its place beside the Bible. It is a treasure house of moral precepts and practical worldly wisdom. His principal works are *Hoeweltyck* (1615), *Spiegel van den eudon ende nieuwen Tijd* (1631), *Trouw Rijn* (1637), and *Ouderdom, Buytenleven en Hofgedachten op Zorghvliet* (1655). Cats was only a mediocre poet, but culturally his significance has been immense. He is the representative of the ideas of the Calvinist masses.

Constantijn Huygens was born at The Hague. In 1616 and 1617 he studied law at Leyden and travelled several times as secretary of embassy (he made three journeys to England). In 1625 he became secretary to the stadholder Frederick Henry, afterwards to Prince William II and finally to Prince William III. He considered his professional work to be the principal part of his existence and his poems were "flowers in his cornfield." He had little fantasy and in his work mainly depicted himself and his surroundings. His principal works in Dutch—for he also wrote in Latin—are *Voorkout* (1621), a description of the well known promenade at The Hague, *'t Costelick Mal* (1622), a satire on eccentric fashions, *Dagwerck* (1639), a description of the manner in which he spends his day, *Oogenroost*, a poem in which he tried to console his blind friend Lucretia van Trello by explaining how nearly all people go through life blinded by their passions, *Hofwijck* (1653), a description of his little country home, *Zeebucht* (1666), which describes the road made after his plan between The Hague and Scheveningen. There is also a play called *Tijntje Cornelis* and an autobiography of his later years, *Chrysworch* (1680) which was only published in the 19th century.

The Influence of Amsterdam.—We now pass to Amsterdam. There at the beginning of the 17th century, two chambers of rhetoric were flourishing, De Eglanter, already mentioned, and 't Wit Lyveland, which was the Brabant chamber where refugees from the southern Netherlands came together. Differences of opinion made themselves felt in the Eglanter. Many of the best members in whose view the practice of rhetoric did not mainly consist in pleasant gatherings, seceded in 1617. Among their number were Hooft and Brederode. Under the direction of Samuel Coster, a medical man who also wrote, they founded the *Duytsche Academie* which aimed at giving instruction, after some time, however, the activities of the new chamber were limited to the production of plays. In 1635 the old Eglanter and 't Wit Lyveland (united since 1623) amalgamated with the seceders and the result was the foundation of the *Amsterdamsche Schouwburg* (Amsterdam theatre) in 1637.

One of the more talented writers in this circle was G. A. Brederode, who was in exception among the great authors of his day in that he had received no classical education. His voluminous lyrical poetry has been collected in his *Boertigh, Amouren en Aendachtigh Groot Luchboeck*. The first part of the book contains comical poems, little sketches of popular life, representing in the sphere of literature those things which in painting characterized the work of Jan Steen, Brouwer and Ostade. The amorous poems of the volume are in the vein fashionable at the time. As a dramatic author Brederode wrote in the first place romantic plays, the subject matter of which came from Spanish romances of chivalry. The comical interludes in these plays, full of popular realism, showed

a talent for comedy which reached its full height in his farces *Klucht van de Koe* (1611-), *Klucht van Symen sonda Soetcheit* (1612-13) *Klucht van den Molenaar* (1613), and also in his two comedies, *Het Mooltje* (1612) and *De Spaansche Brabander* (1617). The first was based on the *Eunuch* of Terence, the second was after *Lazarillo de Tormes*. The local colour in both plays was entirely derived from Amsterdam.

Another lyric poet and playwright whose gifts were more modest, but who was decidedly related to Bredero, was the adventurous wanderer Jan Starter (1594-1628), born in England, who was a member of the Eglantier at the same time as Biedero. He founded a chamber of rhetoric at Leeuwarden, later went to Germany where he became the historian of the count of Hansfelt. His poetry has been collected in the volume *De Friesche Lusthof* (1621).

Pieter Hooft is the most typical representative of the Renaissance in the literature of the Netherlands. His art is personal and refined. He came from an Amsterdam merchant family, was destined for commerce and was sent on a commercial journey to Italy (1598-1601). The love poems which he wrote after his return and the pastoral play *Granda* (1605) show the influence of the Italian Renaissance. In 1606 he was allowed to study law at Leyden. When his studies were finished he was appointed *drost* of Muiden. In this position he lived in the famous Muiderslot or castle of Muiden. Inspired by the place in which he was living and also strongly influenced by the tragedies of Seneca, he wrote in 1612 *Gaerard van Velsen* and in 1623 *Baeto*. In both plays he has expressed his political ideas in a very anachronistic manner. He also adapted Plautus' *Aulularia* into a comedy of Amsterdam called *Ware nar* (1616). Particularly after 1627 his home became the centre of artistic and intellectual life, formed by the Mudekring (circle of Muiden). During the last 20 years of his life, he devoted himself almost exclusively to historical prose. In 1626 he wrote *Henrick de Grote*, in 1628-47, *Nederlandsche Historien*, which he left unfinished. The artistic prose of these writings, strongly influenced by Latin, exercised a great influence on the literary prose style of the 17th century.

The Genius of Vondel.—Joost van den Vondel is the greatest poet of the golden century in Holland. He was born in Cologne of parents who came from Antwerp, whence they had fled as Anabaptist refugees. When Joost was still very young his parents migrated to Amsterdam. There he had a hosiery shop in the Warmoesstraat, but his wife Maaken de Wolf managed the business and allowed her husband to give all his time to study and art. He was a real product of the Renaissance, full of veneration for the ancients whom he tried to imitate, particularly in his tragedies.

Vondel's work is voluminous. There are in the first place the satirical poems occasioned by the religious and political struggles between Arminians and Gomarists. His tragedy *Palamedes* (1625) represents the struggle between Prince Maurice and Oldenbarnevelt in an allegorical form and belongs to his satirical work. There are further *Roskam*, which criticizes the abuses of the government of the regents, and *Harpoen*, which compares the good and the bad minister. We may mention, among his songs celebrating the national greatness of the Dutch republic, the glory of the house of Orange and of Amsterdam, *Lof der Zeevoert* (1622), *Gebortskloek van Willem van Nassau* (1625), *Invijding van het Stadhuys* (1655). Of great beauty are the intimate lyrical songs of moving simplicity which Vondel wrote after the death of close members of his family. After he had become a Catholic he wrote three long poems in defense of his faith: *Altaergehemissen* (1645), *Bespiegelingen van Godt en Godsdiens* (1662), *Heerlyckheit der kerke* (1663). But the principal work of Vondel consisted of 24 original dramas. The first was *Pascha of de Uyttocht der Kinderen Israels uit Egypte*. Among his other dramas are *Gysbreght van Aemstel* (1637), *Maegden* (1639), a dramatic version of an episode of the life of St. Ursula, *Joseph in Dothan* (1640), *Maria Stuart* (1646), *De Leenwonderers* (1648), a play written on the occasion of the peace of Munster. His masterpiece was *Lucifer* (1654), describing the revolt of the angels against God. *Jephtha* (1659) and *Adam in Ballingschap* (1664) are other plays of his.

Three religious poets from the great period of the 17th century deserve separate notice. The first is Johannes Stalpert van der Wiel, parish priest at Delft (1579-1630), whose life of St. Agnes and *Geestelyke Lofsangen*, imbued with a true mediaeval spirit, are his best known works. Jacobus Reesens or Revius (1536-1658), was a Protestant minister of Deventer (*Overyselsche Sangen en Dichten*, 1630) and D. R. Camphuyzen (1580-1627) wrote *Stichtelyke Rymen*.

The Late 17th Century.—Later in the 17th century comes Jan Vos whose rhetorical pieces *Arian en Titus* (1641) and *Medea* (1666) were produced with elaborate stage machinery which made quite a sensation. Gerard Brandt (1626-85) was a prose author who wrote *Historie der Reformatie*, *Leven van Adr. de Ruyter*, *Leven van P. C. Hooft*, *Leven van Vondel*. Heijn Dullaet (1636-84) was a painter, pupil of Rembrandt, who wrote a few poems full of true sentiment which were among the best of his time.

The last generation of the 17th century is represented by the following writers. J. A. van der Goes (1647-84) was an imitator of Vondel. His principal work was *De Ystroom*. His language has something of the ease and grace of Vondel's but rather lacks simplicity. Jan Luiken (1640-171-), a world famous etcher and engraver, ranks as a poet near to Hooft and Vondel. The work of his youth was *De Dinst Lie*, a volume of love and nature poems. When he was 26 he became converted to a mystic and ascetic conception of life. Henceforth he only wrote pious verses, of which the best is the first, *Jesus en de Ziel*. Thomas Asselyen and Pieter Bernagie wrote comedies. The first is known mainly for his play *Jan Klaess of de gewoende Dienstmaegd*, in which he makes fun of the Quakers.

The decadence which had already set in by the end of the 17th century became accentuated in the 18th. The so called *Pruken-tijd* or "period of wigs" was a time of great wealth, when people were seized with a mania for collecting and the art of poetry was practised in an amateurish way. Written in a form that was bound by the strictest rules, it was nothing but servile imitation of French models. The best known among the societies where that kind of poetry was practised, the *Nil Volentibus Arduum*, was established at Amsterdam in 1669. One of its leading members was Andries Pels, who published in 1677 an *ars poetica*.

Early 18th Century Prose.—The three principal authors of the first half of the 18th century are Pieter Langendijk (1683-1756), known to our own day as an author of comedies which are still performed, the moralist Justus van Effen (1684-1735) and the peasant poet Hubert Poet.

The principal works of Langendijk were *Het Wederzijds Huwelijks Bedrog* (1712-14), *Krehs Louwen of Alexander de Groote op het Poetement* (1715) and *De Wiskunstenaars of 't Geruchte Juffertje* (1715). He is an imitator of Molière, and in the polish of his smooth alexandrines shows himself a real man of the 18th century. Justus van Effen was mainly the author of moralizing works, some of which were written in French. He followed the example of the English reviews, *The Tatler* and *The Spectator*, and applied their methods also when later in life (1731-35) he published *De Hollandsche Spectator*. Between 1741 and 1800 at least 30 weekly papers of the same kind appeared. The best known are *De Denker* and *De Gysjaard*. These *Spectatoriale vertoogen* had a great influence on the Dutch *Verlichting*.

Some further typical representatives of the period are Hoogvliet, author of *Abraham de Aartsnyder*, Sybrand Feitama, translator of the *Télémaque* of Fénelon and of the *Henriade* of Voltaire, Balthazar Huydecoper, a philologist and author of tragedies in the style of the French classics. The two Friesian noblemen, Willem and Onno Zwer van Haren, have a certain imaginative originality and are remarkable for the choice of national subjects for their poetry.

English Influence on the Novel.—In the last quarter of the 18th century started the movement of *Verlichting*. Classicism, which had gradually become a rigid and soulless form, was the special butt of the critics. The "enlightened" Elizabeth (Wolff) Bekker (1738-1804) and her friend Agatha Deken (1741-1804), who started by being more piously inclined, joined forces after

they had for some time been publishing independently. Their collaboration produced some novels in letter form. Of these the first is a *Sara Buerckhart* (1783) and *William Tenold* (1783-35) are the most important. In construction and in form they belong entirely to the school of Richardson. They are remarkable for their ease of style and quality of expression.

Rhijn is both (1783-85) is in an entirely different type, a sentimentalist strongly influenced by Young. D. Arnold Klogstock and especially Goethe's *Werther*. He wrote a few sentimental novels, *India* (1783) and *Edmond en Constant* (1786). Later in life he wrote didactic poems (*De Ouderdom*, 1803), and many songs which are still useful as church hymns. He also had a certain significance as a writer on aesthetics, but in that sphere he was less important than Hieronymus van Alphen (1746-1803), who translated Riechel's *Theory of Fine Arts* and provided it with an important introduction. He is now better known as the author of children's poems. Another poet of a very patriotic class Jacobus Bellamy (1757-86). His style was rather bombastic.

Bilderdijk—Willem Bilderdijk (1776-1831) is a great figure who exercised considerable influence upon the spiritual life of Holland. He was an Organist in opposition of the poets of the Patriots. In 1795 he refused to take the oath of allegiance to the government of the Batavian republic which had been established by the French and received the unwelcome severe penalty of exile. He remained about Hamburg and London where he fell in love with Katharina Wilhelmina Schwelckhardt, who later became his second wife. When Louis Napoleon became king of Holland Bilderdijk was recalled to Holland and treated with much consideration. After the restoration King Willem I gave him a pension. He was not appointed a professor at Leiden as he had hoped to be but established himself in that town as a private tutor (1811-17) and had a number of very able students who attended his courses in national history, venerated him as a prophet and adopted a considerable part of his political and religious views. The movement which aimed at propagating these religious ideas was called the *Revol*.

Bilderdijk wrote ballads and longer narrative poems such as *Thuis en Verre en's adentem*. The epic *De Oorlog van de Eerste Wereld* (1820), which he left unfinished, contains beautiful passages. The immense bulk of his lyric poetry contains some equestrian poems especially among his love songs and others full of very deeply felt religious emotion such as *Gebied* (1796) and *Boetsang* (1826). Among the longer poems the *Ode Van Napoleon* (1806) and *Ipschedi* (1810) are celebrated. His *Geschiedenis des Vaderlands* contains part of an autobiography.

Johannes Kinker (1764-1843) was also a critic, a philosopher and a philologist. He criticized the insignificance of his conventional and sentimental contemporaries. Among the numerous but insignificant writers of the French period mention may be made of Adriaan Toosjes, whose *Maurits Luycklager* is a forerunner of the historical novel and Jan Frederik Helmers (1767-1813) who published his bombastic but deeply patriotic poem *De Hollandse Nieuw* in 1812 during the French domination.

The 19th Century—The first part of the 19th century was less distinguished even than the revolutionary period. It was a time of rhetorical self-complacency. The orator Henricus van der Palm (1793-1841), whose *Geschied en Redekunstig Gedenk-schrift van Nederlands Herstelling* (1816) is the best-known work re-established formalism after the laxity of the revolutionary period. The typical representative in Holland of familiar frivole poetry was Hendrik Tollens (1790-1856). During that period we may notice Bilderdijk's ardent admirer and disciple Isaak da Costa (1798-1866). Da Costa's main work, directed against Liberalism, was *Bezuken tegen den Geest der Leu* (1823). Da Costa's poetic works the best known are his *Tijdsongen*, which Da Costa himself called his political poetry. His biblical poem *Heuer* (1847) had a symbolical meaning. Islam will one day bend the knee before Christ. In 1837 he wrote a historical poem *De Slag bij Nieuwpoort*.

Antonie Christiaan Wijnand Staring (1767-1840), an excellent poet who stood almost entirely by himself, was a gentleman farmer of Gelderland. Apart from many fine poems and some epigrams

(*Smeldichten*) he wrote a few fine stories in verse *De Twee Bulten*, the cycle of *Joramir Marco De Hoofdig Boer*, *De Leelinge van Paulus* (1812) and *De Verjongingslaar*.

Jacob Giel (1789-1863), excellent prose writer, became librarian of Leiden university in 1822 and afterward a professor. His main work consists of a series of treatises and essays, of which the eight principal ones have been brought together in one volume, *Onderzoek in Phantasie*. One of them, *Gezicht op den Draken* (1855) attempts a just appreciation of romanticism, which had made its way into Holland about that period. Jacob van Lennep (1802-68) and Jan Frederik Oltmans (1806-54) were gifted followers of Scott but their subject matter was national. Van Lennep wrote poetic stories, a few plays but mainly historical novels and short stories which gave him considerable popularity. He started with medieval stories *De Pleezoo*, *De Roos van Delam*, *Oude Tonderdeis*. His later novels *Ferdinand Huyck* and *Lizabeth March*, written under the influence of *De Gids* (about which more presently) describe the period of the Dutch republic. Van Lennep is easy and entertaining but superficial. Under the influence of French naturalism, he also wrote a contemporary novel called *Klaasje Zilverster*. Under the pseudonym J. van den Hage Oltmans wrote two novels *Het Slot Loerestein* and *De Schapevinder*.

Another important figure in the Romantic movement is Anna Louis Gertruida Bosboom Toussaint (1812-86), who, like Nikolaas Beets, began to write under the influence of the English romantics (*Imago*, *De Graaf van Devonshire*). The criticism of *De Gids* made her choose national subjects. She wrote in praise of the heroes of Protestantism during the 80 years' war against Spain. Her best known works are *Het Huis Laarnesse* (1840), the cycle about Leekwater in ten volumes (1846-55) and *De Delftsche Oorlogsdokter*. Like Van Lennep she deserted the historical novel during her later period and wrote a novel in the form of a diary entitled *Major Frans* (1875).

National Consciousness—Typical of the romantic movement in Holland was the periodical *De Gids*. The critic and author Aernout Drost, who died young, started a review in 1834, called *De Mensen*, which had only a short existence. Everhardus Johannes Potgieter followed him in 1837 with *De Gids*, in which he tried to strengthen the national consciousness of his compatriots. He was haunted by the ideal of national strength, represented by the grandeur of the 17th century. From 1837 to 1865 he directed *De Gids*, contributing to it a number of important criticisms and many sketches, the most characteristic of which is *Jan, Jannetje, en hem jongste Kind* (1842), where he contrasts the past and present of Holland. In *Het Rijksmuseum* (1844) he extolled the Holland of the 17th century. Potgieter's style is difficult and full of learned allusions. Especially important are his later long stories (*Onderweg in de Regen*) and the imaginative poetry of his mature years (*Gedroomd Paardrijden in de Nalaten-schap van den Landjonker*, 1875). Before he died Potgieter had come to despair of the success of his enterprise, and among the younger men he could discover no one whom he judged able to take over his task. The learned historian (later archivist) Reinier Bakhuizen van den Brink (1810-65), mainly known through his studies of the 17th century, published in *De Gids*, was a kindred spirit.

In the Dutch literature of that period a very peculiar place is occupied by Nikolaas Beets (1814-1903). During his student days he was an enthusiastic admirer of the English and French romantics. Under the influence more particularly of Byron, he wrote four stories in verse. But he owes his fame entirely to *Camera Obscura* a book which has become a classic. It consists of a number of sketches which give a delicately humorous picture of the middle class society of his day. Beets also wrote many poems, most of which are in the manner of Tollens.

Peter Hasebroeck (1812-96) was, like Beets, a Protestant minister. His volume *Waardad en Droomen*, published under the pseudonym of Jonathan, somewhat resembles the *Camera Obscura*. A similar resemblance appears in the sketches of student life by Johannes Kneppelhout, who wrote under the pseudonym Khepsaan (1814-83).

There is also a Catholic romantic, Josephus Albertus Alberdingk Thijm (1820-89). Like Potgieter he loved the Amsterdam of the 17th century, but his description of that period is mainly restricted to Catholic circles. The modernist Protestant minister Petrus Augustus de Genestet (1829-61) was a popular poet and also wrote a series of *Leekedichtjes* (lay poems) about the religious struggle between the orthodox and the modernists.

(J. WAL, X)

Carel Vosmaer (1826-88) who edited *De Nederlandsche Spectator* and translated Homer should be mentioned as a critic who appreciated the real importance of the writers who heralded the renaissance of Dutch literature at the end of the 19th century.

Conrad Busken Huet (1826-86), of French descent, was especially important as a witty and sharp critic. In his influential critical work, collected in 25 volumes, *Literaire Fantasmen en Kritieken* (1868 and following years), he adopted the critical method of C. A. Sainte Beuve. After working in the Netherlands East Indies as a journalist he spent the last part of his life in Paris. Important as well is his history of the Dutch 17th century cultural life, *Het Land van Rembrandt* (1882-84).

Edward Douwes Dekker (1820-87), who because of his great gifts as a prose writer and his easy natural style was a forerunner of the revolutionary literary movement of 1880, wrote under the pseudonym of Multatuli his *Max Havelaar* (1860), a glowing and moving protest against the treatment of the Javanese by the Dutch authorities. Douwes Dekker had been an official in the Netherlands Indies. The book created an immense sensation and contributed greatly to the later improvement of conditions in the Dutch colonial possessions.

In 1861 Multatuli published a remarkable collection of intimate essays in the form of letters, *Minnebrieven*, followed between 1862 and 1877 by seven volumes of *Ideeen*, brilliant polemical notes about the fossilized aspects of the Dutch 19th century life, which contain his beautiful unfinished novel *Wouter's Pieterse*. Multatuli is the undoubted genius of Dutch 19th century letters but because of the fearless nature of his writings and his irregular private life he remained a controversial figure who with equally great heat of passion is censured in some quarters and venerated in others.

In the Flemish part of Belgium, where in the course of the several successive foreign dominations popular education had been stagnant, a new movement arose after 1830, the Flemish movement, of which the novelist Hendrik Conscience (1812-83), who taught the Flemish people once more to read and use their own language, was for some time the best-known literary representative. Conscience celebrated the grandeur of the past of Flanders. His best known novels are *De Leeuw van Vlaanderen*, *Jacob van Artois*, *De Loteling*. Among the poets of the movement the foremost is Guido Gezelle (1830-99), whose poetry in which he glorified God and nature is of the greatest importance because of his unorthodox, free and inspired use of the language. His most beautiful poetry is found in *Tyckdrans* (1893) and *Rijmsnoer* (1897).

Renaissance of the 1880s—In the northern Netherlands an important renaissance of literature took place about 1885. It is usually considered to have started in Oct. 1885 with the publication of the first number of the review *De Nieuwe Gids*. The forerunners of this movement were Dekker, the novelist and poet Marcellus Emants and the delicate lyric poet Jacques Perk (1859-81). The *Nieuwe Gids* differed from *De Gids* in that it pursued an exclusively aesthetic ideal. The leaders of the movement were the poets Willem Kloos (1859-1938), Albert Verwey (1865-1937) and Lodewijk van Deyssel, the pseudonym of Karel Alberdingk Thijm (1864-1952). Kloos sang the beauty that pleases the senses. Verwey passed from impressionist to symbolical verse. He also did good work in literary history (among other works he wrote a book about Potgieter). Van Deyssel was the violent and lyrical critic of the movement. Frederik van Eeden (1860-1932), dramatist, poet and prose writer, occupied a special place. His best work in prose is *De Kleine Johannes*, the story of the soul of a child. His *Van de Koele Meren des Doods* is an important pathological novel. Van Eeden also took part in an experiment at

communitistic life which proved a failure. His plays are largely the expression of his social feelings and opinions. The poetess Hildebrandt-Schout (1859-1942) stood very near to the movement with her lyrical works written in particularly delicate language full of resonance. Herman Gorter (1864-1927) acquired a foremost position in Dutch poetry by his poem *Mis*. Jan Hendrik Leopold (1865-1945), poet of a tragic individualism, produced work of great sensitivity. Peter Cornelius Boutens (1870-1943) gradually obtained a mastery of his poetic form and expressed himself in strongly rhythmic verse, sometimes of an unhealthily beauty.

Among the men of the 1880s (*De Tachtigers*) we must also place Jacobus van Looy (1855-1930), a writer of beautiful prose (*Proza Gekken Feesten*, *Jaapje*, *Jaap*, the last two of which are autobiographical). The great novelist Louis Couperus (1865-1923) described the life of the 17th century (*Rijne Vere*, *De Boeken der Kleine Zinnen*) and made splendid imaginative reconstructions of antiquity (*De Berg van Lucht*, *Antiek Toerisme*, *Utrabek*, *De Komediante, Iskander*). The movement of the 1880s was mainly individualistic. Immediately afterward came a group of authors whose feelings were more social. The dramatist and writer of sketches, Herman Heyermans (1864-1924), wrote social dramas which are among the greater triumphs of the Dutch stage (*Gertie*, *Het Zevende Gebod*, *Op Hoof van Zon*, *Ord et labora*, *Alvares*, *De Opgeandene Zon*, *Scharrel*, etc.). The novelist Israel Querido (1872-1931) was a typical Dutch naturalist (*Levensgang*, *Menschen* and the cycle *De Jordaan* in four volumes). In addition we mention the novelists Crel and Marjo Scharren-Antink (*Een Huis vol Menschen*, *De Vriende Heerschers*, *De Geluk Hangt aan een Draventrek*) and some women novelists: Augustine (Orpheus in de Druis), Ina Boudier Bakker, Top Naef and Carry van Brugeen.

20th Century Writers—After the intoxication of the soul and the senses in the revival of the 1880s most of the writers of the early 20th century had turned away from this pronounced individualism in a socialistic or ethical direction. The language became sober once more. In pace, reasonableness and wisdom were stressed more than beauty and colour. This sentiment found expression in Albert Verwey's magazine *De Beweging* (1905-19). Another important reaction to the 1880s was that of the idealistic pietist socialists like Herman Gorter and the powerful lyrical poet Henriette Roland Holst (1869-1952).

Some of the most significant contemporary poets are Adrian Roland Holst (1888-), who is withdrawn like W. B. Yeats in his own mythological world, J. C. Bloem (1887-), who writes a poetry of longing and disillusion, P. N. van Eyck (1887-1954), poet and essayist, Martinus Nijhoff (1894-1953), whose work seems to catch the crystal clear morning light of a Dutch interior by Vermeer, Victor Emmanuel van Vriesland (1892-), erudite essayist and poet steeped in the French symbolist tradition. The principal prose writer of the period of neoromanticism is Arthur van Schelven (1894-1946), who has most mature writing created the same scenic and especially moral world found in Rembrandt's paintings. Aart van der Leeuw (1895-1931) was a subtle poet and prose writer of an idyllic romanticism. Anthonie Donker (1902-) writes a reflective verse of a melancholic nature.

World War I produced three great poets, Jan Slauerhoff (1898-1936), Hendrik de Vries (1896-) and especially Hendrik Marsman (1899-1940) who, under the influence of German impressionism, attempted to break with all tradition. Jan Greshoff (1888-), poet and essayist, has his proper place among the younger generation group around the literary magazine *Forum*, established in 1932 by Menno ter Braak (1902-1940)—a brilliant cultural philosopher and independent thinker, and Eduard de Ponn (1900-40), eminent polemical essayist and novelist of great force, leaders of a movement of writers who wanted in literature less surface, fewer beautiful words and greater sincerity.

Between World Wars I and II, a period of anxiety and mental stress, the influence of Sigmund Freud became strongly marked in irrational poets such as Gerrit Achterberg (1905-) and Eduard Hoornik (1910-) but was most clearly noticeable in the prose, poetry and essays of the most important and prolific contemporary Dutch writer, Simon Vestdijck (1905-), who, as a subtle psychologist like Thomas Mann, owes a great deal to a clever manipulation of Freud's anthropological theories and to the projection of the various states of consciousness in the manner of James Joyce. The main theme of the novels and short stories of Frans Bordewijk (1884-) is the search for an equilibrium between chaotic fear and severe discipline. After the wartime period of occupation, which influenced Dutch literature deeply, and the liberation of 1945 new groups of writers, either in an experimental or existentialist vein, came into being.

Contemporary Flanders has occupied an important place in modern Dutch literature since the foundation of the literary magazine *Van Nu en Straks* at the end of the 19th century, which introduced a similar literary revival as in the Netherlands proper. Among the foremost writers are the novelists Stijn Streuvels (1871-) and Cyriel Buysse (1859-1932), the classicist and imaginative poet Karel van de Woestijne (1878-1929), Herman Terlinck (1879-), novelist and dramatist, who produced his major novel *Het gevecht met de Engel* at the age of 71, Jan van Nijlen (1884-), a poet of the wisdom of the heart, Maxime Gysen (1887-), a highly accomplished moralistic prose writer, Raymond Brulez (a delightful novelist with a philosophical turn of mind, Willem Elsschot

(1882—) satirized mercilessly the huckstering methods in advertising in his novel *Tippen* (197) Gerard Wilshup (1898—) is a masterly psychological observer of the pathological aspects of Finnish rural life. Maurice Rodmans (1895—) introduced into Finnish letters the psychological novel of Gullible eluist.

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DUTCHMAN'S BREECHES (*Dicentra Cucullaria*), 1

North American plant of the fumitory family (Lamiales), known also by various local names, as butterfly lanner, boys and girls ear drops and soldier's cap native to woods from Nova Scotia to South Dakota and southward to North Carolina and Kansas. It is a smooth, delicate plant, rising from a granulated bulb, with the slender stalked, finely dissected leaves appearing to spring from the surface of the ground. In shape the irregular flowers, about $\frac{1}{2}$ in broad, resemble a pair of baggy trousers, whence the popular name. The flowers are white or pinkish, tipped with yellow, and hang tremulously from a slender stalk, 5 in. to 10 in. long. This plant, which blossoms abundantly in early spring is one of the most dainty of North American wild flowers. (See *DICENTRA*)



BY COURTESY OF THE WILD FLOWER PRESERVATION SOCIETY

DUTCHMAN'S BREECHES: AN EARLY SPRING FLOWER IN NORTHERN AND EASTERN UNITED STATES

DUTCH METAL A variety of brass, in which the proportion of zinc is high, giving the alloy a yellow colour, simulating gold. The proportions of copper and zinc in Dutch metal range from 88 to 85 to 15, the colour becoming paler with the higher zinc content. Dutch metal is used in bronzes, and in the preparation of imitation gold leaf, its great ductility lending itself to the purpose. Gilding with Dutch metal costs less than one third the price of real gilding, but the work rapidly tarnishes unless coated with a lacquer. (See *BRASS*)

DUTCH OVEN This utensil is in general use in American colonial days for baking before the open fire, which was the only means of cooking except the brick oven (*qv*). It was round, square or oblong, with the front open. The round variety was often fitted with a spit, turned by a handle on the outside, for roasting meat. Otherwise, the oven was used for baking only. The open side was set close to the fire, to receive the full heat of flames or coals. Usually of tin, it was often called "tin kitchen" or "Dutch kitchen." The bake kettle—a covered receptacle on high legs to set over the fire—was sometimes called a Dutch oven.

DUTCH WARS, a general title for the three naval wars fought between England and the United Provinces (1652–74), but also for the almost continuous series of land campaigns fought by the Dutch against Louis XIV. (1667–78)

NAVAL OPERATIONS

First Dutch War (1652–54)—The immediate causes of the war were the continuous diplomatic rebuffs given by the Dutch to the English Commonwealth government. The real and underlying cause, however, was the commercial rivalry of the two nations, especially in the North Sea and Spitzbergen fisheries and in the East Indian trade while in addition the English disputed the Dutch claim to make their neutral flag cover goods consigned to France with whom England was already unofficially at war. (See *HOLLAND* *History* *ENGLISH HISTORY* *SHIPPING*,

HISTORY of, NAVIGATION LAWS, etc.)

Despite the great maritime strength of the Dutch, which had developed unchecked for nearly fifty years, England began the war with three overwhelming advantages. Geographically, she dominated the Dutch trade route passing through the Straits of Dover, her navy was directed by a single and united body, the Council of State, whereas the Dutch relied on the sporadic co-operation of five different provincial admirals; finally, the Commonwealth government was prepared to lavish huge capital sums on the war, seized from the Royalists, while the Dutch were compelled to finance the war from an income largely derived from their threatened carrying trade and fisheries.

In the spring of 1652 Admiral Martin Tromp (*qv*) took a strong Dutch fleet into the Channel to protect the returning trade. The Dutch country was anxious to appear as the aggressor, but a collision occurred with Admiral Robert Blake's squadron on May 19 off Dover on Blake making the claim to the salute, some Dutch ships having been attacked further down the Channel for the same cause. Admiral Broune came up later with a squadron from the Downs to assist Blake, and Tromp was eventually driven over to the French coast with the loss of two ships.

Blake was now ordered north to destroy the Dutch herring fisheries, which he succeeded in doing, also it possible to intercept the Dutch East India men, said to be returning by the north of Scotland, and to hurry their Baltic trade. Meanwhile Tromp and later on de Ruyter (*qv*) had matters their own way in the Channel against Sir George Ayscough who had only 14 ships, the remainder being with Blake. As soon as the Dutch understood this, Tromp was ordered north to engage Blake. He sighted his adversary, but a storm scattered his fleet off the Shetlands, and in returning home he was superseded by Cornelius de Witt (*qv*) as a result of the outcry caused by the loss of the herring. In September de Witt concentrated his force, as did Blake, each having over 60 sail, and an action was fought on Sept. 28, when the English admiral cleverly neutralized de Witt's attempt to exploit the leeward side of the Kentish Knock as a defended anchorage. The Dutch were severely handled, while many of their captains refused action towards the close, being jealous of de Witt on personal and political grounds.

Tromp was now reinstated in command by the States General with over 80 ships, and ordered to force the outgoing convoy through the Channel, but the English Council of State, thinking that the season for active operations was passed, reduced the fleet considerably, and when Tromp appeared off the Goodwins on Nov. 29 Blake had only 40 ships ready in the Downs, many of them being only hired merchantmen. However, he determined to attack, and on Nov. 30 both fleets were clear of the Goodwins on parallel courses. Off Dungeness a general action was fought in the late winter afternoon, in which Tromp was successful, his convoy passing down mid channel without loss.

An immediate naval reorganization followed this set-back. The Council of State ordered several captains to be tried for unsatisfactory conduct and issued articles of war by which all captains of merchant ships engaged on government service were in future to be entirely under government discipline. The seamen's pay was increased, the victualling improved, and the command was strengthened by the addition of the generals George Monk (*qv*) and Richard Deane for service at sea.

Early in Feb. 1653 Blake took his fleet of about 70 sail down channel to intercept Tromp, who was known to be attempting to conduct the home-bound Dutch convoy of merchantmen through the Channel. Thick fog made reconnaissance difficult, and the English fleet was somewhat scattered when Tromp suddenly appeared off Portland on Feb. 18 with about 80 sail, the wind being from the west. Blake's squadron having become separated had to withstand the whole of the Dutch fleet alone for some hours, till at last help arrived, when Tromp drew off to rejoin his convoy which had meanwhile slipped by unmolested. Next day, Blake pressed the Dutch vigorously and a running fight took place past the Isle of Wight, Tromp forming his fleet in a crescent to protect his convoy which sailed ahead. On Feb. 20, both fleets were off Beachy Head, and Blake again attacked, the English frigates

pressed through to the convoy, which became seriously disorganized, so that night alone saved them from disaster. It seemed impossible for the Dutch to round Cape Gris Nez, but Tromp managed to get the remainder of his fleet and convoy clear away before next morning, after a total loss of 17 men of war and over 50 merchantmen.

Both countries were now feeling the strain of the war, and for some time administrative and financial difficulties incapacitated their fleets, though Tromp was active in protecting convoys coming round the north of Scotland. Blake had been wounded off Portland, and upon Deane and Monk at last getting to sea in force, Tromp at once sought action, and on June 2 and 3 there was heavy fighting, beginning off the Gabbard and ending near the Dutch coast. For the first time the English fleet showed a decided superiority, recent fighting instructions having strictly enjoined them to maintain a line ahead formation and so develop their broadside fire to the utmost. Deane was killed, but Blake joined in with reinforcements on the second day and the Dutch fleet was routed, losing over 20 ships. Blake and Monk at once blockaded the Dutch coast, without returning to harbour. This imposed a great strain on the English resources, but it was amply justified by the disorganization of Dutch trade which quickly followed. Tromp with the main fleet being confined to the Weems while a small force under de Witt lay in the Texel. Early in July the English fleet had to withdraw to land the sick (among them Blake) and to re-provision, but it was back in position in three weeks, during which time Tromp was unable to make any move owing to lack of men, ammunition and stores. At last on July 25 Tromp put to sea and, heading north, succeeded in drawing Monk south from the Texel in a running fight, after which he slipped north during the night of July 29 and effected a junction with de Witt. The action which followed on July 31 (OS) was the fiercest of the whole war. Tromp, who throughout the operations had shown marked superiority in seamanship, obtained the wind and attacked with over 100 sail. The fight lasted nearly 12 hours, by which time the Dutch were completely beaten and had lost 30 ships, while many deserted earlier in the action, and Tromp himself was killed. No other operations of any importance followed, and by the Treaty of Westminster, concluded in April 1654, the Dutch conceded all trade questions under dispute, acquiesced in the Navigation Act, and paid a heavy indemnity. In the Far East their commercial expansion was checked, though in the Mediterranean they remained supreme.

Second Dutch War (1664-67)—Charles II's government pursued a vigorous commercial policy, and was soon embroiled with the Dutch over the West African slave trade, and the interpretation of the Navigation Act. In Oct. 1663, therefore, Captain Robert Holmes was sent to raid the Dutch West African trading posts, and in 1664 he crossed the Atlantic and captured the Dutch colony of New Amsterdam (New York). The Dutch at once sent out Admiral de Ruyter, who recaptured the African ports and attacked Barbados. He was on his way home when, in May 1665, official operations of war began, and a Dutch fleet of over 100 sail under the lord of Opdam captured some English ships which were bringing naval stores from Hamburg. The English fleet, of equal strength, was at once hurried to sea under James, duke of York, then lord high admiral. He was assisted by Prince Rupert, Lord Sandwich and Sir William Penn, and encountered the Dutch off Lowestoft on June 3 (OS). The action lasted all day and resulted in the decisive defeat of the Dutch, after a total loss of over 30 ships, Opdam being blown up in his flagship and Cornelius Van Tromp, the son of Admiral Martin Tromp, covering the Dutch retreat with great skill. Great dissatisfaction was shown at the duke of York's failure to pursue the enemy, and he was quickly replaced by Sandwich who, after a short time, was himself replaced by Monk (now duke of Albemarle), together with Prince Rupert.

The Plague, meanwhile, had so disorganized English administration that no further operations could be undertaken till May 1666, when Monk and Rupert were ready in the Downs with 80 sail. Here they received orders from Charles II to detach one of their three squadrons, to meet a French squadron said to be

approaching up channel from the Mediterranean, whence all English war-ships had recently been withdrawn. The French had declared war, but their squadron never came north of Lisbon, and the east wind, which took Rupert to Portsmouth with 25 sail, brought de Ruyter out with 85 ships against Albemarle's weakened force. Nevertheless, when the wind changed to south west on June 1 (OS), he attacked the Dutch brilliantly, trying to concentrate the whole of his force against their van. In this he was partially successful, the Dutch vice-admiral Evertzen was killed during the action, which lasted all day. On June 2 the Dutch were reinforced, and continued the fight. Their van was disorganized owing to Evertzen's death, and Albemarle concentrated all his force against the rear under Tromp, who was at last relieved by de Ruyter, when Albemarle retired. On June 3 Albemarle continued his retirement, protecting his injured ships with great skill, though Sir George Ayscue surrendered the "Royal Prince" after running on the Galloper shoal. In the evening Rupert and his squadron returned, and on June 4 Albemarle again offered battle and a great *mêlée* ensued, the English finally retiring into the Thames after the total loss of nearly 20 ships. De Ruyter now blockaded the Thames, based on the Essex shore, but Albemarle and Rupert quickly refitted and, working their way through the shoals, eventually forced him into action on St. James's day, July 25, off the North Foreland, where he was completely defeated with a loss of 20 ships. Albemarle now crossed to the Dutch coast and on Aug. 8-9 a special force under Sir Robert Holmes burnt 160 merchantmen anchored in the Vlie Channel and a million pounds' worth of goods in storehouses on shore.

Peace negotiations now began, but the English, exhausted by the war, the Plague and the Great Fire, laid up their line of battle ships for the winter, and the Dutch, pretending to do the same, resolved on a desperate raid in order to obtain better terms. Early in June 1667 de Ruyter suddenly appeared in the Thames and, forcing an entrance into the Medway Channel, despite the forts and boom protecting it, did immense damage to the shipping lying there, burning three first rates, capturing another, and causing a panic in London. By the Peace of Breda (July 1667) the Dutch ceded New York, and the Navigation Act was amended in their favour.

Third Dutch War (1672-74)—Unlike the two previous wars, which were entirely commercial, this war was part of a great European political struggle. Louis XIV. who was intent on seizing the Spanish Netherlands, had recently been checked by the Triple Alliance of England, Sweden and the United Provinces, but in 1670 by the "Secret Treaty of Dover" he had persuaded Charles II to abandon his former allies and co-operate with the French. The English and French fleets were to be combined under an English admiral, Charles was to establish Roman Catholicism in England, and was to receive large money subsidies. The Dutch, anxious to avoid a simultaneous war by land and sea, made every possible concession demanded of them and finally no better way of provoking them could be found than to order Sir Robert Holmes to attack their Smyrna convoy in the Channel (March 13, 1672).

De Ruyter with about 80 sail was at once ordered to sea, but administrative difficulties made him too late to prevent the junction of the French fleet of 35 sail under d'Estrees with the English fleet of 55 sail under James, duke of York, assisted by Lord Sandwich, Sir John Harman and Sir Edward Spragge. The allies, however, were also suffering from hasty preparation, and went to Solebay on the Suffolk coast to complete their complements and stores. Early in the morning of May 28, 1672, they were surprised by de Ruyter while still at anchor. Sandwich with the Blue squadron at once stood to the north and engaged the Dutch, and though his flagship was burnt and he himself drowned his squadron routed the one opposed to it under Van Ghent, who was also killed. Meanwhile, the French turned south and held off from the battle, and de Ruyter, merely detaching a small force to watch them, concentrated his attack on the English centre. Here the duke of York was very hard pressed and had to shift his flag twice, and only the arrival of the ships of the Blue

quadron prevented complete disaster, after which de Ruyter drew off.

The Test Act now forced the retirement of the duke of York and many other Catholic officers, and no further operations were attempted till 1673, when the allied fleet was commanded by Prince Rupert, and it was planned to land troops on the Dutch coast. The Dutch, who were also attacked by Louis XIV on land, passed through an internal revolution which brought William, prince of Orange, to the chief naval and military command. He at once ordered de Ruyter to sea, but there was hardly enough ammunition for both army and fleet. De Ruyter occupied a well-chosen anchorage in the Schooneveldt channel from where he could command his own coast. On May 28, 1673, the allied fleet attacked him with fifty ships and frigates, but was severely handled and driven back on their main fleet, de Ruyter counter-attacking with great skill and the fight lasting till night, when the Dutch again retired to their own coast.

On June 4 de Ruyter himself made a sortie and caught the allies somewhat dispersed, and after a running fight again retired to his shoals the allies returning to the Thames to refit. De Ruyter now attempted to blockade them, but was driven back by plague in his ships, and at the end of July the allies returned in force to blockade the Dutch ports, and threatened an invasion from the east coast. William of Orange ordered de Ruyter to break the blockade and relieve the Dutch trade at all costs. De Ruyter found the allies off the Texel and, through the deliberate slowness of the French, easily out-maneuvred them and obtained the weather gauge. On Aug. 11, 1673, he again had the wind, and attacked them running south. The French, who were leading, attempted to surround his van and, having failed, withdrew from the action. Sprague in the rear fought a magnificent but detached action with Cornelius Tromp, regardless of the general tactics of the battle. The French having disappeared, de Ruyter was again able to concentrate superior numbers against the English centre, which was very hard pressed. The centre and rear now became confused in a general *mêlée* and Sprague was drowned while crossing in a boat to his third ship. Great efforts were made to capture his first ship, the "Royal Prince," but she was splendidly defended, and towards evening the French returned and the Dutch withdrew. The unpopularity of the war in England compelled the English government to make peace with the Dutch in the following year.

Meanwhile, a revolt in Sicily led the insurgents to seek help from the French against their Spanish rulers, and a French army occupied Messina. The Spaniards appealed to the Dutch for help, and de Ruyter took out a squadron and fought an indecisive action on Jun 8, 1676, with Duquesne who was bringing French reinforcements to Sicily. Later, a combined Hispino-Dutch attack on Messina failed, and de Ruyter was mortally wounded off Augusta on April 22. Charles II now made a treaty of alliance with the Dutch, despatched troops to help them in Flanders, and sent Sir John Narbrough to the Mediterranean, on which the French evacuated Sicily and, in 1678, made the peace of Nijmegen.

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OPERATIONS ON LAND

The contemporary military history of Europe included, first, the war between France and Spain, 1654-59, usually called the Spanish Fronde (see *FRONDE*, THE), of which the most notable incident was the great battle of the Dunes (q.v.). About the same time a war was fought in northern Europe (1655-60), celebrated chiefly for the three days' battle of Warsaw (July 28-30, 1656), and the successful invasion of Denmark by the Swedes, carried out from island to island over the frozen sea (Feb. 1658), and culminating in a long siege of Copenhagen (1658-59). Between the second and third wars of England and the United Provinces came the short War of Devolution (1667-68)—a war of sieges in the

Low Countries in which the French were commanded chiefly by Turenne. In 1668 the French under Condé made a rapid conquest of Franche Comté. This was, however, given up at the peace. The war of 1672-78, the first of the three great wars of Louis XIV, was fought on a grander scale.

Invasion of Holland, 1672.—The diplomacy of Louis had, before the outbreak of war, deprived Holland of her allies—England (Treaty of Dover, 1670), Sweden (Treaty of Stockholm, 1672) and the emperor, and when he declared war on the United Provinces in March 1672, it seemed that the Dutch could offer little resistance. The French army under Louis in person started from Charleroi and marched down the Meuse unopposed. The powerful Dutch fortress of Maastricht was masked, and the French then moved towards Dusseldorf. In the electorate of Cologne they were in friendly company, and the main army soon moved down the Rhine from Dusseldorf, the corps of Turenne on the left bank, that of Condé on the right. At the same time a corps under Marshal Luxemburg, composed of Louis's German allies (Cologne and Munster) moved from Westphalia towards Over-Yssel and Groningen. The Rhine fortresses offered but little resistance to the advance of Turenne and Condé. William of Orange with a weak field army tried to defend the Yssel-Rhine line, but the French rapidly forced the passage of the Rhine at Tolhuis (June 12) and passed into the Betuwe (between the Lek and the Wal). Condé now advised a cavalry raid on Amsterdam, but Louis, acting on the suggestion of the war minister, Louvois, preferred to reduce Nijmegen, Gorinchem and other places, before entering Utrecht province. Condé's plan was, however, partially carried out by Count Rochefort, who with 1,800 troopers captured successively Amersfoort and Naarden. His further progress was checked at Muiden, which the Dutch garrisoned in the nick of time, and he returned to the main army, taking Utrecht *en route*. Louis now moved on Amsterdam, brushing aside the feeble opposition which was offered, and it seemed that the French must achieve their object in one short campaign. But the Dutch people were roused. The month before, the citizens of Utrecht had refused to raise their suburban villas, and defence of the fortifications had consequently been impossible. Now, the dikes were cut and the sluices opened, and Amsterdam was covered by a wide inundation, against which the invader was powerless. At the same time the men of Zeeland repulsed a French raid from Aath on Aadenburg, and this infraction of the neutrality of the Spanish Netherlands served but to raise up another enemy for Louis. Luxemburg too, at first successful, was repulsed before Groningen. A revolution placed William of Orange at the head of the Government. The alliance of Brandenburg and the Munz electorate had already been secured, and Spain, justly fearing for the safety of her Flemish possessions, soon joined them. The emperor followed, and Louis was now opposed, not by one State, but by a formidable coalition.

War Against the Coalition.—In the autumn the war spread to the Rhine. No attempt could be made on Amsterdam until the ice should cover the floods. Turenne was therefore despatched to Westphalia and Condé to Alsace, while a corps of observation was formed on the Meuse to watch the Spanish Netherlands. But the coalition had not yet developed its full strength, and Turenne's skill checked the advance of the Imperialists under Montecuccoli and of the Brandenburgers under the Great Elector. A war of manoeuvre on the middle Rhine ended in favour of the French, and the allies then turned against the territories of Cologne and Munster, while William, disappointed in his hopes of joining forces with his friends, made a bold, but in the end unsuccessful, raid on Charleroi (Sept.-Dec. 1672). The allies in Germany were now not merely checked, but driven from point to point by Turenne, who displayed a degree of energy rare in the military history of the period. After a severe winter campaign, the elector, defeated in combat and manoeuvre, was forced back to the Weser, and being but weakly supported by the Imperialists, found himself compelled to make a separate peace (June 6, 1673). Turenne then turned his attention to the Imperialists who were assembling in Bohemia, and made ready to meet them at Wetzlar. Meanwhile the other French armies were

fully employed. During the winter, Luxemburg made a bold attempt to capture Leyden and The Hague by marching a corps from Utrecht across the frozen inundations. But a sudden thaw imperilled his force and he had to make a painful retreat along the dikes to Utrecht. And Conde, who then returned to the command of the army in Holland, failed to make headway against the defence of Amsterdam. Louis' own army, originally collected for the relief of Charleroi in December (advanced on Maastricht, and after a brief siege, in which Vauban directed the besiegers, captured this most important fortress (June 29, 1673). Louis, after the capture of Maastricht, led his army southwards into Lorraine and overran the electorate of Trier. But nothing of importance was gained, and Turenne's summer campaign was wholly unsuccessful.

Capture of Bonn.—From Wetzlar he moved to Aschaffenburg. Soon the Imperialists advanced in earnest, greatly superior in numbers. Marching via Eger and Nuremberg (Sept. 3) on the Main, Montecucculi drew Turenne to the valley of the Tauber, then, having persuaded the bishop of Wurzburg to surrender the bridge of that place, he passed to the right bank of the Main before Turenne could intervene. The Imperialists soon arrived at Frankfurt, and the French position was turned. Montecucculi thus achieved one of the greatest objects of the 17th century strategists, the wearing down of the enemy in repeated and useless marches. The French retreat to the Rhine was painful and costly, and Montecucculi then passed that river at Mainz and made for Trier. Turenne followed, unable to do more than conform to his opponent's movements, and took post to defend Trier and Alsace. Thereupon Montecucculi turned northward to meet William of Orange, who evaded Conde's weak army and marched rapidly via Venlo (Oct. 22) on Coblenz. The elector of Trier, who had not forgotten the depredations of Louis' army in the spring, followed the example of the bishop of Wurzburg and gave a free passage at Coblenz. William and Montecucculi joined forces in the electorate and promptly besieged Bonn. This fortress fell on Nov. 12, and the troops of the coalition gained possession of an unbroken line from Amsterdam to the Breisgau, while Louis' German allies (Cologne and Munster), now isolated, had to make peace at once. Louis' allies were leaving him one by one. The German princes and the empire itself rallied to the emperor, Denmark joined the coalition (Jan. 1674), the Great Elector re-entered the war, and soon afterwards England made peace.

Operations of 1674.—In 1674 therefore Louis reluctantly evacuated those of the United Provinces occupied by his army. He had derived a considerable revenue from the enemy's country, and he had moreover quartered his troops without expense. The resources of the French Government were almost intact for the coming campaign, the corps of observation in Roussillon, under Marshal Schomberg, made a successful campaign against the Spaniards, and the war was carried even into Sicily. Conde, in the Spanish Low Countries, opposed with inferior forces the united army of Spaniards, Dutch and Austrians under William, and held the Meuse from Grave to Charleroi on the Sambre. The war in this quarter was memorable for Conde's last, and William's first, battle, the desperate and indecisive engagement of Senefé (Aug. 11), in which the two armies lost one seventh of their strength in killed alone. The king's part in the campaign was, as usual, a war of sieges, an army under his personal command overran Franche-Comté in six weeks, and Louis, aided by the genius of Vauban, reduced Besançon in nine days. Turenne's Rhine campaign began with an invasion of Germany, undertaken to prevent interference with Louis in Franche-Comté. Bournonville, the imperial commander who now replaced Montecucculi, lay in the Cologne and Trier electorates. An army of South Germans, in the Breisgau, under the duke of Lorraine and Count Caprara, moved northward to the Neckar valley to unite with Bournonville. Turenne determined to attack the southern army before the junction could be effected. He crossed the Rhine at Philippsburg early in June, and on the 16th fell upon the inferior forces of Caprara in their entrenched position of Sinheim. The result of the battle was a complete victory for the French, who followed up their success by driving a portion of Bournonville's army (on

which the duke of Lorraine had rallied his forces) from the Neckar (action of Lidenburg near Heidelberg, July 7). Turenne then laid waste the Palatinate, in order that it should no longer support an army, and fell back over the Rhine, ignoring the reproaches of the elector palatine, who vainly challenged him to a duel. This devastation has usually been considered as a grave stain on the character of the commander who ordered it, but Turenne's conception of duty did not differ in this respect from that of Cromwell, Marlborough, Wellington and the generals of the American Civil War. It was held to be necessary and expedient, and it was accordingly carried out. Bournonville's army near Frankfurt was still to be dealt with, and the Great Elector and his Brandenburgers were rapidly approaching the Main valley. After a slight attempt to invade Lorraine, which Turenne easily stopped, the Imperialists suddenly recrossed the Rhine and marched rapidly into the neighbourhood of the Strasbourg bridge.

Turenne's Winter Campaign in Alsace.—The magistrates of this city were not less amenable than had been the bishop of Wurzburg in 1673. Bournonville obtained a free passage, and Turenne was too late to oppose him. The French general, however, determined to fight, as he had done at Sinheim, to prevent the junction of the two hostile armies. The Great Elector was still in the Neckar valley when the battle of Enzheim (8m from Strasbourg) was fought on Oct. 4. This time it was indecisive, and Bournonville's superior forces, soon augmented by the arrival of the elector, spread into Alsace. Turenne steadily retired to his camp of Dettweiler, unable for the moment to do more, and the Germans took up winter quarters in all the towns from Belfort to Strasbourg (Oct.-Nov. 1674). But Turenne was preparing for another winter campaign, the most brilliant in the great commander's career.

First he placed the fortresses of middle Alsace in a state of defence, to deceive the enemy. Then he withdrew the whole of the field army quietly into Lorraine. Picking up on his way such reinforcements as were available, he marched southward with all speed behind the Vosges, and in the last stages of the movement he even split up his forces into many small bodies, that the enemy's spies might be misled. After a severe march through hilly country and in the midst of snowstorms, the French reunited near Belfort, and without a moment's delay poured into Alsace from the south. The scattered Imperialists were driven towards Strasbourg, every corps which tried to resist being cut off. Bournonville stood to fight at Mulhausen with such forces as he could collect (Dec. 29, 1674), but Turenne's men carried all before them. The advance continued to Colmar, where the elector, who was now in command of the Germans, stood on the defensive with forces equal to Turenne's own. The battle of Turkheim (q.v.) (Jan. 5, 1675) nevertheless resulted in another and this time a decisive victory for the French, a few days after the battle Turenne could report that there was not a soldier of the enemy left in Alsace. His army now went into winter quarters about Strasbourg, and drew supplies from the German bank of the Rhine and even from the Neckar valley (Jan. 1675).

Operations of 1675.—This opening of the campaign promised well, and Louis as usual took the field as early as possible. In the course of the spring (May-June) the king's army recaptured some of the lost fortresses of the Meuse and took in addition Liège and Limburg. The expeditionary corps in Sicily also gained some successes in this campaign, and Schomberg invaded Catalonia. On the Rhine was fought the last campaign of Turenne and Montecucculi. The elector having withdrawn his forces to Brandenburg (see SWEDEN History), Montecucculi resumed command, and between Philippsburg and Strasbourg the two great commanders manoeuvred for an advantage, each seeking to cover his own country and to live upon that of the enemy. At last Turenne prevailed, and in opening the action, he was killed by a cannon shot (July 27). The sequel showed how dependent was even the best organized army of the time upon the personality of its commander.

All the advantages won were hastily surrendered, and Montecucculi, sharply following up the retreat of the French, drove

them over the Rhine and almost to the Vosges. At the same time the duke of Lorraine defeated Marshal Créquy (Aug. 11) at Conzér Brucke on the Moselle, and captured Trier (Sept. 6), which, as a set-off against Bonn, Turcnne had taken in the autumn of 1673. The situation was more than alarming for the French but Conde was destined to achieve his first success—for once a success of careful strategy and prudent manoeuvre. Luxembourg was left in charge in Flanders, and Conde took command of the remnant of Turcnne's old army and of the fugitives of Créquy's Montecenis. His skill failed completely to shake his position and in the end Conde compelled him to retire over the Rhine. Both retired from their commands at the close of the year, Turcnne was dead, and a younger generation of commanders henceforward carried on the war.

Operations of 1676.—In 1676 the naval successes of France in the Mediterranean enabled the corps under Marshal Vivonne in Sicily to make considerable progress, and he won in important victories at Messina (March 5). Vivonne was made viceroy of Sicily. Louis himself, with his marshals and Viubin, conducted the campaign in the north. The town of Conde fell on April 26, and the king then manoeuvred against the prince of Orange in the neighbourhood of Valenciennes. An attempt made by the latter in the summer to besiege Maastricht was frustrated by Marshal Schomberg, with a detachment of the king's army (August). Rochefort meanwhile covered the Meuse country and Luxembourg Créquy, who had now returned from captivity (he had been taken after the battle of Conzér Brucke) opposed the Imperialists in Lorraine, but he was unable to prevent the fall of Philipsburg, which occurred on Sept. 17. The French now had waste the land between the Meuse and Moselle for the same reason which brought about the devastation of the Palatinate in 1674, and the year closed with a war of manoeuvre on the upper Rhine between the Imperialists under the duke of Lorraine and the French under Luxemburg.

Operations of 1677 and 1678.—The chief event of the campaign of 1677 in the Netherlands was the siege of Valenciennes, which fortress was invested by Louis in the first weeks of the campaigning season. Five marshals of France served under the king in this enterprise, but their advice was of less value than that of Vauban, whose plans the king followed implicitly, even so far as to order an assault *de vive force* against the unanimous opinion of the marshals. This succeeded beyond Vauban's own expectation, the picked troops entrusted with the attack, of an outwork forced their way into the town itself (March 17). The success was followed by the siege of St Omer and the defeat of William's relieving army by the duke of Orleans (battle of Mont Cassel, April 11, 1677). The summer campaign was a contest of skill between Luxemburg and William, which resulted in favour of the French.

In Germany the credit of the French successes was due to Créquy, who was no longer the defeated general of Conzér Brucke, but the most successful of Turcnne's pupils. He began by driving back the duke of Lorraine to the Rhine. Another attempt by the Lorraine family to reconquer their duchy was thus foiled, and at the same time a second imperial army, which had crossed the Rhine by Philipsburg, was shut up in an island of the Rhine and forced to make terms with the French. A large reinforcement sent by the duke of Lorraine to its assistance was completely defeated by Créquy in the battle of Kochersberg near Strasbourg (Oct. 7) and the marshal followed up his successes by the capture of Freiburg on Nov. 14. During the year there was a brisk war in the West Indies, and also in Catalonia, where the French maintained the ground won by Schomberg in the previous campaign. In 1678 Louis took the field in February. The skilful manoeuvres of the French, whether due to Louis' own generalship or that of his advisers, resulted in the speedy capture of Ghent and Ypres (March), and the retention of the prizes in the usual war of posts which followed. The last battle of the war was fought at St Denis (outside Mons) between William and Luxemburg on Aug. 14, three days after the peace of Nijmegen had been concluded. William sustained another defeat, but the battle was one of the most fiercely contested of the whole war. On the

Rhine Créquy began by winning the battle of Rheintelden (July 6) after which he inflicted upon the Imperialists another defeat at Gengenbach (July 23) and took Kehl. In the short campaign of 1679 before France and the empire had concluded peace, he was equally successful.

In Spain the French army under Marshal de Navailles had almost made steady progress, and thus the last campaign was wholly in favour of the French. The peace of Nijmegen gave Louis many of the Netherlands frontier fortresses, and little else. He was thus freed by the intervention of England on the side of the coalition and would have made peace earlier but for his reluctance to abandon his ally Sweden. The French army had, however, well established its reputation. Vauban was unique amongst the officers of his time, and Créquy and Luxemburg were not unworthy successors of Turcnne and Conde. The two marshals added to their reputation in the "Reunion War" of 1680-84. Créquy died in 1687. Luxemburg's greatest triumph was won seven years later (see GRAND ALLIANCE, WAR OF THE). Vauban retired from active service as a marshal 25 years after the peace of Nijmegen. But the interest of the war does not reside wholly in the personalities of the leaders. There were great commanders before Turcnne and Conde. It is as the debut of a new method of military organization and training—the first real test of the standing army as created by Louvois—that the Dutch War of 1672-79 is above all instructive. (C. F. A.)

DUTCH WEST INDIA COMPANY, THE (*De Westindische Compagnie*), a company founded by letters patent from the Netherlands states general dated June 3, 1602. The purpose for which the company was formed was to regulate and protect the contraband trade already carried on by the Dutch in the American and African possessions of Spain and Portugal, and to establish colonies on both continents and their islands. By the terms of the charter the company was to be composed of five boards or branches, established in Amsterdam, Zealand, the Meuse (Rotterdam), the North Department (Friesland and Hoorn), and Groningen. Each was to be represented on the general governing board according to the importance of the capital contributed by it. Thus Amsterdam, which contributed four-ninths of the capital, had eight directors on the board. Zealand, which subscribed two-ninths, had four. Rotterdam was represented by two directors. The northern district and Groningen appointed one director each.

The company was granted the monopoly of the trade with America and Africa and between them, from the Arctic regions to the Straits of Magellan, and from the Tropic of Cancer to the Cape of Good Hope. The policy the company proposed to follow was to use its monopoly on the coast of Africa in order to secure the cheap and regular supply of negro slaves for the possessions it hoped to acquire in America. The trade was thrown open by the voluntary action of the company in 1638. The general board was endowed with ample power to negotiate treaties, and make war and peace with native princes, to appoint its officials, generals and governors, and to legislate in its possessions subject to the laws of the Netherlands. The states general undertook to secure the trading rights of the company, and to support it by a subvention of one million guilders (about £100,000). In case of war the states general undertook to contribute sixteen vessels of 300 tons and upwards for the defence of the company, which however, was to bear the expense of maintaining them. In return for these aids the states general claimed a share in the profits, stipulated that the company must maintain sixteen large vessels (300 tons and upwards) and fourteen "yachts" (small craft of 50 to 100 tons or so), required that all the company's officials should take an oath of allegiance to the Netherlands as well as to the board of directors, and that all despatches should be sent in duplicate to the government and to the board.

The history of the Dutch West India Company is one of less prosperity than that of the Dutch East India Company. In early days the trade was not sufficient to meet the heavy expense of the armaments raised against Spain and Portugal. The company was never able to secure the control of the supply of slaves from Africa. Its settlement of New Netherland was lost to England

In the West Indies it gained a valuable footing among the islands. It occupied St. Eustatius in 1634, Curacao with Bonaire and Aruba in 1634 and 1635, Saba in 1640 and St. Martin in 1648 but its greatest conquests and its greatest losses were alike met on the continent of South America. After a first unsuccessful occupation in 1623, of Bahia, which was immediately retaken by a combined Spanish and Portuguese armament, the company obtained a firm footing in Pernambuco. The glory of the wars which arose out of this invasion belongs to the history of Brazil. The company had been largely guided in its policy of assailing the Portuguese possessions by the advice of the Jews, who were numerous in Brazil, and who found means to communicate with their fellows in religion, the refugees in Amsterdam. The most prosperous period of the company was during the tolerant and liberal administration of Count John Maurice of Nassau Siegen (1636-44).

The monopolist tendency of all Dutch colonization, the religious hostility of the Roman Catholic Portuguese, and the support given by France and England to Portugal after her revolt from Spain combined at last to make the position of the company in Brazil untenable. It resigned all claim on the country by the treaty of 1661. But though deprived of its establishment in Brazil the company found a compensation in Surinam and Esse-queibo (Dutch Guiana), where there was no Spanish or Portuguese population to resist it, and where the resources of the country offered great profits. The advantages of the settlement in Guiana were not, however, reaped by the company founded in 1621. In 1674 it had become so embarrassed that it was dissolved, and reconstituted in 1675. The newly formed company continued to exploit the Dutch possessions in America till 1794, when they were all swept into the general reorganization consequent on the French invasion of Holland. The West India Company founded after the Napoleonic epoch in 1828 was only meant to develop trade, and was not successful.

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DUTT, MICHAEL MADHU SUDAN (1824-1873), the greatest native poet of India in the 19th century, was born at Sagandani, in the district of Jessore in Bengal, on Jan. 25, 1824. His father was a pleader in Calcutta, and young Madhu Sudan received his education in the Hindu college of Calcutta. In 1843 he ran away to avoid a marriage into which his father wished to force him, and embraced the Christian religion. Continuing his studies now in the Bishop's college, Madhu Sudan learnt Greek and Latin and some modern European languages, and in 1848 went to Madras. There he wrote English verses, and married the daughter of a European indigo-planter, but was soon separated from her. He then married an English lady, with whom he returned to Calcutta in 1856, and soon discovered that the true way to win literary distinction was by writing in his own language, not by composing verses in English. His three classical dramas—*Ratnavali* (1858, Eng. trans. 1904), *Sarmishtha* (1859, Eng. trans. 1859, 1914) and *Krishna Kumari*—appeared between 1858 and 1861, and were "recognized as works of merit. But his great ambition was to introduce blank verse into Bengali. His knowledge of Sanskrit poetry, his appreciation of the Greek and Latin epics, and his admiration of Dante and of Milton impelled him to break through the fetters of the Bengali rhyme and to attempt a spirited and elevated style in blank verse. His first poem in blank verse, the *Tilotama*, was only a partial success, but his great epic which followed in 1861, the *Meghanad Badha*, took the Indian world by surprise, and at once established his reputation as the greatest poet of his age and country. He took his story from the old Sanskrit epic, the *Ramayana*, but the beauty of the poem is all his own, and he imparted to it the pathos and sweetness of Eastern ideas combined with the vigour and loftiness of Western thought. In 1862 Madhu Sudan left for Europe. He lived in England for some years, and was called to the bar, and in 1867 returned to his country to practise as a barrister in Calcutta. He still wrote much, but nothing of enduring merit. He died in a Calcutta hospital on June 29, 1873.

DUTT, TORU (1856-1877), Indian poetess, was born in Calcutta on March 4, 1856, and died there of tuberculosis on Aug. 30, 1877. She was the youngest child of Govin Chunder Dutt, member of a distinguished Christian family in Bengal who were noted for their poetical gifts. Toru visited Europe with her parents in 1869 and spent some time in Nice and at Paris. Toru Dutt became an enthusiastic lover of French and French literature, James Darmesteter, in his *Essais de Littérature Anglaise*, states that "French became her favourite language and France the country of her election." Early in 1870 the family arrived in London, removing in 1871 to Cambridge. On their return to India in 1873 Toru contributed to the *Bengal Magazine* translations into English from the Romantic school of French poetry, which were afterwards published with other pieces, in a volume entitled *A Sheaf Gleaned in French Fields* which won the praise of Andre Theunet and Sir Edmund Gosse. Her translations of speeches delivered by Victor Hugo and Thiers in the French Legislative Assembly were also published in the *Bengal Magazine* for June and July 1875. Her most remarkable work was a French novel, *Le Journal de Mlle. D'Afrique*, dedicated to Lord Lytton, and published post-humously by Didier (Paris 1879), with a preface by the Orientalist, Mlle. Clarisse Badier. This book was highly praised by Madame de Sévigné and James Darmesteter has included an appreciation of it in his *Essays: Ancient Ballads and Legends of Hindustan* (London, 1882) constitute Toru Dutt's best work in English. In this book she made available, for the appreciation of English readers, some of the great stories of Indian classical literature and also some beautiful miscellaneous poems. Of these, *Our Casuarina Tree* is rich in imagery and musical cadences.

See H. Das, *Life and Letters of Toru Dutt* (1921). (H. DA.)

DUTY, a term loosely applied to any action or course of action which is regarded as morally incumbent, apart from personal likes and dislikes or any external compulsion. Such action must be viewed in relation to a principle, which may be abstract in the highest sense (e.g., obedience to the dictates of conscience) or based on local and personal relations. That a father and his children have mutual duties implies that there are moral laws regulating their relationship, that it is the duty of a servant to obey his master, within certain limits is part of a definite contract, whereby he becomes a servant engaging to do certain things for a specified wage. Thus it is held that it is not the duty of a servant to infringe a moral law even though his master should command it. For the nature of duty in the abstract, and the various criteria on which it has been based, see ETHICS.

From the root idea of obligation to serve or give something in return, involved in the conception of duty, have sprung various derivative uses of the word, thus it is used of the services performed by a minister of a church, by a soldier, or by any employee or servant. A special application is to a tax, a payment due to the revenue of a state, levied by force of law. Properly a "duty" differs from a "tax" in being levied on specific commodities, transactions, estates, etc., and not on individuals, thus it is right to talk of import duties, excise-duties, death- or succession duties, etc., but of income-tax as being levied on a person in proportion to his income.

DUUMVIRI or **DUOVIRI**, in ancient Rome, the official style of two joint magistrates. Such pairs of magistrates were appointed in Rome itself and in the colonies and municipia. (1) *Duumviri iure iurando*, municipal magistrates, whose duties were concerned with the administration of justice. (2) *Duumviri quinquennales*, municipal officers, who were elected every fifth year for one year to exercise the function of the censorship. (3) *Duumviri sacrorum*, officers who originally had charge of the Sibylline books (see DECEMVIRI). (4) *Duumviri aedis locandae*, originally officers specially appointed to supervise the erection of a temple. (5) *Duumviri navales*, officers appointed for the equipment of a fleet. Originally chosen by consuls or dictators, they were elected by the people after 311 B.C. (6) *Duumviri perduellionis*, the earliest criminal court for trying offences against the State (see TREASON). (7) *Duumviri viis extra urbem purgandis*, subordinate officers under

the aediles, whose duty it was to look after those streets which were outside the city walls. By 12 B.C. their duties were transferred to the *Curiales avarum*.

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DU VAIR, GUILLAUME (1556-1621) French author and lawyer, was born in Paris. Du Vair was in orders, and, though during the greater part of his life he exercised only legal functions he was, from 1617 till his death, bishop of Lisieux. His reputation, however is that of a lawyer, a statesman and a man of letters. He became in 1583 councillor of the parliament of Paris and is deputy for Paris to the Estates of the League; he pronounced his most famous political or legal discourse, an argument nominally for the civil law but in reality directed against the alienation of the crown of France to the Spanish infants. In 1597 appeared his treatise *De Placitoque francico*. He was sent to England in 1596 with the marshal de Bouillon to negotiate a league against Spain; he became (1599) first president of the parliament of Provence (Aix), and in 1616 keeper of the seals. He died at Tournes (Lot et Garonne) on Aug. 3, 1621. The most celebrated of his treatises is *La Philosophie morale des Stoïques*, translated into English (1664) by Charles Cotton. *De la constance et consolation des calamités publiques*, composed during the siege of Paris in 1590, and translated into English as *A Beecher against Adversities* (1662), and *La sainte Philosophie*, in which religion and philosophy are intimately connected. Pierre Charron drew freely on these and other works of Du Vair who had a great indirect influence on the development of style in French; for Malherbe was an admirer of his writings. The reformer of French poetry learned much from the treatise *De Placitoque francico*, to which the counsels of his friend were no doubt added.

Du Vair's works were published at Paris in 1641. See *Niceron*, *Mémoires*, vol. xliii, and monographs by C. A. Sapey (1847 and 1858).

DUVAL, ALEXANDRE VINCENT PINEUX (1767-1847) French dramatist, was born at Rennes on April 6, 1767. He was in turn sailor, architect, actor, theatrical manager and dramatist. Of his 60 or more plays *Les Projets de mariage* (1790), *Les Fugitifs vengés* (1794) and *Les Hérétiques* (1796) have been revived on the modern French stage. In 1812 he was elected to the Académie. He died on Sept. 1, 1842.

DUVAL, CLAUDE (1643-1670), a famous highwayman was born at Domfront, Normandy, in 1643. Having entered domestic service in Paris, he came to England at the time of the Restoration in attendance on the duke of Richmond, and soon became a highwayman notorious for the daring of his robberies and his gallantry to ladies. In the end he was captured in London and hanged at Tyburn on Jan. 27, 1670. His body was buried in the centre aisle of Covent Garden church, under a stone with the following epitaph—

"Here lies Du Vall Reader if male thou art,
Look to thy purse if female to thy heart."

A full account of his adventures ascribed to William Pope, was reprinted in the *Harleian Miscellany*, and Samuel Butler published a satirical ode *To the Happy Memory of the Most Renowned Du Val*.

DUVENECK, FRANK (1848-1910), American figure and portrait painter, was born at Covington, Ky., Oct. 9, 1848. He was a pupil of Diaz in the Royal Academy of Munich, and a prominent member of the group of Americans who in the '70s overturned the traditions of the Hudson river school and started a new art movement. His work shown in Boston and elsewhere about 1875 attracted great attention and many pupils flocked to him in Germany and Italy, where he made long visits. After returning from Italy to America he gave some attention to sculpture, and modelled a fine monument to his wife, now in the English cemetery in Florence. In 1905 he presented to the Cincinnati (O.) Museum a large collection of his own works. He died in Cincinnati, Jan. 3, 1910.

DU VERGIER DE HAURANNE, JEAN (1581-1643), abbot of St. Cyran, father of the Jansenist revival in France, was

born of wealthy parents at Bayonne and studied theology at Louvain. After taking holy orders he settled in Paris, where he became known as a mine of miscellaneous erudition. His friendship with Cornelius Jansen, a young champion of Augustinianism, led him to oppose the Louvain Jesuits who stood for Scholasticism. The two divines retired to Du Vergier's home at Bayonne, where he became a canon of the cathedral, and Jansen a tutor in the bishop's library. Here they remained some years, intently studying the fathers. Eventually, Jansen went back to Louvain, while Du Vergier became confidential secretary to the bishop of Poitiers, and was presently made sinecure abbot of St. Cyran. Thenceforward he was generally called M. de St. Cyran. At Poitiers he met Richelieu—as yet simply the zealous young bishop of the neighbouring diocese of Luçon. Western Touraine being the headquarters of French Protestantism, the two prelates turned St. Cyran's learning against the Huguenots. He began to dream of reforming Catholicism on Augustinian lines, and thus defeating the Protestants by their own weapons. They appealed to primitive antiquity, he answered that his Church understood antiquity better than theirs. They appealed to the spirit of St. Paul, he answered that Augustine had saved that spirit from eternalizing away by coupling it with a high sacramental theory of the Church. They flung practical abuses in the teeth of Rome, he entered on a bold campaign to bring those abuses to an end. Before long his reforming zeal necessitated his removal to Paris where his attempt to grun the support of influential people led to his friendship with the Arnauld family. Jansen was now attacking Jesuit dialectics, which he thought had corrupted theology, by writing a book on Augustine, the great master of theological method.

St. Cyran attacked their hand to mouth utilitarianism, which had played havoc with traditional church institutions and their defiance of episcopal authority by his *Petrus Aurelius* (1633).

This work so annoyed Richelieu, now the powerful and extremely Erastian prime minister, that St. Cyran was imprisoned until Richelieu's death in 1642. St. Cyran himself died of a stroke of apoplexy in Oct. 1643.

St. Cyran's character has been always something of a puzzle. Many excellent contemporary judges were profoundly impressed, others, as one of them said, went away bewildered by this strange riddle, who leapt from one point to another in incoherent phrases. Grace of expression he had none, perhaps no man of equal spiritual insight ever found it so hard to make his meaning clear. On the other hand, Jansenism, considered as a practical religious revival, is altogether his work.

He dragged the Augustinian mysticism out of the Louvain classrooms, and made it a spiritual force in France. Without him there would have been no Pascal—no Provincial Letters, and no *Pensées*.

See C. Lancelot, *Mémoires de M. de S. Cyran* (Cologne, 1718), *Sainte-Beuve, Port-Royal*, 5 ed (1888). J. Laporte, *La doctrine de Port Royal*, vol. 1 (1923) contains a list of the printed and ms works of St. Cyran.

DUVEYRIER, HENRI (1840-1892), French explorer of the Sahara, was born in Paris, and at the age of 19, having already learnt Arabic, began a journey in the northern parts of the Sahara which lasted nearly three years. In 1864 he published *Exploration du Sahara les Touareg du nord*. After 1870 he made several other journeys in the Sahara. He also examined the Algerian and Tunisian *shatts* and explored the interior of western Tripoli.

Duveynier devoted special attention to the customs and speech of the Tuareg, and to the organization of the Senussi. In 1881 he published *La Tunisie*, and in 1884 *La Confédération musulmane de Sidi Mohammed Ben Ali Es Senouss et son domaine géographique*.

See C. Maunoir and H. Schivmer, *Sahara, Algérie et Tunisie* with a Biography of Duveyrier by C. Maunoir (1905).

DUX, BOHEMIA see DUCHOV

DUX (Lat., leader), in music, an old name for the opening statement of the subject in a fugue, so called because, coming first it is the "leader", the second statement, or answer being

called, in the same fanciful spirit, the *comes* or companion (See FUGUE and CONTRAPUNTAL FORMS)

DUXBURY, a town of Plymouth county, Massachusetts, on Plymouth bay, 36 mi SSE of Boston. The population in 1950 was 3,149, and in 1940 it was 2,359 by the federal census. Duxbury was settled in 1631 by Miles Standish, William Brewster, John Alden and a few others, and it was named after the Lancashire seat of the Standish family. A church was organized in 1632 and the town was incorporated in 1637. The house built in 1666 by Alexander Standish, son of Miles, is still standing. The cod, mackerel and clam fisheries were formerly important, and in the 18th century and the first half of the 19th there were large shipyards here.

DVINA, the name of two rivers of European Russia.

1 The Northern Dvina, or *Dvina Syevernaya*, belongs to the basin of the White sea, and is formed by the junction of the Sukhona and the Yug, which meet in the neighbourhood of Veliky-Ustyug, at a height of 300 ft above the sea, in 61°20' N and 46°20' E. The conjoint stream then flows north-west to the Gulf of Archangel, which it reaches 50 m below the city of Archangel. From its mouth to the confluence of the co tributary streams the distance is about 470 m, and to the source of the Sukhona 780 m. The drainage area is estimated at 141,000 sq m. Except at the rapids the current of the Dvina is comparatively slow, as the average fall per mile is only 9 in. Till its union with the Vychegda, a river which exceeds it in volume, it flows for the most part in a single, well-defined and permanent channel, but below that point it often splits into several branches, and not infrequently alters its course. Near Archangel it divides into three distinct arms, which form a regular delta, but of these that of Berezoj alone is navigable for sea-going vessels, and even it is impeded by a bar at the mouth, with not more than 14½ or 15½ ft of water at full tide. Just above the point where the delta begins the river is joined by a large tributary, the Pinega, from the right. Above the confluence of the Vychegda the breadth is about 1,750 ft, below that point it widens out to 3,500 ft, and near Archangel it attains more than three times that measure. The channel is free from ice for about 174 days in the year. By means of the Duke Alexander of Wurttemberg Canal, the river is connected with the Neva and the Volga.

2 The Southern Dvina, or *Dvina Zapadnaya* (western Dvina) belongs to the Baltic basin, and takes its rise in a small lake about 800 ft above the level of the sea, not far from the sources of the Volga and the Dnieper. It flows south west through the province of Pskov, and through the White Russian SSR. But some distance west of Vitebsk it turns north-west, forming part of the boundary between White Russia and Poland, and then flows through Latvia where it enters the southern end of the Gulf of Riga. Its length is 640 m and it drains an area of 39,960 sq m. From Daugavpils (Dvinsk) to Riga, a distance of 135 m, there is altogether a fall of 295 ft, of which 105 ft are in the 40 m from Jakobstadt to Friedriehstadt. In the lower part of its course the river attains an ordinary depth of 30 ft and an average breadth of 1,400 ft, but during the spring flood it sometimes rises 14 ft above its usual level, and its waters spread out to a mile in width. Near the mouth the river is usually free from ice for 245 days in the year, and in White Russia 229 ft. It is navigable from the confluence of the Mezha (i.e. from Vitebsk) downwards, but the number of rapids and shallows greatly diminishes its value. Navigation can also be carried on by the following tributaries: the

DVOŘÁK, ANTON (dvor'zhahk) (1841-1904). Bohemian musical composer born at Nelahozeves (otherwise Mulihausen) in Bohemia on Sept. 8, 1841, was the son of František Dvořák, a small publican and village butcher. At the door of his father's inn Dvořák first appeared as a practical musician, taking his place among the fiddlers who scraped out their "lurants" and other wild dances for the benefit of the holiday-making local beaux and belles. At the village school he learnt from Josef Spitz both to sing and to play the violin, with so much effect that soon he was able to assist in the parish church services. At 12 years old he was sent by his father to Zlonic, near Schlan, to an uncle, with whom he lived while passing through the higher-grade classes at school. Here, too, he was fortunate enough to find a valuable friend in A. Liehmann, organist and chief musician of the little town, a competent musician, who instructed the boy in elementary theory, organ and pianoforte playing. The theory studies, however, could not long be continued, since Liehmann soon acknowledged in his own dialect that the boy was extraordinarily full of promise ("Aus Tonda, dem Sappermentsbuben 'mal 'was werden konnte!") at the same time realizing that he could not do much to assist. But Dvořák soon left Zlonic for Bohmisch Kamnitz, where he learnt German and advanced his musical studies under Hancke. A year later he was summoned to return to Zlonic to assist his father, who had set up in business there. But his craving for a musical career was not to be checked, and after considerable trouble, his father's consent was obtained to his settling in Prague to devote himself entirely to the study of music.

In Oct. 1857 Dvořák entered the organ-school of the *Gesellschaft der Kirchenmusik*, where he worked for three years. The small financial aid his father was at first able to lend soon ceased, and after being in Prague but a very few months Dvořák found himself practically thrown on his own resources. By playing the viola in a private orchestra and in various inns of the town he succeeded in obtaining a precarious livelihood. On the opening in 1862 of the Bohemian Interimstheater, Dvořák, with part of this band, formed the nucleus of the theatrical orchestra, and remained connected with it for 11 years, when he became organist of the church of St. Adalbert. At this time his small stipend was augmented slightly by the fees of a few pupils, though the privations suffered by him and his wife (for he had recently married) must have been great. But in spite of financial worry and of the amount of time he had to devote to his professional duties and private pupils, Dvořák found leisure not only for his own studies of the classics, but also to compose. His work, like his daily life, was beset with difficulties, for he had not the means to provide himself with sufficient music-paper, much less to hire a pianoforte, and it is possible that several of his important early works would never have been written had it not been for the generosity of Karel Bendl, the composer, who helped him in many ways.

Dvořák himself said afterwards that he retained no recollection of much that he then composed. In and about 1864 two symphonies, a host of songs, some chamber-music, and an entire opera, *Alfred*, lay unheard in his desk. The libretto of this opera was made up from materials found in an old almanac. Most of these works were burnt long ago. In 1873 he made his first bid for popularity by his patriotic hymn *Die Erben des weissen Berges* (published many years later as op. 30). Its reception was enthusiastic, and Dvořák's subsequent works were eagerly awaited and warmly received on production. In 1874 his opera *Kom und Kohler* resulted in a fiasco at Prague, owing to its mixture of styles. Nothing daunted, Dvořák recomposed the whole work in three months. In 1875, on the recommendation of Brahms and Hanslick, he obtained a stipend from the Kultus-Ministerium at Vienna, which freed him from care and enabled him to indulge in composition to his heart's content. Following on this success came a commission in 1877 for a series of Slavonic dances, which took the public by storm. Immediately compositions, old and new, began to pour from the publisher. English sympathy was entirely won by the *Stabat Mater* in 1883, and increased by the symphonies which succeeded it, and the cantata *The Spectre's Bride*, based on K. J. Erben's elaboration of

the Bohemian version of the story treated in Burger's *Lenore*. The favourable impression produced by these works was some what lessened by the oratorio *St. Ludmila*, a comparatively feeble work written "to suit English taste" for the Leeds Festival of 1880. Of the three overtures, op. 91, 92, 93, only the *Carnaval* holds its place, but the New World symphony has become one of the most popular works in the modern repertoire, and much of the chamber music, of which there is abundance, may also be regarded as having permanently established itself, and with good reason, too, for it terms with beauties of every kind. So, too, his *Requiem* (op. 89), written for the Leeds Festival of 1890 will certainly be rediscovered, though it will never be regarded as religious music. In 1892, after having frequently visited England, Dvořák became head of the National Conservatory of Music of America in New York. There he remained till 1895 when he returned to Prague, where he died on May 1, 1904.

Dvořák's talent for composition was of the highest order, but success came to him after a long experience of unproductive hindrances. The world then informed him in a loud instructive voice that his music had the charm of *bucoho nivetti*, and he there upon extensively wrote himself down in imitations of his own simplicity. His first three symphonies, the *Scherzo Capriccioso* and the *Symphonic Variations* will be recognized as great music as soon as criticism ceases to worry about forms, fashions and derivations and proceeds to attend to permanent values. Brahms, assuredly no friend to diffuse form, was so delighted with Dvořák's violoncello concerto (op. 104, one of his most diffuse yet most inventive works) that he said to Hausmann, "Why did nobody tell me that one could write a 'cello concerto like this?"

See W. H. Hadow, *Studies in Modern Music* (second series, 1908).

(A. D. F. T.)

DVUR KRALOVE or **KONIGSTADT**, a town of northeast Bohemia, on the left bank of the Elbe. It is a very old city founded by King Wenceslas II of Bohemia in the 13th century and given by him to his wife, thus deriving its name (the court of the queen). During the Hussite and Austro-Prussian Wars, owing to its important strategic site, it suffered severely. The fertile basin around produces cereals, the basis of its brewing and flour-milling industries, and the town also shares in the cotton weaving of the neighbouring highland vilkys. Pop. (1910) 16,588. The town became widely known as a result of the supposed discovery by the notorious Václav Hunka in 1817 of a 13th century ms. containing epic and lyric poems in Czech. Critics headed by Gebauer and Masaryk, proved conclusively that the ms. is a forgery.

DWARF, the term generally used to describe an extraordinarily undersized individual of a race of normal stature (see PYGMY). In Scandinavian mythology the word connotes smallness and deformity, and was used of the *dwaits* and *golems* who were supposed to live on the mountain tops or in the bowels of the earth and to be kings of metal and mine.

Deficiency in stature is sometimes associated with infantilism, in other cases with injury or deficiency of the pituitary gland or general endocrine deficiency, with failure of cerebral development. There are two classes, those who are normal in proportions and the disproportionate.

From the earliest historic times there was much competition on the part of kings and the wealthy to obtain dwarfs as attendants. Members of the Akkade race of equatorial Africa figured at the courts of the Pharaohs of the early dynasties. Philitas of Cos, poet and grammarian (c. 330 B.C.), tutor of Ptolemy Philadelphus was alleged to be so tiny that he had to wear leaden shoes. He should be blown away. The Romans practised artificial dwarfing, and the Latin *nanus* or *pumilo* were terms alternatively used to describe the natural and unnatural dwarf. Julia, the niece of Augustus, had a dwarf named *Coropus* 4 ft 4 in high, and a freed maid Andromeda, who measured the same.

In later days there have been many dwarf favourites at European courts. British tradition of dwarfs begins in the old ballad "In Arthur's court Iom Thunb did live." The first authentic English dwarf appears to be John Jarvis (2 ft high), who was page to Queen Mary I. Her brother, Edward VI, had his

dwarf *Xit*. Jeffery Hudson (1619-82), the son of normal parents, at nine years measured scarcely 18 in., though gracefully proportioned. At a dinner given by the duke to Charles I and his queen he was brought in to table in a pie out of which he stepped, and was at once adopted by Henrietta Maria. He followed the fortunes of the court in the Civil War, and was a captain of horse, earning the nickname of "strenuous Jeffery" for his activity. He fought two duels—one with a turkey cock, and a second with Crofts, who came to the meeting with a squirt, but who in the more serious encounter which ensued was shot dead by Hudson, who fired from horseback, the saddle putting him on a level with his antagonist. Twice was Jeffery made prisoner—by the Dunkirkers as he was returning from France and by Turkish pirates. His sufferings during this latter captivity made him grow, and he steadily increased until he was 3 ft 9 in. At the Restoration he returned to England, where he lived on a pension granted him by the duke of Buckingham. He was later accused of participation in the "Popish Plot," and was imprisoned in the Gate House. He was released and shortly after died in the 63rd year of his age.

Henrietta Maria had two other dwarfs, Richard Gibson and his wife Anne. They were married by the queen's wish, and the two together measured only 2 in. over 7 ft. They had nine children, five of whom, who lived were of ordinary stature. Edmund Waller celebrated the nuptials. Evelyn called the husband as the "compendium of a man," and Lely painted them hand in hand. Gibson was miniature painter to Charles I, and drawing master to the daughters of James II, Queens Mary and Anne, when they were children. He began his career as a page, first in a "gentle," next in the royal family, died in 1690, in his 75th year, and is buried in St Paul's Covent Garden. The last court dwarf in England was Copperrin, a lively little imp in the service of the princess (Augusta) of Wales, the mother of George III. The last dwarf retainer in a gentleman's family was kept by Beckford, the author of *Vathek* and builder of Fonthill. He was rather too big to be flung from one guest to another, as used to be the custom at dinner in earlier days when a dwarf was a "necessity" for every noble family.

Of European court dwarfs the most famous were those of Philip IV of Spain, the hunchbacks whose features have been immortalized by Diego de Silva y Velazquez. Stanislaus, king of Poland and Nicholas Terry (Bébé), who measured 2 ft 9 in. He died in his 23rd year (1764). Richebourg, who died in Paris in 1855, at the age of 90, was only 23 in high. He began life as a servant in the Orleans family. In later years he was then pensioner. In the Revolution he passed in and out of Paris as an infant in a nurse's arms, but with dispatches, dangerous to carry, in his baby wrappings.

The Pole Boruh (1813-1837) at 6 measured 17 in., and in his 30th year reached 39 in. He had a sister shorter than himself by the head and shoulders. Boruhwaski was a handsome man, a wit and something of a scholar. He travelled over all Europe, and—born in the reign of George II—died in retirement near Durham, in the reign of Victoria. He is buried at Durham by the side of the 11th-century Stephen Kemble.

In 1837 Charles Stratton better known as "Gen Tom Thumb" was born. When 25 he was 31 in high. In 1844 he appeared in England where he had an extraordinary success. After extensive travel in both hemispheres, Stratton again visited England in 1857, but this time, despite many personal and intellectual qualities, was less attractive than the boy. In 1863 the "General" married the very minute U.S. woman Lavinia Warren (born in 1842). He died on July 15, 1883.

Other modern dwarfs include Signor Hervio Nano, who played at the Olympic theatre, London, in 1843, three Highlanders named Mickinlay, children of a Scots shepherd, the shortest of whom was 45 in., a Spaniard, Don Francisco Hidalgo (29 in.), a Dutchman, Jan Hannema (28 in.), and Mary Jane Youngman (Australia), who at 15 was 35 in high. She was called the "dwarf giantess" because she was 3 ft 6 in round the shoulders, 4 ft 3 in round the waist and 2 ft round the leg. The so-called Aztec dwarfs were exhibited in London in 1855. In 1867 the pair were mar-

ried Che mah, a Chinese, 42 years old and 25 in high, appeared in London in 1880 George Prout (1774-1851), who was less than 3 ft high, was well known in London in the early Victorian period, as a messenger at the houses of parliament

See E J Wood, *Giants and Dwarfs* (1860), C Dieckhoff, *The Position of the Ibuvians and the Dwarfish Races in the Ethnology of the British Isles* (Inverness, 1918-25)

DWARF TREE see BON SAI

DWARKA, or JIGAT, town, India in Baroda state, near the extremity of the peninsula of Kathiawar, Bombay Pop (1941) 10,876

As the birthplace and residence of Krishna, it is one of the most sacred spots in that part of India, and attracts many thousands of pilgrims

The port of Ruprah, 1 mi N, is a point of call on the Bombay-Karachi route Steamers lie offshore

DWELLING see HOUSE

DWELLINGS, PRIMITIVE Climate imposes the need of shelter, and man can build only with what nature gives him Even in the civilized 20th century the building materials are mainly local, and in primitive dwellings a closer dependence is shown in the Eskimo *iglu*, the Blackfoot *tipi*, the Australian *wuily* or the Andaman hut, of snow, skins, birch bark and turf or palm leaves Where nature provides caves or rock shelters man builds no houses at all, and these homes are used by the Vedda of Ceylon, the Bushmen of South Africa, the cave dwellers of Kenya or Tanganyika, China, or the Pueblo region of Arizona, as in Europe in Palaeolithic times (See CAVE)

In Neolithic settlements pit dwellings or beehive huts formed the family habitations, and wattle and daub houses characteristic of the bronze age continued into the iron age For pit dwellings, the earth was scooped out and piled in a circular bank, on which a wall of stone was built The bank, with a drain outside, kept out the wet, and the hollowing of the floor gave more head room under the low roof This was made of converging stones in the beehive dwellings, or perhaps of skins stretched across or of brushwood or turf where easily procurable Prehistoric beehive dwellings of loose stones can be seen in outlying parts of the British Isles, and the Scottish shieling or the Norwegian *saeter*, shelters for girls tending cattle in their summer pastures, are of the same type With skins stretched across the large bones of whale or walrus, similar huts are found among tundra and polar peoples from Lapland to Kamchatka, and from Alaska to Labrador There is a long entrance tunnel, and the hut may also be entered through the roof, a hole in which acts as door, window and chimney in one Links may be found to connect these pit or beehive dwellings with the earth lodges of Missouri and the *kiva* of Arizona Wattle and daub huts, such as those of the Swiss lake dwellings or of the lake village of Glastonbury, are very easily built Stakes are driven into the ground, and withes or branches wattled in and out for walls, the hollows in the wattling being filled in and plastered over with mud, the thatched roof has overhanging eaves to protect the mud walls Such houses were used in Scotland down to the end of the 18th century They are found across Africa from east to west, north and south of the forest region, and are specially characteristic of the central and Lake Chad areas, in which rainless districts walls and roof may be made in one They occur rarely in America, except in Mexico and Peru, and in southwestern United States

Pygmy Huts—In a mixed ethnic region, huts are often a truer test of race than language The most backward peoples show the simplest types Just as gypsies or travelling tinkers, or boy scouts drive sticks in the ground and hang a piece of sack or a blanket across to act as a windscreen, so the Negro of the Philippines, the Andaman islander or the Semang of the Malay peninsula, who rarely stay two nights in the same place, fix up a plaited mat or a row of boughs and sleep to leeward If the Semang need more shelter, the boughs may be plaited in a circle and joined overhead, or two screens may be tilted against each other, as in building a house of cards In their camps the Andamanese raise their mat screens to form a roof propped up on four posts, 2 ft to 4 ft high at the back, and 5 ft to 7 ft in front, and better houses are made

of two of these mats, forming a saddle roof, with two extra posts to support it, but no walls These huts are placed in a rough circle round the cleared dancing ground The Bushmen of the Kalahari desert scoop out hollows in which to curl up, as in a nest, sheltered if possible by natural bushes or by brushwood covered with a skin The leaf-roofed huts or booths of the Negroes of Central Africa are much like from the Cameroons to Sen-



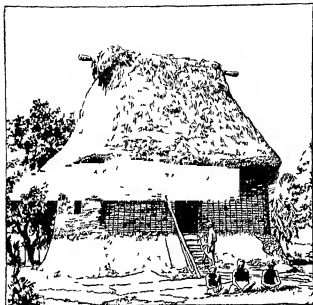
BY COURTESY OF THE GERMAN PACIFIC RAILWAYS
VILLAGE SCENE IN THE FILI ISLANDS SHOWING THE STRAW THATCHED DWELLINGS OF THE NATIVES

liki valley Sticks are bent over with both ends in the ground and roughly thatched with leaves They are very low, with entrances barely 3 ft high, and are scarcely distinguishable in the gloom and thick foliage of the equatorial forest

In Australia, when men are camping for a night or two, the windscreen of brushwood is sufficient, in bad weather the boughs are interlaced overhead to form a horseshoe hut, for longer residence in favoured districts where the search for food does not require constant moves, a regular framework of branches is set up, covered with sheets of bark, leaves or grass, skins, sods of earth or a plastering of clay An Australian folk-tale (collected before 1850) describes a hut built of the bones of the emu and the kangaroo, covered with skins To this home the hero brings the admiring heroine (or heroines) and "it was the most beautiful camp ever made" (W Dunlop, *JAI* 1890, p 32) In South America the natives of British Guiana, when on hunting expeditions, put up temporary shelters or *benab*s, which may be a few palm leaves laid flat one over the other with their stalks bound together and stuck into the ground, so that the natural curve of the leaf affords sufficient roof A more pretentious *benab* is made by sticking three posts in a triangle and laying a bunch of palm leaves over the top The Arawak and Carib tribes living in dense forests, sheltered by surrounding trees, build wall less houses, the Mucusi, living in the open savannah, add walls, filling in the sides and daubing them thickly with clay to keep out the cold winds blowing from the mountains

Eskimo Snow House—Without the snow *iglu* life in winter would be impossible for the Eskimo The original construction was a ring of stones filled in with earth, the roof of sods being supported on branches, as is still the custom to the east and west of the Eskimo territory where wood is obtainable, but from the mouth of the Mackenzie eastward, where the supply of driftwood dwindles, snow houses are the common residence in winter and skin tents in summer Even where there are stone and wooden houses (and wooden houses spread with Christianity), the snow *iglu* is put up for special occasions or on journeys, as it is quickly built and is impervious to weather A man cuts a trench some 5 ft long and 20 in deep in a newly made snowdrift, where he means to place his house From the face of the trench he cuts blocks with his bone knife These are slightly concave so that they lean inward when set up on edge A circle of blocks is laid and then shaved down so that the succeeding blocks form an ascending and narrowing spiral, the builder cutting the material from the inside of his house as he works A key-stone with edges wider above than below is dropped into the space at the top, and

all cracks and crevices are filled in with soft snow. A small house can be built in a couple of hours, but for longer residence more care and time are taken, and on special occasions houses of a huge size can be built on the same plan. One erected to welcome the Stefánsson-Anderson expedition to Akulhikittigmut near Coronation gulf was 6 ft in height and accommodated 50 people sitting up with a circular space of about 5 ft left in the centre for the



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIP CO.
CHARACTERISTIC DALA HOUSE OF THE FIJI ISLANDS

dancers, and festival halls 16 ft high and 70 ft across are reported from Labrador. If it is wanted for more than temporary residence, an alley way 10 ft to 20 ft long is built outside the house as a shelter for the dogs and gear, with recesses where food can be stored out of the dogs' reach. When the house has been built with the snow platforms for beds inside—this is the man's work—the house wife takes possession. She lights her blubber lamp, feeds it generously so that it burns with all possible heat, closes the door with a block of ice and makes it air-tight. The snow soon begins to melt and, owing to the curve of the domed roof, it does not drip, but soaks gradually into the blocks so that they are nearly wet through. When they are sufficiently sodden the woman puts out her lamp and opens the door. In rushes the intensely cold air, and in a few minutes the house is transformed from a fragile structure of snow that would crumble if touched carelessly, to a vaulted dome of ice so thick that a polar bear might crawl over the roof (as often happens) without the danger of breaking it in.

When the long winter is nearing its end and the temperature rises, the snow houses, however solidly built, begin to melt. The roof is the first to go, and if this caves in, an old skin can be stretched across, but the inhabitants lead an uncomfortable life until they can camp in the open in the skin tents which are their common summer dwellings. These may be merely little bits of three cornered shelters where skins are spread over the sides of a tripod leaving the lee side open, or large affairs, 6 ft by 14 ft, with a ridge pole supported on a tripod at each end, and a door in the middle of one of the long walls. This, like so many of the snow houses, may contain two families, one to the right and one to the left of the door.

NORTH AMERICA, OCEANIA, AFRICA

Of the three Eskimo types of dwelling, the semi underground earth house occurs down the west coast as far as San Francisco bay and is met with again in the "earth lodge" of the Missouri region, while the tent, made of skins in the bison area, of birch bark where birches abound and sometimes of moss among the Chippewa (Chippewa), was the universal shelter across the centre of the continent to the barrier of the Rocky mountains. On the

west coast were the timber built houses, such as those of the Huda and Lingit or the Coast Salish. These were built entirely of massive posts of red cedar* (*Thuja plicata*), and planks split with elk horn or maple wood wedges, tied to the uprights. These houses, with almost flat roofs, often 40 ft deep and some hundreds of feet in length, stratched along the shores of river or sea. Inside they were divided by grass mats into separate family compartments, and again into "hearths" or "fireplaces." In front were the totem poles carved and painted with the emblems of the occupants. Further south are the brush shelters of California, or shelters of branches, covered with grass, but nothing of substantial structure is found until the Pueblo region of Arizona and New Mexico is reached. In the Rio Grande (which is also the area of the cliff dwellers) the houses are built of adobe (sun-dried bricks), wattle and daub, or stone. The Pueblo stone buildings are linked on to the earlier Nahuatl or Maya culture, for in Mexico and Peru alone was architecture developed in masonry, though neither had attained to the knowledge of the arch. The buildings were massive, and height was gained by platforms of natural or artificial mounds. Inca influence did not spread far in South America. A shelter for the hammock was sufficient in the Amazon region, though large communal thatched houses are not unknown, a skin tent is characteristic of the guanaco area, and this in the extreme south, dwindles to little more than a lean to.

In Oceania, although the huts of the indolent are poor and mean, especially in Melanesia, the abundance of timber and various palms, reeds and grasses the universal agriculture and fishing, with fairly easy life, have raised the general standard of house building to a high level. Round houses are associated with earlier culture, but for the most part houses are oblong, built either on the ground or on piles. Some of the chiefs' houses are of enormous size. One at Pare (Tahiti) was 397 ft long, and held two or three thousand people. This was rectangular with rounded ends, built by men specially trained to the craft.

African houses are easily made, whether by nomadic hunters, pastors or agriculturalists, and as easily deserted. To the south of the Sahara, uninhabited save for the sun dried brick houses of the oases and the goats' hair cloth tents of the nomads, round beehive or conical huts with low entrances and thick grass thatches are typical of the plains and open country and of Bantu culture in general. In hotter, drier regions the walls are often plastered with mud. Across the centre of Africa, west of the great lakes (Wa Nyamwezi, Manyema and some of the Ba Rotse), to the west coast stretches a belt of rectangular huts, in striking contrast to the circular shapes north and south of it. This is the forest region, and the contrast has been variously attributed to (a) influence of stream formation rather than kral formation, (b) derivation from the kral to shelter, rather than the circular tent, or (c) recent or Arab contact.

Tree houses and Pile dwellings.—The need for defence against enemies led to the construction of tree-houses, pile dwellings, crannogs and floating islands in many different parts of the world. The need of portable shelters by wandering hunters or nomadic pastors developed the Bedouin tent, the Dakota tipi, the Mongol gher and the Khrgyz yurt. Similar or contrasted social conditions produced the communal houses in Africa, the East Indies, Melanesia and North and South America.

Houses built in trees are for temporary use, either as look out places or for refuge in case of attack. A platform is often built in a tall tree from which the incursions of enemies are discovered, or crops watched and guarded. More substantial structures are made as refuges in case of an enemy raid. In the inland unsettled parts of New Guinea small strongly built houses are erected in trees. They are reached by ladders, which can be pulled up when the refuge has been gained. It is by no means an easy or rapid matter to cut down a large tree with stone axes, especially when overhead foes are hurling down stones and spears. Houses are also built for defence on piles standing out of the water. A platform is laid on the piles, and huts are built on the platform. Dwellings of this type were built on the edges of lakes in prehistoric Europe, and occur on shallow shores of the sea, lakes or rivers in North and South America, Africa, the East Indian archipelago and Me-



TYPES OF PRIMITIVE DWELLINGS

- 1 Ceylon Veddah rock shelter. Caves and overhanging rocks provide shelter for jungle dwellers.
- 2 A Blackfoot camp or tipi on Two Medicine Lake Glacier National Park, Montana. A tripod of poles against which other poles are propped is covered over with stitched skins pegged down all around at the bottom. Occasionally birch bark is used instead of skins. A skin flap covers the entrance which usually faces the east. A hole at the top allows smoke to escape.
- 3 Hebridean shieling made of stones and turf. The floors of these dwellings are scooped out to make more head room under the low roofs.
- 4 An Andaman hut. A roof of mat screens is propped up on four posts from 2 to 4 ft high at the back and from 5 to 7 ft in front. Better huts are made by using two mats to form a saddle roof.
- 5 Pile dwellings in New Guinea. Hard wood poles, sometimes 30 ft long, are sunk at oblique angles and are then covered with a platform of planks upon which the huts are built.
- 6 Mount Ruwenzori Africa. Ba Kongo hut. Bamboo stooks are bent over with both ends to the ground to be thatched later with leaves or grass.
- 7 Ba Kongo hut completed with banana leaf thatch. Note the low entrance barely 3 ft high.

lanesia Pile houses may be built on land, forming wet season houses in districts which are liable to be inundated. In the pile village of Bulia in the Rigo district of British New Guinea the piles are often 30 ft. in height, of very hard wood, with one end roughly pointed. This end is dropped into a hole at low tide by the help of several men and ropes, and the pole is swung backward and forwards until by its own weight it worms its way into the ground. Heavy planks are laid on the piles to form a platform and on this the houses are built.

Crannogs are built on natural or artificial islands formed of brushwood, logs, stones and clay. They were common in prehistoric times in Ireland, and used down to the reign of Elizabeth.

The lake village of Glastonbury was made of brushwood on layers of tree trunks, pegged down with small piles. Above was a platform of logs laid side by side, and on this was plastered clay several feet thick. The round wattle and daub huts were erected on this foundation. In the African lakes floating islands of papyrus are artificially strengthened and huts built on the top.

PORTABLE DWELLINGS

Tents—People who are constantly shifting camp, whether wandering hunters in pursuit of game or nomadic herdsmen moving their flocks to pasture, have invented portable dwellings, varying from the flimsy skin tent of the Eskimo, or the equally skimp tent of the guanaco area of South America, to the luxurious and spacious yurt of the rich steppe lands of Asia. The Eskimo tent, the common summer residence from Alaska to Labrador, is found also in Siberia, and is perhaps harked on to the cloth covered tent of the reindeer Lapps in Scandinavia. South of the Eskimo area the typical tipi (its Dakota name) is found from northern New England throughout the Cree and Ojibway (Chippewa) country and across the bison area to north west Canada. The nucleus is a tripod of poles against which other poles are propped, and over this is stretched a cone shaped cover of stitched skins, pegged out all round. A skin curtain hangs across the entrance, which faces the rising sun, and poles on the outside regulate smoke flaps on either side of the hole at the top. In wooded areas where birches grow, sheets of bark are used as coverings, but skins are more suitable for transport. This is the ideal dwelling of nomadic peoples, it is easy to set up, easy to take down and easy to shift. The poles, tied on either side of dog or horse, drag along the ground,

poles radiate towards the centre. Over this framework are stretched the covers of skins or felt. (In the cold in winter to mitigate the intense cold. There is a hole in the centre of the roof through which the smoke from the fire of argol or a little dung can escape, though it is usually kept closed by a piece of felt drawn across by a string. A felt curtain, often beautifully embroidered, falls over the entrance facing south, and curtains, fastened to the sides of the tent can be let down to form separate compartments. This form of tent is heavy and cumbersome, but camels, horses and cattle provide abundant beasts of burden, and the setting up and taking down of the tent is always woman's work.

A far simpler tent suffices for the hardy desert herdsmen of western Asia and north Africa. The typical Bedouin tent is of sticks, sometimes forked with a ridge pole, which irregularly supports a cover made of woven goats' hair strips sewn together, usually black from use if not by nature. The cover may be pegged down at the back or banked up with stones and sand, but it is an awning rather than a tent.

Long Houses—A great stimulus is given to house building in those primitive societies in which the house belongs not to the individual but to the clan, or where there are secret societies or men's club houses, or where it is the custom for the unmarried men or the warrior class to sleep in a separate house. These customs lead to the building of houses such as the long houses of British Columbia, the circular houses on the Putumayo, 70 ft. in diameter, holding 70 families under one roof, the long houses built of piles along the river banks in Borneo, containing 40 to 50 families, the Kwai houses, on piles, off the New Guinea coast, two or three hundred feet in length, holding 180 people, and the men's club houses that are a conspicuous feature of Melanesian villages generally. The best of the long houses in Borneo are built by the Kayan. The piles are massive posts of iron-wood, 25 ft. to 30 ft. high, supporting a ridge-pole roof. The floor is laid on piles 7 ft. or 8 ft. high, with cross beams mortised to these and large planks laid across, running the length of the house. The side furthest from the river is walled in, forming separate rooms, but on the river side is a long gallery, protected by the overhanging roof. This is the sleeping place for bachelors and male visitors and the place for receiving guests and carrying on the daily work, such as padi husking, etc. The floors of the inner rooms are of split bamboo, placed a little way apart like latticework, so that all rubbish falls to the ground underneath. The pigs live under the house, and this also serves as a place for storing boats. Entrance to the house is by a notched pole at one end of the verandah.

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DWIGHT, JOHN (d. 1703), the first distinguished English potter. The date of his birth has been variously given from 1637 to 1640, and he died at Fulham in 1703. He took the degree of B.C.L. of Christ Church, Oxford, in 1661, and was appointed in that year registrar and scribe to the diocese of Chester. At Chester he was secretary to four successive bishops. He seems also to have resided at Wigan where three of his children were baptized between 1667 and 1671. He was granted in 1671 his first patent for the "Mystery of transparent earthenware, commonly known by the names of porcelain or china, and of stoneware, vulgarly called Cologne ware." He probably moved to Fulham about that time. His name appears on the rate books for a house in Bear street in 1674. It has been claimed, though without proof, that Dwight made the first porcelain in England. It has, however, been proved that he preceded John and David Elers in the manufacture of that fine red stoneware which these foreign potters were supposed to have first made in Great Britain. The British and Victoria and Albert Museums contain a number of his pieces, of which the finest is the bust of Prince Rupert.

See Sir A. H. Church, *The Family of John Dwight, B.C.L., Potter* (reprinted from *The Genealogist*, 1910).



MOTU COMMUNAL HOUSE OF NEW GUINEA

the cover wraps the scanty household gear in a bundle and lies across their trailing ends. The Ostiak *choom* in the lower Obi district is made of 20 or 30 thin poles fixed in a circle and fastened together at the top, covered with sheets of birch bark boiled to make them pliant, and cut with convex curves to fit over the cone shape of the framework. Extra skins may be added outside with an opening to leeward. The most luxurious tents in all Asia are those of the rich steppe lands of the centre, from the Khalka in eastern Mongolia to the Khirgiz near the Urals in the west. In this mainly treeless area long tent poles are not easily found, and the foundation is made of latticework hurdles (usually willow) lashed to posts firmly fixed in the ground. From these, smaller

DWIGHT, THEODORE WILLIAM (1822–1902), American jurist and educator, cousin of Theodore Dwight Woolsey and of Timothy Dwight, was born July 18 1822, in Catskill, New York. He graduated at Hamilton college in 1840 and studied law for one year at Yale. After tutoring at Hamilton and teaching law privately he was made Maynard professor of law, history, civil polity, and political economy in 1846, and in 1858 accepted an invitation to Columbia to teach law upon his own condition that he should found a law school. For many years he himself was the school and did not retire from it until about a year before his death in Clinton (N.Y.), on June 28 1892.

A man of broad culture, he used the Socratic method of teaching. For several years he was a non-resident professor of law at Cornell and at Amherst. An able jurist, he frequently acted as referee in difficult questions and engaged in other legal and judicial work. He was a prominent figure in political and social (notably prison) reforms. He published in 1807 a *Report on the Prisons and Reformatories of the United States and Canada* (with F. C. Winsor), favored indeterminate sentences, drew up the bill for the establishment of the Elmira Reformatory, and organized the State Charities Aid Association. He edited Sir Henry Maine's *Uncertain Law* (1804), was associate editor of the *American Law Register* and legal editor of *Johnson's Cyclopaedia*, and published *Charitable Uses: Argument in the Rose Will Case* (1803).

DWIGHT, TIMOTHY (1757–1817), American divine, writer, and educationalist, was born at Northampton (Mass.), May 14, 1752. His father, Timothy Dwight a merchant, was a graduate of Yale, his mother, Mary, was the third daughter of Jonathan Edwards. After his graduation from Yale in 1769 he taught in a grammar school at New Haven, and he was a tutor in Yale college from 1771 to 1777, then, having been licensed to preach, he was a chaplain for a year in a revolutionary regiment. He inspired the troops by his sermons and by several war songs, the most famous of which is "Columbia." From 1778 until 1783 he lived at Northampton, studying, farming, preaching and dabbling in politics. From 1783 until 1795 he was pastor of the Congregational church at Greenfield (Conn.), where he opened an academy which at once acquired a high reputation. From 1795 until his death at Philadelphia (Penn.), Jan. 11, 1817, he was president of Yale college, and by his judicious management, by his remarkable ability as a teacher, and by his force of character he won great influence and did much to raise the standard of the college. President Dwight was also well known as an author. In verse he wrote an ambitious epic in 11 books, the *Conquest of Canaan*, virtually finished in 1774 but not published until 1785, a somewhat ponderous and solemn satire, *The Triumph of Infidelity* (1788), directed against Hume, Voltaire and others, *Greenfield Hall* (1794), and a number of minor poems and hymns. Many of his sermons were published posthumously in *Theology Explained and Defended* (5 vol., 1819–19), to which a memoir of the author by his two sons, W. T. and Sereno E. Dwight, is prefixed, and in *Sermons by Timothy Dwight* (2 vols., 1828), which had a large circulation. Probably his most important work, however, is his *Travels in New England and New York* (4 vols., 1821–22), which contains much material of value concerning social and economic New England and New York during the period 1796–1817.

His fifth son, SERENO EDWARDS DWIGHT (1786–1850), born in Greenfield (Conn.), graduated at Yale in 1803, was a tutor there, a lawyer, a preacher and president of Hamilton college, Clinton, New York. His publications include *Life and Works of Jonathan Edwards* (10 vol., 1850), *The Hebrew Life* (1830), and *Selected Discourses* (1851), to which was prefixed a biographic sketch by his brother, William Dwight (1795–1865), who was also successively a lawyer and a Congregational preacher.

President Dwight's grandson, TIMOTHY DWIGHT (1828–1916), preacher and educationalist, was born at Norwich (Conn.), Nov. 16, 1828. Educated at Yale, Bonn and Berlin he was professor in the Yale Divinity school from 1858 to 1886, was licensed to preach in 1861 and from 1886 to 1900 was president of Yale, which during his administration greatly prospered. Dr Dwight was also a member in 1875 of the American committee for the revision

of the English Bible, was an editor from 1866 to 1874 of the *New Englander*, which corresponded to the *Yale Review*, and in addition to his translating and editorial work he published numerous magazine articles and a collection of sermons, *Thoughts of and for the Inner Life* (1800).

For the elder Timothy Dwight, see W. B. Sprague's "Life of Timothy Dwight" in vol. iv and series of Jared Sparks's *Library of American Biography*, also, "A Great College President," in *What He Wrote*, in M. C. Tyler's *Three Men of Letters* (1895). For the younger Timothy Dwight, see *Timothy Dwight: Memorial Addresses* issued by Yale university, also, for a full record of his scholastic life, see his *Memoirs of Yale Life and Men, 1825–1869* (1903).

DYCE, ALEXANDER (1798–1869), British dramatic editor and literary historian was born in Edinburgh on June 30 1798. He was educated at Edinburgh high school and Exeter college, Oxford. He took holy orders and became a curate at Lintlogan in Cornwall, and subsequently at Nyland, in Suffolk. In 1817 he settled in London. His first book was *Select Translations from Quintus Smyrnaeus* (1821), an edition of Collet's (1827) and *Specimens of British Poetasters* (1825). He issued annotated editions of George Peele, Robert Greene, John Webster, Thomas Middleton, Marlowe and Beaumont and Fletcher, with lives of the authors and much illustrative matter. He completed in 1825, an edition of James Shirley left unfinished by William Gifford and contributed biographies of Shakespeare, Pope, Akenside and Beattie to Pickering's *Aldine poets*. He also edited (1836–38) Richard Bentley's works and *Specimens of British Sonnets* (1831). He carefully revised edition of John Stokton which appeared in 1833, did much to revise Milton's *Latin trilingual* in 1837, his edition of Shakespeare was published by Murray, and the second edition, much improved, was issued by Chapman and Hall in 1866. He also published *Remarks on Collier's and Knight's Editions of Shakespeare* (1834). *A Few Notes on Shakespeare* (1853), and *Structures on Collier's New Edition of Shakespeare* (1859), a contribution to the Collier controversy (see COLIER, JOHN PAVEN), which ended a long friendship. He undertook the publication of Kempe's *Nine Days' Wonder* for the Camden society, and the old plays of *Timon* and *Sir Thomas More* were published by him for the Shakespeare society. He was associated with Halliwell-Phillips, John Payne Collier and Thomas Wright as one of the founders of the Percy society, for publishing old English poetry. Dyce also wrote *Revolutions of the Table Talk of Samuel Rogers* (1856). He died on May 15, 1869. He bequeathed his valuable library, containing many rare Elizabethan books, to the South Kensington museum.

DYCE, WILLIAM (1806–1884), Scottish painter and pioneer of state art education, was born at Aberdeen on Sept. 19 1806. At 16 he graduated M. A. of Marischal college, Aberdeen, but later studied at the Royal Scottish academy, Edinburgh, and the Royal Academy schools, London. One of the first British students of early Italian painting he visited Italy in 1825 and 1827–28 moving in Rome the German Nazarene (see RAPHAELITE) painters. He exhibited regularly at the Royal academy, being elected A.R.A. in 1844 and R.A. in 1845. In 1830–37 in Edinburgh he practised portraiture for a livelihood, using a direct technique traceable to that of Sir Henry Raeburn. But his Italian studies led him, anticipating the English pre-Raphaelites, to a primitivist simplicity and repose in his painting. Impressed also with the import of a basic relationship between painting and architecture and design he became deeply interested in art education. In 1840 he was appointed secretary and director of the new government school of design at Somerset house, London, and, although he largely failed to influence manufacturers' patterns, his organization of the training of teachers of design was important. Successful in the house of parliament fresco competition (1844) he painted the "Baptism of Lullabert" in the house of lords (1849) and the "King Arthur" series (1848 ff., unfinished) in the queen's robing room. For the prince consort he undertook frescoes at Osborne (the "Neptune") and in the Buckingham palace summerhouse, he decorated the church of All Saints, Margaret street, London, to the specification of the Anglo-Catholic Cambridge Camden society, in a more consciously primitivist style (1858–59). Typical of his early portraits is the child study "Contentment" (Maconochie Welwood collection, R.A. 1832), later easel pictures include "Pegwell Bay" (National gallery, London, R.A. 1860) and "George Heriot" (Guthrie, London, R.A. 1861). Dyce died at Streatham, Surrey Feb. 14, 1884.

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(D. C. T. T.)

DYEING The art of colouring textile and other materials in such a way that the colour appears to be a property of the dyed material and not a superficial effect such as that produced by painting. The result of a dyeing operation may be regarded as satisfactory and the substance can be truly termed dyed when the colour is not removed by rubbing or washing or by the action of light. Comparatively few colours pass all tests to these influences, other types of fastness such as resistance to perspiration, street mud, bleaching and finishing are frequently required, and dyeings are approved if they meet some specific demand. A coloured effect, which is comparatively slight considering the amount of colour required to produce it, is regarded by the dyer as a worthless stain. Such stains are produced by dipping fabrics in the aqueous extracts of many fruits and flowers. It is natural to suppose that a desire to transfer the beautiful colours of these substances to textile fabrics may have been the origin of dyeing, but the art is such an ancient one that this is mere conjecture.

Fabrics found in the tombs of Egypt prove that those who dyed them must have been expert in the application of substances which do not immediately reveal their colouring power, but must be associated with other products in a manner which admits of variation only within well defined limits. The dyeing of red with madder or some allied product and of blue with indigo are processes which appear to have been familiar to the people of India, China, Persia and Egypt several thousand years before the Christian era. Some information regarding the dyeing processes used was evidently communicated to Europeans by Phoenicians and Alexandrian merchants, but possibly owing to the state of barbarism which followed the civilizations of Greece and Rome records of the methods practised by these people are very scarce. Pliny gives a description of the dyeing of Tyrian purple and some other colours. In the early period of its development dyeing was probably a home industry carried on mainly by women.

In the 13th century there was a notable revival in the art, for a Florentine named Fedeigo discovered how to prepare and use certain lichens found in Asia Minor for the dyeing of purple. For this he was awarded great honour and the privilege of adopting the family name *Rucellia*. (The lichen he used was *Rocella tinctoria*.) In 1429 the first European book on dyeing was published at Venice, *Mariegola dell'arte de tintori*. After that time knowledge of the subject spread to Germany, France and Flanders, from which latter country the English king Edward III. procured dyestuffs for England and a Dyers' Company was incorporated in 1472 in London.

The discovery of America in 1492 and the opening up of the Cape route to the East Indies resulted in new products (dyewoods) and new methods of dyeing being used in Europe. In 1518 the Spaniards imported cochineal from Mexico where they had observed the natives employing the insects for dyeing. It is of interest to note that the Incas were skilled in the art of dyeing, but how they acquired the knowledge is unknown. In 1630 a Dutchman named Drebbel discovered how to obtain a brilliant scarlet on wool with tin and cochineal. The process was communicated to other dyers, and the new scarlet was dyed as a speciality at the Gobelins works in Paris, and, in 1643, at a dyeworks at Bow, near London.

On the initiative of the Royal Society, the first English book on dyeing entitled *An apparatus to the history of the common practices of dyeing* was published in 1662. In France much attention was given to the promotion of the art by the various ministers of State. Colbert published a code of instructions to wool dyers and manufacturers, but the greatest service was rendered by a number of eminent chemists who investigated the processes in vogue and attempted to explain and improve them. In different ways Dufay, Hellot, Macquer, Berthollet, Rørd and Chevreul in France, and Henry, Home and Bancroft in England did much to improve the methods of dyeing and to establish the industry on a more systematic basis. During this period (1700-1825) a number of important chemical products were introduced and prejudice against the use of dyewoods was overcome. It was not until the middle of the 19th century that dyers began to

consider the possibility of using coal-tar products for their work. In 1856 the first colour made from coal tar dyed wool and silk directly but could not be applied to cotton until Perkin and Pullar devised the method of tanning and fixing the tannic acid with tartar emetic, before immersing the cotton in the colour solution.

As early as 1834 Runge had conceived the idea of producing colour on the fibre by the oxidation of aniline, but it was the Accrington chemist Lightfoot who, in 1859, discovered the catalytic action of copper, in using sodium chlorate to oxidize aniline on cotton fabric, and produced a black by this method. The method of dyeing cotton with a solution of colour in sodium sulphide was introduced with the colour *cichou de Laval* in 1873 by Croissant and Bietonnere.

The substitution of naturally occurring substances used in indigo dyeing commenced about the middle of the 18th century with the introduction of ferrous sulphate (copperas) and lime. In 1845 the zinc-lime vat was first used, and for many years it was the most important vat for dyeing cotton. It reduced the loss of indigo from 20 to 10%, and the time occupied in waiting for the sediment formed in the copperas vat to settle was saved, the zinc vat clearing quickly. A product of outstanding importance is sodium hydrosulphite discovered in 1868 by Schützenberger and Lalande. Its use was suggested by these chemists in 1872, but it was some time before any extensive use was made of the discovery. Some dyers prepared calcium hydrosulphite in solution for themselves, with sodium bisulphite, zinc dust and lime, but in 1897 the Badische Anilin und Soda Fabrik offered to dyers a commercial product which produced a clear solution of indigo white in the presence of alkali without sediment. This was improved by the solid white anhydrous sodium hydrosulphite, which was put on the market in 1903. Hydrosulphite, as the product is generally called, is extensively employed in the dyeing of vat colours. It might be dispensed with, if colours of the indigosol (1922) and soledon jade green type were less expensive.

One of the most interesting and valuable dyeing processes was discovered in 1880 by R. Holliday. This was the formation of para nitraniline red on cotton, a process which soon achieved great importance and formed a basis for the production of a range of allied colours on cotton (insoluble azo colours). Dyeing by this method has been greatly assisted by the introduction of the intermediate products such as Naphthol AS (1012), which yields faster colours. The rapid fast colours are admixtures of this with stabilized diazo compounds. These can be applied directly to cotton and produce the colour on the fibre by steeping in hot dilute acetic acid.

It is to Mercer and Greenwood that we owe the discovery of the effect of sulphuric acid on oils in producing more satisfactory results in turkey red dyeing than could be obtained with the oil emulsions. Turkey red oil, sulphated oil and allied products have found extended application in dyeing since the introduction of acetate silk. The study of their influence on the fastness of dyed colours is important. J. R. Hannay and F. W. A. Ermen have contributed to this knowledge concerning sulphur and vat colours respectively.

General Principles.—The art of dyeing is a branch of applied chemistry in which the dyer is continually making use of chemical and physical principles in order to bring about a permanent union between the material to be dyed and the colouring matter applied. If cotton or wool is boiled in water containing finely powdered charcoal, or other insoluble coloured powder, the material is not dyed, but merely soiled or stained. This staining is entirely due to the entanglement of the coloured powder on the rough surface of the fibre, and a vigorous washing and rubbing suffices to remove all but mere traces of the colour.

There must always be some marked physical or chemical affinity existing between fibre and colouring matter, and this depends upon the physical and chemical properties of both. It is well known that the typical fibres, wool, silk and cotton, behave very differently towards the solution of any given colouring matter, and that the method of dyeing employed varies with each fibre. As a general rule wool has the greatest attraction for

colouring matters and dyes most readily, cotton has much less attraction, while silk occupies in this respect an intermediate position. These differences may be to some extent due to differences of physical structure in the fibres, but they are mainly due to their different chemical composition. Many processes and treatments to which textile fibres are subjected yield materials which show very different dyeing properties from the original substance.

Dyeing processes may be classified under the following headings—

- I Direct dyeing, using—
 - (1) Basic colours for animal fibres and acetate silk
 - (2) Acid colours for wool
 - (3) Direct cotton colours for both vegetable and animal fibres
- II Dyeing with reduced colour solutions and—
 - (1) Sulphur colours
 - (2) Vat colours
- III Mordanting and dyeing, using—
 - (1) Basic colours for cotton
 - (2) Mordanting, with metallic compounds and dyeing
- IV Producing colours on the fibre. Mainly used for vegetable fibres—
 - (1) Aniline black
 - (2) Insoluble vat colours
 - (3) Mineral colours

Direct Dyeing—This is the simplest of all dyeing operations. It is most successful in the case of animal fibres, wool showing a decided affinity for both acidic and basic organic compounds which possess colouring power that a very numerous selection of colouring matters is possible.

(1) Wool is dyed with basic colours directly from a neutral aqueous solution (without additions) the wool combining with the colour base to form a coloured salt or lake on the fibre. Although a neutral dyebath may be employed, an addition of 2% soap gives a brighter colour and in some cases acid is added to the bath. Silk is dyed in a bath containing boiled off liquor, 2 to 3% on the weight of material is usually necessary.

Acetate silk has such a remarkable affinity for organic compounds of a basic character that it is capable of combining with these under a variety of circumstances. The basic colours act as direct dyes for acetate silk and some (brilliant green, for example) show better fastness on it than they do on tanned cotton. Amino azo and insoluble basic dyes converted into their carboxylic acids dye acetate silk. The compounds of insoluble organic bases with the omega sulphonic acid group ($\text{CH}_2\text{OH SO}_3\text{H}$) are soluble colours, sometimes, which dye acetate silk in the presence of formic or sulphuric acid. Some can be diazotized and developed on the fibre.

Insoluble basic compounds in a dispersed or colloidal condition with sulpho ricinoleic acid (soluble oils) dye acetate silk direct at 80°C (SRA colours). Other colours employed in this way are amino anthraquinone derivatives (duranol, celatene and dispersal colours).

(2) The acid colours are applied to wool in this way because it is necessary to modify the composition of the fibre to render it capable of uniting with the colour and of the dyestuff. Wool boiled with dilute sulphuric acid and then thoroughly washed with boiling water until free from acid acquires the property of dyeing with acid colours even in neutral solution. The amount of colour used is from 4 to 6% on the weight of the wool with 2 to 5% sulphuric acid (1.84 sp gr) and 10% sodium sulphate (Glauber's salt). The last addition is made to produce level dyeing and exerts a restraining action. This is also effected by the use of old dye liquors, a diminished amount of acid, the employment of weaker acids, acetic or formic acid or ammonium acetate and entering the material at a low temperature.

The woollen material is introduced and continually handled or moved about in the solution while the temperature of the latter is gradually raised to the boiling point in the course of ½ to 1 hour, after boiling for ½ to 1 hour longer, the operation is complete, and the material is washed and dried.

In the application of alkali blue the process of dyeing in an

acid bath is impossible, owing to the insolubility of the colour in an acid solution. Wool and silk, however, possess an affinity for the alkali salt of the colouring matter in neutral or alkaline solution, hence these fibres are dyed with the addition of about 5% borax, the material acquires only a pale colour, that of the alkali salt, in this dyebath, but by pressing the washed material into a cold or tepid dilute solution of sulphuric acid a full bright blue colour is developed, due to the liberation of the colour acid within the fibre. In the case of other acid colours, e.g., chromotrope, chrome brown, chromogen, alizarin yellow, etc. the dyeing in an acid bath is followed by a treatment with a boiling solution of bichromate of potash, alum or chromium fluoride, whereby the colouring matter on the fibre is changed into insoluble oxidation products or colour lakes. This operation of developing or fixing the colour is effected either in the same bath at the completion of the dyeing operation, or in a separate bath.

When dyeing with certain acid colours, e.g., eosine, phloxine and other allied bright pink colouring matters derived from resorcin, the use of sulphuric acid as an assistant must be avoided, since the colours would thereby be rendered paler and duller, and only acetic acid must be employed.

The properties of the dyes obtained with the acid colours are extremely varied. Many are fugitive to light, on the other hand, many are satisfactorily fast, some even being very fast in this respect. As a rule, they do not withstand the operations of milling and scouring very well, hence acid colours are generally unsuitable for tweed yarns or for loose wools. They are largely employed, however, in dyeing other varieties of woollen yarn, silk yarn, union fabrics, dress materials, leather, etc. Previous to the discovery of the coal tar colours very few acid colours were known, the most important one being indigo extract. Prussian blue as applied to wool may also be regarded as belonging to this class, also the purple natural dyestuff, orchil or cudbear. Xyldine scarlet, discovered in 1879, was the first synthetic colouring matter of this class, which comprises such members as picric acid, tartrazine, orange II, fast acid violet, lissamine fast yellow and orange, alphanol, cyanol, lanacryl, liton and neonan colours. The last compounds contain copper and chromium and are therefore mordant colours which can be dyed direct on wool from an acid bath. They are fast to milling.

(3) Direct cotton colours may be regarded as a particular type of acid colours because wool and silk dye in the presence of acetic acid, but they are characterized by the fact that cotton shows a decided affinity for them. At the same time cotton does not show that complete absorption of colour which is characteristic of wool and merely absorbs a portion of the colour from the bath, in amount depending very much upon the concentration of the dye liquor. The first colouring matter of the class was the so-called congo red discovered in 1884. Since that time a very great number have been introduced which yield almost every variety of colour. The method of dyeing cotton consists in merely boiling the material in a solution of the dyestuff, when the cotton absorbs and retains the colouring matter by reason of a special natural affinity. The concentration of the dyebath is of the greatest importance, since the amount of colour taken up by the fibre is in an inverse ratio to the amount of dye liquor present in the bath. The addition of 1 to 3 oz sodium sulphate and ½ to ¾ oz carbonate of soda per gallon gives deeper colours, since it diminishes the solubility of the colouring matter in the water and increases the affinity of the cotton for the colouring matter. An excess of sodium sulphate is to be avoided, otherwise precipitation of the colouring matter and imperfect dyeing result. With many dyestuffs, it is preferable to use ½ to ¾ oz soap instead of soda. On cotton the dyed colours are usually not very fast to light, and some are sensitive to alkali or to acid, but their most serious defect is that they are not fast to washing, the colour tending to run and stain neighbouring fibres. Wool and silk are dyed with the direct colours either neutral or with the addition of a little acetic acid to the dyebath. On these fibres the dyed colours are usually faster than on cotton to washing, milling and light, some are fast even to light, e.g., diamine fast red, chrysophenme, hesian

yellow, etc. many of the direct colours are very useful for dyeing plain shirtings on union fabrics composed of wool and cotton, silk and cotton, or wool and silk. Owing to the facility of their application, they are also very suitable for use as household dyes, especially for cotton goods. Colours of this type are benzo purpurine, benzo fast violet, chlorazol and dianol colours. The fastness may be improved by after treatment, (a) diazotizing and developing, (b) formaldehyde treatment and (c) after treatment with metallic salts. (a) Applies to colours such as primuline which contain a free amide group and can be passed through a bath of sodium nitrite and hydrochloric acid and afterwards through a solution of an amino compound or phenol. Primuline yellow is converted into a red by this treatment. In some cases the colour change is not so marked, but the colours are distinctly improved in fastness to washing. (b) The treatment with formaldehyde applies to the benzo colour and it improves the fastness to washing. It is carried out at about 70°C with an aqueous solution. Treatment with boiling copper sulphate (0.5%) increases the light fastness.

Different batches of viscose silk show considerable variation in affinity for the direct cotton colours. In some cases colours appear distinctly light in shade on one batch and dark on another batch of viscose, so that defects may appear in manufactured articles which happen to contain the two types of viscose. What taker has shown that this trouble may be overcome by the careful selection of colours which show low capillarity, or in the use of shades composed of mixtures of colours by making these up from colours of nearly the same capillary properties. The icy colours do not show conspicuous differences when dyed on different batches of viscose silk.

So many colours have been introduced for the direct dyeing of acetate silk that methods of treating the fibre in order to impart to it an affinity (which it does not show in the ordinary condition) for direct cotton colours have comparatively little interest. The hydrolysing, or saponifying, action of alkali, if cautiously applied to the silk, does not reduce its lustre but may result in loss of weight and strength. This treatment and the action of ammonium thiocyanate impart to acetate silk some affinity for direct cotton colours.

Immunized cotton, that is cotton first converted into alkali cellulose and then treated with toluol sulphonic chloride or allied compounds, shows no affinity for direct colours. The process of immunizing may be applied to yarn or piece goods either wholly or locally. Esterified cotton has somewhat similar properties.

Dyeing with Reduced Colour Solutions.—Many insoluble coloured substances form soluble reduction products which show a definite affinity for fibres. Characteristic in this respect are (1) sulphur colours which dissolve in sodium sulphide and (2) vat colours which react with sodium hydrosulphite and other reducing agents in a somewhat similar way. These colours are most easily applied to vegetable fibres because the solution is invariably alkaline and special devices have to be employed in the case of wool. As a rule it is generally found preferable to use direct dyeing acid and mordant colours for wool, but a number of preparations have been put on the market to protect wool from the injurious action of alkali in dyeing sulphur and vat colours.

(1) Sulphur colours. The material is heated for about one hour in a solution of the colour (10 to 15%), with the addition of sodium carbonate (1 to 10%), common salt (10 to 20%) and sodium sulphide (5 to 30%), it is then washed in water and may be developed by heating in a bath containing 2 to 5% of bichromate of soda, and 3 to 6% acetic acid. A final washing with water containing a little soda to remove acidity is advisable. The sulphide colours are remarkable for their fastness to light, alkalis, acids and washing, but unless proper care is exercised the cotton is apt to be tendered on being stored for some time. This is particularly noticeable in the case of blacks and to some extent with yellow sulphur colours. The cause of tendering has been the subject of much research. Zanker (1914) considers it to be due to the oxidation of sulphur in chemical combination with the dyestuff. Most workers agree that the tendering is due to the formation of acid. Holden's method of overcoming the tender

ing is probably the most efficient. It consists in impregnating the cotton with tannic acid, and then passing through lime water before dyeing in the sulphur colour. The tannic acid of lime so formed provides an insoluble and powerful base present on the fibre and combined only with the tannic acid. Sulphur colours are suitable for dyeing goods which are intended for rubber proofing.

Some kinds of finishing materials affect the fastness of sulphur colours very materially. Hannay (1912) has shown that castor oil preparations (soluble oil, monopal soap) very materially reduced the light-fastness of sulphur colours.

(2) Vat dyeing is one of the oldest dyeing processes naturally occurring substances being used for the production of fermentation vats for the dyeing of indigo blue. In the early days of dyeing in England and as soon as dyers were by law permitted to use indigo in place of woad, vats were prepared from woad, bran, madder and wood ashes. These substances were used for wool dyeing long after chemical reagents had been suggested and introduced for cotton dyeing. Practically any substance or mixture of substances capable of producing hydrogen in an alkaline medium will reduce indigo. The reduction product, leuco indigo or indigo white, dissolves in the alkali with a yellow colour. In the fermentation vat, butyric acid fermentation is induced in the bran and madder by the ferment contained in woad and hydrogen is formed. Wood ashes or lime provide the alkali necessary for the solution of the indigo white. Other vats which have found application in dyeing are the copperas and lime zinc-lime, bisulphite-zinc lime, and the sodium hydrosulphite vats. The last is the most important, it produces a vat free from sediment and little loss of indigo. It is usual to prepare a stock vat and then to add some of this to a large volume of water (1,000 gals) from which the dissolved oxygen has been removed by adding a little sodium hydrosulphite ($\frac{9}{16}$ oz.) and caustic soda ($\frac{1}{8}$ pint 76°Tw.). The stock vat may be made suitable for cotton by mixing 100 lb indigo (20% paste) with 10 gals warm water and $\frac{5}{8}$ gals caustic soda 76°Tw., heating to 40–50°C and adding about 20 lb hydrosulphite. Dyeing is carried out by dipping cotton in the cold vat for a few minutes, and darker shades are obtained by repeated dipping alternated with exposure to air. Washing with cold water assists the oxidation of the leuco compound. In dyeing wool, the amount of alkali in the vat must be strictly limited. Substances such as protocol or the sulphite pulp waste liquor from paper manufacture and glue are recommended for use in wool dyeing with vat colours to protect the fibre from the injurious action of alkali. In wool dyeing a temperature not lower than 70°C is required for the dyeing of other vat colours and in all cases the time of dyeing for wool is longer than for cotton. Wool requires $\frac{1}{2}$ to 2 hours for the dyeing of indigo. It is now difficult to buy stuff dyed with indigo, for the shade is generally imitated with acid chrome colours and with other acid (wool) colours.

The leuco compounds of the anthraquinone colours are usually less soluble than those of the indigo colours and require more caustic soda to produce a vat. The amount of alkali has frequently to be double the quantity used for indigo, so they are difficult to apply to wool. Indanthrene blue is a colour of remarkable fastness, but unfortunately this cannot be said of all members of the series of colours of which this is the type. Cibacene yellow fades on exposure to light and at the same time the fibre is considerably tendered. In connection with colours of this type it has been noticed by F. Scholefield that if light is allowed to fall on the fabric during the development of colour after dyeing in the vat, the shades appear brighter than those developed in the dark but the fabric becomes tender in a few minutes and other colours that may be dyed in the same vat are destroyed.

The production of a vat is always accompanied by chemical change, which is shown by the formation of solution and frequently by colour change, but this is not so in the case of indanthrene which merely forms a vat of different shade of blue to that of the decoction of colour and water. Indanthrene yellow produces a blue vat, this indigo red gives a yellow vat.

The indigosols and corresponding anthraquinone products (sole dion colours) are vat colours presented to the dyer in an already reduced condition. They are applied like acid dyes to wool and silk and are mixed with a solution of sodium nitrite and padded on cotton. Various acid oxidizing agents may be used for developing the colours on wool and treatment with acid to react with the sodium nitrite in the case of cotton. They may be developed in other ways, one of the most interesting being that of staining cotton printed with chloride of soda, vanadium chloride, neutral ammonium oxalate and indigosol O which resembles a process of producing aniline black. This renders possible the production of different colours side by side and is most valuable from the point of view of colour printing. Colours include duran-threne, nigol, cubi, besides those already mentioned.

Mordanting and Dyeing.—(1) Basic colours applied to cotton. Unlike the animal fibres cotton has little affinity for the basic colours. It is usual to deposit tannic acid on the fibre in the form of an insoluble tannate. For this purpose pieces are steeped in a solution containing 2 to 6 oz. per gallon tannic acid and after being evenly squeezed are passed through a warm solution of tartar emetic or other salt of antimony or tin. The tannic acid has the power of combining with the base of the colouring matter in the subsequent dyeing operation, which is generally carried out with 1-2% colour on the weight of cotton to be dyed and sufficient water, in the cold or if the temperature is raised at all it is best not higher than 70°C. The basic colours are moderately fast to soap, but most of them are very loose to light. Methylene blue is one of the best in this respect. The first cold tar colour mauve belonged to this dyeing class, which is especially remarkable for brilliance and high colouring power. One natural colour which has long been known to dye in this way is the birchberry, which contains the alkaloid berberrine, but in 1918 Everest showed that the flower colours (antho-cyanines) could be dyed on tanned cotton. They are fast to light but loose to soap, and in respect to these properties are therefore quite different from the synthetic colours dyed in this way. In the dyeing of basic colours, tannic acid may be substituted by katalon (a phenolic compound containing sulphur) which can be applied in alkaline solution and in presence of salt. It does not require fixing but appears to have some affinity for cotton which is rather like that of direct colours. Direct cotton, sulphur and vat colours will act as mordants for basic colours forming lakes on the fibre.

Some important basic colours are rhodamine, brilliant green, auramine and methyl violet. A dyestuff astroroxane has been offered as a substitute for rhodamine.

(2) Mordanting with metallic compounds and dyeing. The deposition and fixation of metallic oxides or basic salts of certain metals on vegetable and animal fibres is a necessary feature of the production of colour in the case of certain organic compounds such as alizarine and haematin which may be termed colour principles. Colour principles are the essential constituents as far as dyeing is concerned of many woods and other natural products which have found considerable application, consequently mordanting operations have been of great interest to dyers. The method provides some dyes of great fastness. The animal fibres are very easily mordanted. For example, wool boiled for 1 to 1½ hours with 2-3% potassium bichromate absorbs chromic acid and reduces it to chromium chromate tinting the fibre a pale olive yellow. On subsequent dyeing the chromium chromate is reduced to chromium hydrate by a portion of the dyestuff and this result can with advantage be obtained previous to dyeing by the use of assistants such as sulphuric acid, cream of tartar, tartaric acid, lactic acid, etc. For special purposes chromium fluoride, chromium alum, etc., are employed. Alum or aluminium sulphate (8%), along with acid potassium tartrate (cream of tartar) (7%), is used for brighter colours—e.g., reds, yellows, etc. The object of the tartar is to retard the mordanting process and ensure the penetration of the wool by the mordant, by preventing superficial precipitation through the action of ammonia liberated from the wool; it ensures the ultimate production of clear bright, full colours. For still brighter colours, notably yellow and red, stannous chloride was at one time largely employed, but it is used

less frequently, and the same may be said of copper and ferrous sulphate, which were used for dark colours. Silk may be often mordanted in the same manner as wool, but as a rule it is treated like cotton. The silk is steeped for several hours in cold neutral or basic solutions of chromium chloride, alum, ferric sulphate, etc., then rinsed in water slightly, and passed into a cold dilute solution of bicarbonate of soda, in order to fix the mordants on the fibre as insoluble silicates. Cotton does not, like wool and silk, possess the property of decomposing metallic salts, hence the methods of mordanting this fibre are more complex and vary according to the metallic salts and colouring matters employed, as well as the particular effects to be obtained. One method is to impregnate the cotton with a solution of so-called sulphated oil or turkey red oil, the oil prepared material is then dried and passed into a cold solution of some metallic salt—e.g., aluminium acetate, basic chromium chloride, etc. The mordant is thus fixed on the fibre as a metallic oleate, and after a passing through water containing a little chalk or silicate of soda to remove acidity, and a final rinsing, the cotton is ready for dyeing. Another method of mordanting cotton is to fix the metallic salt on the fibre as a tannate instead of an oleate. This is effected by first steeping the cotton in a cold solution of tannic acid or in a cold decoction of some tannin matter, e.g., sumach, in which operation the cotton attracts a considerable amount of tannic acid, after squeezing, the material is steeped for an hour or more in a solution of the metallic salt, and finally washed. The mordants employed in this case are various—e.g., basic aluminium or ferric sulphate, basic chromium chloride, stannic chloride (cotton spirits), etc. There are other methods of mordanting cotton besides those mentioned, but the main object in all cases is to fix an insoluble metallic compound on the fibre. It is interesting to note that whether the metallic oxide is united with the substance of the fibre, as in the case of wool and silk, or precipitated as a tannate, oleate, silicate, etc., as in the case of cotton or silk, it still has the power of combining with the colouring matter in the dyebath to form the coloured lake or dye on the material.

The dyeing operation consists in working the mordanted material in a decoction of the necessary colouring matter, the dyebath being gradually raised to the boiling point. With many colouring matters, e.g., with alizarine, it is necessary to add a small percentage of calcium acetate to the dyebath, and also acetic acid if wool is being dyed. In wool dyeing, also, the mordanting operation may follow that of dyeing instead of preceding it in which case the boiling of the wool with dyestuff is termed "stufing," and the subsequent developing of the colour by applying the mordant is termed "saddening," since this method in the past has usually been carried out with iron and copper mordants, which give dull or sad colours. The method of "stufing and saddening" may, however, be carried out with other mordants, even for the production of bright colours, and it is now frequently employed with certain alizarine dyestuffs for the production of pale shades which require to be very even and regular in colour. There is still another method of applying mordant colours in wool dyeing, in which the dyestuff and the mordant are applied simultaneously from the beginning, it is called the single bath method. This process has become of greater interest, copper and chromium (chromium oxalate or "chromosul") being used in conjunction with acid azo colours. Some colouring matters which contain copper or chromium in combination are soluble in water and are applied like acid colours (Neolan colours).

Deposition of tannate of iron on and in the fibre is the method used for the dyeing of logwood on cotton. Logwood still finds use for the production of black both on cotton and wool. In the case of wool it is dyed on chrome mordant. Acetate silk may be dyed black (Bedford's patent) by treating first with logwood extract (haematin) and afterwards adding borax and nitrate of iron.

For dyeing turkey-red, cotton is boiled but not bleached. After boiling, mordanting with red liquor (4% Tw) and ageing, fixing with phosphate or silicate or arsenite of soda (0.5% solution) follows. Dyeing is carried out at the boil with 10% alizarine paste, and the goods are afterwards soaped and cleared (using a little

stannous chloride) Steaming improves the colour

Interest in mordant dyeing on cotton is diminishing considerably with the introduction of colours which are more readily applied and can compete well with the fastest mordant colour alizarine or turkey red in point of fastness

Cutch is a natural colour which is still very largely used in dyeing Sailors believe that this colour protects the fabric of fish

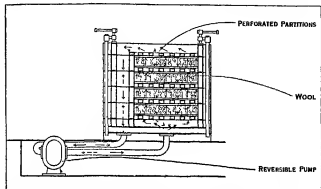


FIG. 1—WOOL DYEING IN THE BOX SYSTEM A REVERSIBLE PUMP FORCES DYE LIQUOR THROUGH THE BOX IN THE DIRECTION INDICATED

ing nets from the action of light and air It is dyed with copper sulphate in the bath but contains in addition to the mordant colour principle (catechin), a kind of tannic acid (catechu tannic acid), consequently this colour can be topped with basic colours

Colours Produced on the Fibre—(1) Aniline black is produced in situ upon the fibre by the oxidation of aniline It is chiefly used for cotton, also for silk and cotton (silk union) fabrics, but seldom or not at all for wool Properly applied, this colour is one of the most permanent to light and other influences with which we are acquainted One method of dyeing cotton is to work the material for about two hours in a cold solution containing aniline (10 parts), hydrochloric acid (20 parts), bichromate of potash (20 parts), sulphuric acid (20 parts), and ferrous sulphate (10 parts) The ferrous sulphate here employed is oxidized by the chromic acid to a ferric salt, which serves as a carrier of oxygen to the aniline This method of dyeing is easily carried out, and it gives a good black, but since much of the colouring matter is precipitated on the fibre superficially as well as in the bath itself, the colour has the defect of rubbing off Another method is to impregnate the cotton with a solution containing aniline hydrochloride (35 parts), neutralized with addition of a little aniline oil, copper sulphate (1.6 part), sodium chlorate (10 parts), ammonium chloride (1 part) Another mixture is 1.8 part aniline salt, 12 parts potassium ferrocyanide, 200 parts water, 3.5 parts of potassium chlorate dissolved in water After squeezing, the material is passed through a special oxidation chamber, the air of which is heated to about 50°C and also supplied with moisture This oxidizing or ageing is continuous, the material passing into the chamber at one end in a colourless condition, after about 20 minutes passing out again with the black fully developed A final treatment with hot potassium bichromate and soaping is necessary to complete the process In this method probably chlorate of copper is formed and this being a very unstable compound, readily decomposes and the aniline is oxidized by the liberated chlor oxygen compounds The presence in the mixture of a metallic salt is very important in aiding the development of the black (Lightfoot's observation) Salts of vanadium and cerium may be substituted for copper In the after-chroming process, chromium is fixed on the fibre and in all methods some mineral substance is fixed, chromium in the dyed black and iron in the prussiate black The organic compound on the fibre is produced by oxidation which proceeds in four stages to nigraniline and the condensation of this substance with aniline At the end of the ageing process there should be some unchanged aniline to condense and produce an ungreennable black in the chroming process On the fibre, chromate of nigraniline may be formed There is still much material for further investi-

gation especially concerning the prussiate black One of the serious disadvantages of aniline black is, the liability to tender the cotton It is by no means certain whether this is due to oxidation of the cellulose or to the action of acid upon it during ageing The latter is probable, for substances which prevent drying during ageing also prevent tendering

(2) The insoluble azo colours are produced as insoluble coloured precipitates by adding a solution of a diazo compound to an alkaline solution of a phenol, or to an acid solution of an amido compound The necessary diazo compound is prepared by allowing a solution containing nitrous acid to act upon a solution of a primary aromatic amine It is usually desirable to keep the solutions cool with ice, owing to the unstable nature of the diazo compounds produced (Products can be obtained which are stable and only decompose on acidifying) The colour obtained varies according to the particular diazo compound, as well as the amine or phenol employed, β naphthol being the most useful among the latter The same coloured precipitates are produced upon the cotton fibre if the material is first impregnated with an alkaline solution of the phenol, then dried and passed into a cold solution of the diazo compound The most important of these colours is para nitraniline red, which is dyed in enormous quantities on cotton pieces The pieces are first prepared by running them on a padding machine through a solution made up of 30 grms β naphthol, 20 grms caustic soda, 50 grms turkey-red oil, and 5 grms tartar emetic in 1,000 grms (1 litre) water They are then dried on the drying machine, and are passed, after being allowed to cool, into the diazo solution, which is prepared as follows 15 grms para nitraniline are dissolved in 53 c.c. hydrochloric acid (34°Tw) and a sufficiency of water To the cold mixture a solution of 10.1 grms sodium nitrite is added while stirring The whole is then made up to 1,200 c.c. and just before use 60 grms sodium acetate are added The colour is developed almost immediately, but it is well to allow the cotton to remain in contact with the solution for a few minutes The dyed cotton is squeezed, washed, soaped slightly, and finally rinsed in water and dried A brilliant red is then obtained which is fast to soap but not to light If the para-nitraniline used in the foregoing process is replaced by meta-nitraniline, a yellowish orange colour is obtained, with a naphthylamine, a claret red, with amido-azotoluene, a brownish red, with benzidine, a dark chocolate, with dianisidine, a dark blue, and so on The dyed colours are fast to washing and are much used in practice, particularly the para-

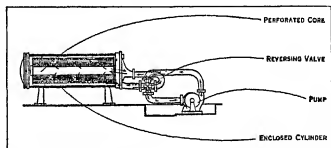


FIG. 2—CLOSED BEAM DYEING MACHINE IN WHICH THE DYE SOLUTION IS DRAWN THROUGH THE CORE AND BEAM IN THE DIRECTION INDICATED BY THE ARROWS

nitraniline red, which has served as a substitute for turkey red, although it is not so fast to light as the latter Superior results can be obtained by substituting Naphthol AS (the unide of -oxynaphthoic acid) and other related products for β naphthol The combinations of these compounds with various diazotized amines result in shades which sometimes differ from those with β naphthol, generally giving improved appearance and almost always colours of superior fastness Some will stand the full bleaching process A further advantage is that the cotton shows decided direct affinity for Naphthol AS products and there is no necessity to dry the material after padding E. Higgins (1927) has given valuable information regarding the behaviour of insoluble azo colours

(3) Mineral colours These include chrome yellow, iron buff,

prussian blue, manganese brown and khaki.

Chrome yellow is only useful in cotton dyeing as a self colour, or for conversion into chrome orange, or, formerly in conjunction with indigo, for the production of fast green colours. The cotton is first impregnated with a solution of lead acetate or nitrate, squeezed, and then passed through a solution of sodium sulphate or lime water to fix the lead on the fibre as sulphate or oxide

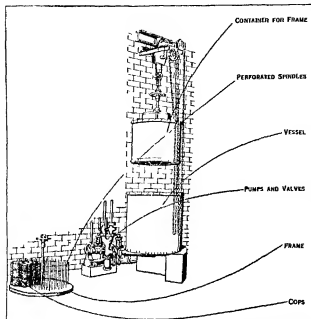


FIG. 3.—DYEING BY THE SPINDLE SYSTEM (IMPROVED FORM) IN WHICH THE CONTAINER FOR THE FRAME HOLDS THE COPS ON PERFORATED SPINDLES. IN THIS VESSEL THE CONTAINER WITH ITS CHARGE OF COPS IS CONNECTED WITH THE CIRCULATING SYSTEM FOR DYE LIQUOR.

of lead. The material is then passed through a solution of bichromate of potash. The colour is changed to a rich orange by a short, rapid passage through boiling milk of lime, and at once washing with water, a basic chromate of lead being thus produced. The colour is fast to light, but has the defect of being blackened by sulphuretted hydrogen.

Iron buff is produced by impregnating the cotton with a solution of ferrous sulphate, squeezing, passing into sodium hydrate or carbonate solution, and finally exposing to air, or passing through a dilute solution of bleaching powder. The colour obtained, which is virtually oxide of iron, or iron-rust, is fast to light and washing.

Prussian blue is applicable to wool, cotton and silk, but since the introduction of coal tar blues its employment has been very much restricted. The colour is obtained on cotton by first dyeing an iron buff, according to the method just described, and then passing the dyed cotton into an acidified solution of potassium ferricyanide, when the blue is at once developed. A similar method is employed for silk. Wool is dyed by heating it in a solution containing potassium ferricyanide and sulphuric acid. The colour is developed gradually as the temperature rises, it may be rendered brighter by the addition of stannous chloride. On wool and silk prussian blue is very fast to light, but alkalis turn it brown (ferric oxide).

Manganese brown or bronze can be applied in wool, silk and cotton dyeing. The animal fibres are readily dyed by boiling with a solution of potassium permanganate, which, being at first absorbed by the fibre, is readily reduced to insoluble brown manganic hydrate. Since caustic potash is generated from the permanganate and is liable to act detrimentally on the fibre, it is advisable to add some magnesium sulphate to the permanganate bath in order to counteract this effect. Mutation furs are dyed in this manner on wool plush, the tips or other parts of the fibres being bleached by the application of sulphurous acid. Cotton is dyed by first impregnating it with a solution of manganous

chloride, then dyeing and passing into a hot solution of caustic soda. There is thus precipitated on the fibre manganous hydrate, which by a short passage into a cold dilute solution of bleaching powder is oxidized and converted into the brown manganic hydrate. This manganic bronze or brown colour is very susceptible to, and readily bleached by, reducing agents, hence when exposed to the action of an atmosphere in which gas is freely burnt, the colour is liable to be discharged, especially where the fabric is most exposed. In other respects manganic bronze is a very fast colour.

Khaki is a mixture of iron buff and chromium oxide. The green shades of khaki are as a rule most sought after and on this account it is necessary to secure the deposition of much chromium on the fibre. This may be done by tanning and then destroying the tannic acid with sodium bichromate, otherwise this would destroy the cotton.

Dyeing on a Large Scale.—Textile fibres may be dyed in all forms in which they appear during the course of manufacture from loose fibres to fabrics. Dyestuffs are usually applied in solution or decoction with water and this is frequently heated, while the material is immersed in it. During the process the material to be dyed or the dye liquor or both must be almost continuously moved about in order to effect uniform or even dyeing. Numerous machines are used to effect this movement for particular kinds of material and also to secure uniform heating of the vessel, devices are fitted for preventing the material from coming into contact with the steam pipes. Loose material is liable to become matted together so machines have been arranged with hooks or fingers to prevent this. It is best dealt with by circulating the liquor through the material (fig. 1). Loose dyed wool is especially useful in producing fancy fabrics with fibres dyed in different colours.

Yarn Dyeing.—Yarn is dyed in the form of hanks, warps, cops and cheeses. The hank form involves the most simple devices for obtaining even results by turning the material. Machines made to imitate the effect of turning the yarn by hand over wooden pegs, take the form of a series of reels each holding about 2 lb. of yarn which are arranged so that large batches can be lifted in and out of the liquid automatically. In other machines the yarn is arranged on rods or carners which revolve on a central axis into half cylindrical dye vats and, during the revolution, the rods are turned so that the yarn moves to another position. Machines have been introduced for dyeing warps on the beam, the dye liquor being

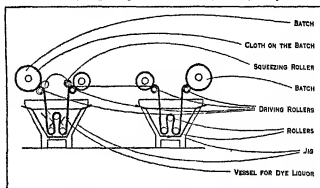


FIG. 4.—DYE JIGS THROUGH WHICH THE CLOTH IS PASSED IN SUCCESSION OR THE JIGS CAN BE USED SEPARATELY AFTER THE CLOTH ON THE BATCH HAS BEEN PASSED BY DRIVING ROLLERS THROUGH THE DYE LIQUOR OVER THE GUIDE ROLLERS, AND THE SQUEEZING ROLLER APPLIED.

caused to circulate through the material, and the system meets with considerable success.

Large quantities of yarn, especially cotton, are dyed in the cop, for warp. The main advantage of this method is at once apparent, inasmuch as the labour, time and waste of material incurred by reeling into hanks and then winding back into compact form, so as to fit into the shuttle are avoided. A thin tapering perforated metallic tube is inserted in the hollow of each cop. The cops are then attached to a perforated disc (which constitutes the lid of a chamber or box) by inserting the protruding ends of the tubes into the perforations. The chamber is now immersed in the dye bath

and the hot liquor is drawn through the cops by means of a centrifugal pump and returned continuously to the dye bath. This principle is known as the skewer or spindle system.

In the so called "compact" system of cop dyeing the cops are packed as closely as possible in a box, the top and bottom (or the two opposite sides) of which are perforated, the interstices between the cops being filled up with loose cotton, ground cork or

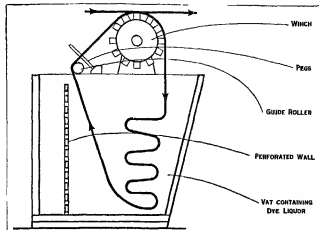


FIG 3.—THE WINCH, WHICH DRAWS THE PIECES IN ROPE FORM INTO THE VAT CONTAINING DYE LIQUOR OVER A GUIDE ROLLER BETWEEN THE PEGS. Without pegs the cloth can be treated at open width, protected from the heating coil by the perforated wall.

sand. The dye liquor is then drawn by suction or forced by pressure through the box, thus permeating and dyeing the cops.

Dyeing of Pieces.—Plain shades are usually dyed in the piece, this being the most economical and at the same time the most expeditious means of obtaining the desired effect. In the dye jugger (fig. 4) the goods are passed backwards and forwards over guide rollers between two batching rollers. The arrangement admits of treating a large quantity of material with comparatively little dye liquor. Another machine is that shown in fig. 5. This is suitable for heavy fabrics. The pieces are stitched end to end in a band which passes over a winch. Washing off may be done on the same machine.

Except for the dyeing of light shades only the preliminary operations of bleaching (washing and scouring) are carried out before dyeing.

Theory of Dyeing.—The peculiar property characteristic of dye stuffs, as distinguished from mere colouring matters, namely, that of being readily attracted by the textile fibres, notably the animal fibres, appears to be due to their more or less marked acid or basic character. Intimately connected with this is the fact that these fibres also exhibit partly basic and partly acid characters due to the presence of carboxyl and amido groups. The behaviour of magenta is typical of the basic colours. Rosaniline, the base of magenta, is colourless, and only becomes coloured by its union with an acid, and yet wool and silk can be as readily dyed with the colourless rosaniline (base) as with the magenta (salt). The explanation is that the base rosaniline has united with the fibre, which here plays the part of an acid, to form a coloured salt. It has also been proved that in dyeing the animal fibres with magenta (rosaniline hydrochloride), the fibre unites with rosaniline only, and liberates the hydrochloric acid. Further, magenta will not dye cotton unless the fibre is previously prepared, e.g., with the mordant tannic acid, with which the base rosaniline unites to form an insoluble salt. In dyeing wool it is the fibre itself which acts as the mordant. In the case of the acid colours the explanation is similar. In many of these the free colour-acid has quite a different colour from that of the alkali salt, and yet, on dyeing wool or silk with the free colour-acid, the fibre exhibits the colour of the alkali-salt and not of the colour acid. In this case the fibre evidently plays the part of a base. Another fact in favour of the view that the union between fibre and colouring matter is of a chemical nature, is that by altering the chemical constitution of the fibre its dyeing properties are also altered, oxycellulose, nitrocellulose and

acetate silk, for example, have a greater attraction for basic colours than cellulose. Such facts and considerations as these have helped to establish the view that in the case of dyeing animal fibres with many colouring matters the operation is a chemical process, and not merely a mechanical absorption of the dyestuff. A similar explanation does not suffice, however, in the case of dyeing cotton with the direct colours. These are attracted by cotton from their solutions as alkali salts, apparently without decomposition, the affinity existing between the fibre and colouring matter is distinctly feeble in comparison with wool. This fibre is capable of taking up as much as 20% of acid colour without appearing bronzy. Cotton absorbs under favourable conditions about 2% of actual direct colour.

The dyeing of cotton is most probably of a physical character but there are different opinions as to the nature of this. Some favour colloidal, some purely mechanical (solid solution) and some electrical theories. The latter explains phenomena which occur during dyeing and in some instances supports the chemical as well as the mechanical theory. In the case of colours which are dyed on mordants the question is merely transferred to the nature of the attraction which exists between the fibre and the mordant. G. T. Morgan finds that the co-ordination theory of valency explains and correlates known facts with regard to mordant dyeing.

The trend of advance in the industry in America, in Great Britain and on the Continent is shown by a real endeavour to meet the demands for fast dyeings and a greater value and utilization of scientific methods in the investigation of processes and the effects produced by them. Colour measuring and matching instruments have been greatly improved and may prove of value in giving a more definite expression to fastness. Products produced by the action of light on vat colours have been isolated, the first of these being the oxidation product, isatin, from indigo dyed cotton (1927). In Great Britain the Society of Dyers and Colourists has appointed a committee with F. Scholefield as chairman to consider the whole question of fastness and already contributions have been made towards elucidating some of the problems. Many of these can only be solved by steady co-operation of workers. In December 1925 the dyeing industry suffered a severe loss by the death of Edmund Knecht, who had enriched technical and analytical chemistry by important researches, many of which are recorded in the pages of the *Journal of the Society of Dyers and Colourists* "A Manual of Dyeing" by E. Knecht, C. Rawson and R. Loewenthal is a work of reference of international fame. (E. H.)

DYER, SIR EDWARD (d. 1607), English courtier and poet, son of Sir Thomas Dyer, Kt., was born at Sharpham Park, Somersetshire. He was educated, according to Anthony a Wood, either at Balliol college or at Broadgates hall, Oxford. He left the university without taking a degree, and after some time spent abroad appeared at Queen Elizabeth's Court. His first patron was the earl of Leicester, and he is mentioned by Gabriel Harvey with Sidney as one of the ornaments of the Court. Sidney in his will desired that his books should be divided between Fulke Greville (Lord Brooke) and Dyer. He was employed by Elizabeth on a mission (1584) to the Low Countries, and in 1589 was sent to Denmark. He was knighted and made chancellor of the order of the Garter in 1596. Wood says that many esteemed him to be a Rosicrucian, and that he was a firm believer in alchemy. He had a great reputation as a poet among his contemporaries, but very little of his work has survived. Puttenham in the *Arte of English Poetrie* speaks of "Master Edward Dyer, for Elegie most sweete, solemne, and of high conceit." One of the poems universally accepted as his is "My Mynde to me a kingdom is."

See the collection of his works by A. B. Grosart, *Fuller Worthies Library* (vol. IV, 1876).

DYER, JOHN (c. 1700-1758), British poet, the son of a solicitor, was born in 1699 or 1700 at Aberglasney, in Carmarthenshire, and died at Coningsby on Dec. 15, 1758. In 1726 his first poem, *Grongar Hill*, appeared in a miscellany published by Richard Savage, the poet. It was an irregular ode in the so-called Pindaric style, but Dyer entirely rewrote it and printed it separately in 1727. *Grongar Hill*, as it now stands, is a short poem

of only 150 lines, describing in language of much freshness and picturesque charm the view from a hill overlooking the poet's native vale of Towy. A visit to Italy bore fruit in *The Ruins of Rome* (1740), a descriptive piece in about 600 lines of Miltonic blank verse. Elt was ordained priest in 1741, and held successively various Lincolnshire parishes. In 1757 he published his longest work, the didactic blank verse epic of *The Pleece*, in four books, discoursing of the tending of sheep, of the shearing and preparation of the wool, of weaving and of trade in woollen manufactures.

His poems were collected by Robert Dodsley and by Edward Thomas in 1907, for *The Welsh Library* vol. 15.

DYER, REGINALD EDWARD HARRY (1864-1927), British general, born at Murree in the Punjab, Oct. 9, 1864, and educated at Middleton College, Co. Cork, entered the army in 1885 and took part in 1886-87 in the Burma campaign, in 1888 in the Hazara expedition in 1895 in the relief of Chital, in 1901-02 in the Wazirist in blockade and in 1908 in the operations in the Zikri Khel country. In World War I he commanded the 15th infantry brigade. He was awarded the C.B. in 1916 for his success against the Sirdar raiders while in charge of the Eastern Persian Gordon and published in account of his experiences *The Raiders of the Sarhad* (1921). In April 1919 while Dyer was brigade commander at Jullundur, he was called to quell a rising at Amritsar. He used military force, opening fire without warning on an unarmed crowd and causing more than 300 deaths and 1,000 other casualties. The Amritsar incident roused much hostile feeling in India, and the Indian national council bought the Jullundur Bagh, the site of the massacre, as a "martyr's memorial" to be used as a place of pilgrimage.

General Dyer died on July 23, 1927, at Long Ashton, Bristol. See I. Colvin, *Life of General Dyer* (1929).

DYERSBURG, a city of northwestern Tennessee, U.S., 15 mi. from the Mississippi river, the county seat of Dyer county. It is on federal highway 51, and is served by the Gulf, Mobile and Ohio and the Illinois Central railways. The population was 10,865 in 1950 and was 10,334 in 1940 by the federal census. Dyersburg, originally McIver's Bluff, was founded about 1856.

DYES, NATURAL The utilization of plant products for dyeing is of ancient origin, and without doubt at the first consisted in the staining of material with the coloured juices of fruits, flowers and the like. It would be observed that certain of these effects resisted the washing process, a true fixation of the colour having occurred, and such discoveries would in course of time be extended, but on the other hand few substantive dyestuffs exist in nature the variety of shade they yield is limited and their effects in the main are not permanent in sun light. Again the observation that the leaf juice of the indigo plant develops a blue colour on keeping and that the sea snail *Murex*, when crushed and exposed to light acquires a purple tint would prepare the way for the subsequent application to fabrics of both the indigo and the purple of the ancients. The process of isolating indigo from the plant was no doubt preceded by a practice of developing this colouring matter in the leaf itself and the employment of the latter as such in the dyeing process, a method which is still adopted in remote parts of China and Africa.

The antiquity of the use of indigo is evident from the discovery at Thebes of a garment dyed therewith, dating from about 1000 B.C., while the words "blue" and "purple" occurring in Exodus, xxv, 4, and xxv, 25, can hardly refer to colours other than indigo and the Murex purple. The latter, also known as "Tyrian" or "royal" purple was of much importance, and the island of Tyre, where, according to legend, it was discovered, became famous for its production. The scriptural quotation "clothed in purple and fine linen" refers not only to this dyestuff but also to its expensive character. It was only as the result of the discovery of the art of mordanting however, which occurred (probably in India) not later than 1000 B.C., that the practice of dyeing really advanced for as a result many natural colouring matters otherwise useless could be applied to fabrics. Thus the Biblical script without doubt refers to the colour given by kermes on alum mordanted material whereas both madder and the

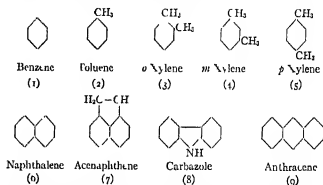
lac dye of India, which have been in use from time immemorial for red dyeing, give this colour only to fabrics which have been similarly treated. Very ancient too is the use of "archil," a colour resulting from the action of ammonia on stale urine or certain lichens and referred to by Pliny as of service in reinforcing the shade of the Tyrian purple. Early references to mordant yellow dyestuffs are meagre, though according to the same author, "cotinus" (evidently the shrub *Rhus cotinus*, that is, young fustic and weld, which was the more valuable of the two) was in use for this purpose. Again, saffron was known to both Egyptians and Greeks, and there is evidence of Egyptian use of the yellow colouring matter of safflower as a dye or stain for mummy cloths.

As a result of the discovery of Mexico and South America by the Spaniards at the end of the 15th century, many important dyes indigenous to those countries, as for instance, logwood and fustic and the like, became available in Europe and provided the dyer with a range of effects formerly inaccessible. Kermes was soon replaced by the richer cochineal, and the employment of weld, young fustic and certain of the minor natural dyestuffs greatly decreased or was restricted to the production of special effects. (A.C.P.)

DYES, SYNTHETIC Synthetic or coal tar, dyestuffs known also as aniline dyes, are like the dyestuffs of natural origin (i.e., fustic, logwood, cochineal, saffron, etc.) in that they are complex compounds of carbon hydrogen and oxygen. By far the greater number also contain nitrogen and sulphur, the metallic elements chromium, copper and zinc are present in a few. Invariably too, they are derived from compounds belonging to the aromatic class of organic chemical compounds (see CHEMISTRY, Organic Chemistry), e.g., benzene, toluene, the three xylenes, naphthalene, acenaphthene, anthracene and carbazole.

Coal tar, or aniline, dyestuffs do not exist as such in coal tar but are made from these nine primary substances, which do occur as such in coal tar or which are formed along with the tar in the coking of coal. The first three are water white liquids at ordinary temperatures, the last four are white solids. All are characterized chemically by the presence of the well known benzene ring, and the last six may be regarded as simple or complex derivatives of benzene in which hydrogen atoms have been replaced by radical consisting primarily of carbon and hydrogen.

Only one of the substances is commonly known to the layman. Ordinary moth balls are pure naphthalene.



Raw Materials—In the destructive distillation of coal for the production of coke or gas, many organic chemical reactions take place with the formation of a wide variety of organic chemical compounds. The nine basic raw materials are among these compounds, they do not exist as such in coal. The products distilling from the coke or gas retorts are fractionally condensed, that is to say, the more complex compounds with the higher boiling points are liquefied first from the gas stream, then the middle cuts consisting of compounds with intermediate boiling points, are condensed and finally the lighter oils with the lowest boiling point are obtained. The uncondensed gases passing through the condensing system, composed for the most part of carbon monoxide, hydrogen and methane, are either fed into gas mains or used as fuel for the coke ovens.

The first fraction condensed is coal tar. It contains little or no benzene, toluene or xylene these latter materials comprising the bulk of the lighter oils. But it does contain the anthracene, carbazole and acenaphthene and a part of the naphthalene formed in the coking process. For the separation of its valuable constituents, the coal tar is fractionally distilled in great retorts holding 20-30 tons. Among the products taken off from the lower fractions are naphthalene and acenaphthene, whereas, from the highest fractions, anthracene and carbazole are obtained. The residue left in the retorts is pitch, used either for the manufacture of roofing materials or in road construction.

In the United States, coal tar distillers as a rule do not carry the distillation as far as it is taken in Europe. The anthracene and carbazole fractions are left in the pitch. The latter then is softer and more pliable, and therefore more useful in road construction. The anthracene derivatives required for dyestuff manufacture are made synthetically from phthalic anhydride, which in turn is made from naphthalene. Carbazole requirements in the United States are comparatively low and are met either by taking the anthracene and carbazole fractions from a very small portion of the tar distilled, or by making the material synthetically from nitro- or aminodiphenyl. Because of the economics involved and of the relative unimportance of synthetic dyes derived from acenaphthene, this material is not separated from coal-tar fractions in the United States for use in the dyestuff industry.

Naphthalene and acenaphthene are present also in the middle cuts from the coke retorts. These cuts are likewise fractionally distilled for the separation of their valuable constituents. Finally, the lighter oils are fractionated for the separation of benzene, toluene and a mixture of the xylenes.

It must not be inferred that the nine basic raw materials of the dyestuff industry are the only valuable products obtained from coal tar fractions, or that distillation is the only process used for their separation and purification. Various cuts are washed with alkali for the removal of acids such as phenol and the cresols, and with acids for the removal of bases such as pyridine, picoline and quinoline. From such washings, the products named are recovered.

The nine raw materials obtained in a crude state by the processes outlined are refined for usage in the organic chemical industry (1) by fractional distillation, (2) by hot pressing, (3) by washing or crystallization and (4) by sublimation. Hot pressing consists of applying pressure to a mixture of solids and oils at an elevated temperature, the lower-boiling oils being thus squeezed out. This process is applied particularly to naphthalene. Washing consists of thoroughly mixing the material to be purified with a solvent, whereby undesired compounds are dissolved. The mixture is then filtered either at ordinary or at elevated temperatures. This process is applied primarily in the purification of anthracene.

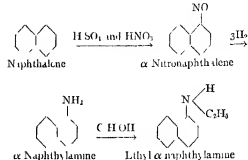
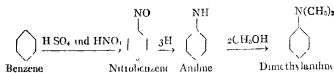
Intermediates—From the nine basic raw materials, properly refined, literally thousands of products, termed intermediates in the dyestuff industry, can be manufactured. In their production, many products of the heavy chemical industry, such as sulphuric, nitric and hydrochloric acids, caustic soda and caustic potash, sodium carbonate, ammonia and chlorine, must also be used. Consequently, these products, too, might be considered raw materials in the dyestuff industry.

For the manufacture of by far the greater number of these intermediates, a few relatively simple chemical reactions, termed by the dyestuff chemist "basic intermediate processes," are used. Any process of this type consists in the application of a chemical reaction of a particular type to any one of a number of different materials. For example, benzene, toluene, xylene and naphthalene are nitrated, i.e., subjected to the action of nitric acid. Nitration then is a "basic intermediate process," and, in the case of the dyestuff industry, the most common one.

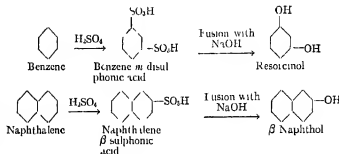
Other widely used processes include reduction, sulphonation, chlorination, oxidation, hydrolysis by fusion with caustic soda or potash, alkylation and amidation.

A few examples (I-VII) will illustrate the enormous diversity of intermediates which can be made from the nine basic raw materials.

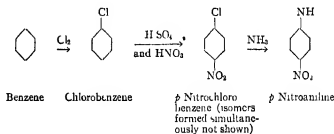
(I) Nitration, reduction and alkylation



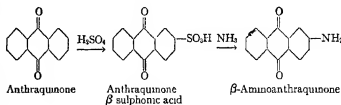
(II) Sulphonation and fusion



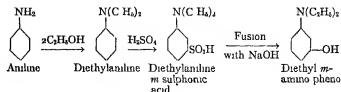
(III) Chlorination, nitration and amidation



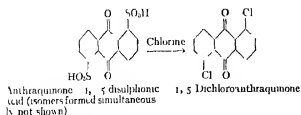
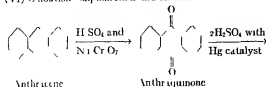
(IV) Sulphonation and amidation



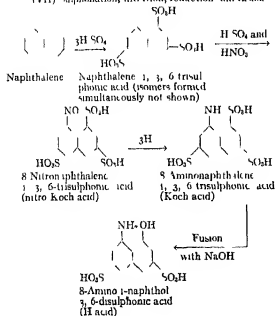
(V) Alkylation, sulphonation and fusion



(VI) Oxidation, sulphonation, and chlorination

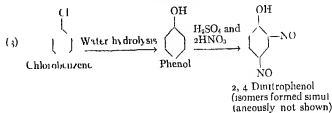
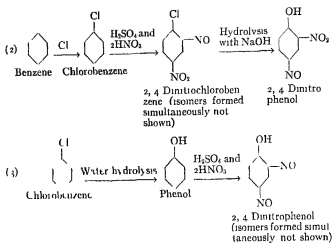
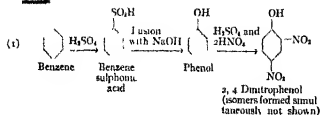


(VII) Sulphonation, nitration, reduction and fusion



In commercial practice the intermediates shown in the given examples (I-VII) are not necessarily made in the designated manner, it is possible in many cases to make a given product over two or even three and four routes. Here chemical economics comes into play. Frequently, because of the phenomenon of isomerism (qv) valuable by-products are formed and what is an economical process for one manufacturer may be an uneconomical process for another. Indeed, it has happened in the dyestuff industry that uses have been found for a substance originally regarded as a by-product which have made this substance the most desired product of a reaction, the former main product becoming then the by-product. Sometimes too a new and improved route may be discovered by one manufacturer and patented.

A single example having to do with the manufacture of a very important dyestuff, sulphur black, will illustrate this choice of routes. The most important intermediate in general use for the manufacture of this dye is 2,4-dinitrophenol. It can be made from benzene in three ways:



Isomerism plays an extremely important role in the manufacture of dyestuffs and often determines the route over which an intermediate is made. The very important compound 1,5-diaminoanthraquinone for example, can be made either by dinitrating anthraquinone, separating the 1,5- and the 1,8 isomers and then reducing the 1,5-dinitro compound to the corresponding diamine, or by disulphonating anthraquinone, separating the 1,5- and the 1,8 isomers and then subjecting the 1,5-disulphonic acid to the action of aqueous ammonia at high temperatures and pressures. In the first case, the by-product 1,8-dinitroanthraquinone possesses little utility, whereas in the second, the 1,8-disulphonic acid can be used much more advantageously.

Sometimes the purity of an intermediate when made over two routes determines the process used for the manufacture of the product. It is very difficult, for example, to obtain α -naphthol of high purity by sulphonating naphthalene and then fusing the sulphonic acid with caustic. On the other hand, a relatively pure material can readily be made by the hydrolysis of α -naphthylamine with acid. All this follows from the fact that it is much easier to obtain pure α -nitronaphthalene than it is to obtain pure naphthalene α -sulphonic acid.

Not only can basic intermediate processes be applied to the nine raw materials of the dyestuffs industry, but also to many products derived from these raw materials. For example, the nitrotoluenes may be chlorinated, or the naphthylamines, sulphonated. Here, too, isomeric products are formed and separated. Great difficulty is occasionally encountered in the separation of these highly substituted isomeric products because of the similarity of their chemical and physical properties.

From a consideration of the use of nine basic raw materials (seven of them of extreme importance), of the application of at least ten important basic intermediate processes and of the phenomenon of isomerism, it must be apparent that the number of possible intermediates that can be made will run into the thousands. Such is the case. On the other hand, it is estimated that 90% of the tonnage of synthetic dyestuffs made in the world is derived from less than 200 intermediates. A so-called "specialty dyestuff," sold in limited quantities for one particular usage, may require one or more intermediates of use for no other organic chemical product.

DYESTUFFS

Nomenclature—Any company of consequence manufacturing dyestuffs produces, as at least part of its line, exactly the same substances that are made by competitive firms. There is no difference chemically between the dyestuff called eosine when made in Italy, England, Germany or the United States. The same may be said for a wide variety of dyes, each of which has become, following its discovery and introduction, a standard article of commerce. Both process and product patents expire after a given number of years, and any manufacturer is then free to produce a dyestuff on which another firm previously held a monopoly.

The nomenclature employed in the dyestuffs industry follows

from these facts. When the chemical compound benzene meta diazo bis-metaphenylenediamine dihydrochloride was discovered in 1863 and manufactured as a dyestuff, it was sold under the simple name of Bismarck brown. Its success was instantaneous. In time it was manufactured by no less than 21 firms, and in almost all cases under the name originally given it, Bismarck brown. When the chemical compound tetraethylidiamino orthocarbonyl phenyl xanthyli chloride was first manufactured in 1887, it was sold under the name rhodamine B. In time, 12 other manufacturers made the product and 11 of them sold it under the name of rhodamine B. When a closely related chemical compound, diethylidiamino orthocarbonyl phenyl xanthyli chloride was first made in 1892 and found to dye textile fabrics in much yellower shades of red than rhodamine B, it was marketed under the name of rhodamine 6G. In time 11 manufacturers made the product, and 7 of them sold it under the name of rhodamine 6G.

In general, it may be said that synthetic dyestuffs are so complicated structurally that it would be impossible to market them under their chemical names. It is for this reason that names such as eosine, Bismarck brown and rhodamine are invented. Some times such names are trade marked by the original manufacturers, and, since trade marks as a rule run much longer than patents, it is necessary on occasions for other producers to invent new names for a particular dyestuff or line of dyestuffs.

A perfect example of this is found in the marketing of vat colouring matters derived from anthracene. The first one of these was discovered in 1901 and shortly thereafter was sold as indan threne blue R by the Badische company in Germany. Soon others of these anthraquinone vat dyestuffs were discovered and manufactured. All were sold under the trade marked name of indan threne, e.g., indanthrene yellow G, indanthrene green G, indanthrene violet R, indanthrene golden orange G, etc. By the time World War I ended, original patents having expired, these colours were being made in Switzerland, England and the United States. But they could not be marketed under the name indan threne. In Switzerland, the Society of Chemical Industry, Basel, called them cyanone, in Great Britain, Scottish Dyes called them cyan, in the U.S., the Calco company, calcosol, the du Pont company, ponsol, and in Japan, a few years later, the Japanese Dyestuffs Manufacturing company, vijayanthrene. Thus, caldon yellow G is chemically identical with indanthrene yellow G, calcosol yellow G and vijayanthrene yellow G, etc.

Usually, the trade-names given to dyestuffs designate all characteristics of the products that can be gathered into a single catchy word. Thus, the name Indanthrene is derived by combining *ind* of indigo, designating a vat colouring matter, and *anthrene* from anthracene—the whole name thus implying a vat dyestuff from anthracene. But occasionally names that have little or nothing to do with dyestuff characteristics are chosen. In these cases, however, the names are suggestive: *siurus* yellow G, *orion* blue 2B, *nigrosine* B, *pluto* black BL, *malachite* green, etc. Early in their development of the industry, the Germans invented a system of nomenclature whereby the approximate shade of a dyestuff could be designated, letters being added to its name to indicate variations in shade. Most common of these letters were G for *grün* (green), B for *blau* (blue) and R for *rot* (red). If the product gave a green shade of blue on dyeing, it was designated as blue G, and, as it gave progressively greener dyes, as blue 2G, blue 4G or even blue 6G, the latter being a very greenish blue. If, on the other hand, the shade of the blue dyeing tended to purple, the letter R was suffixed, blue R, blue 2R and blue 3R, etc. The system proved to be helpful to the industry and has been generally adopted.

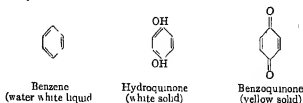
Theoretical—Intermediates used in the manufacture of dye stuffs derived from benzene, toluene, the xylenes, naphthalene, acenaphthene and carbazole are in general white or colourless substances. Intermediates from anthracene are coloured, and here in a few cases a product may be both an intermediate and a dyestuff. The compound 1,4-diaminoanthraquinone, for example, is an excellent product for colouring gasoline in violet shades, a usable material for dyeing acetate silk in bluish red shades and at the same time an intermediate for several extremely

important anthraquinone vat dyestuffs. Thus, with the introduction of synthetic fibres into world commerce, and with the wide employment of colouring matters in the modern world, the line of demarcation between an intermediate and a dyestuff cannot be so sharply drawn as it was prior to World War I.

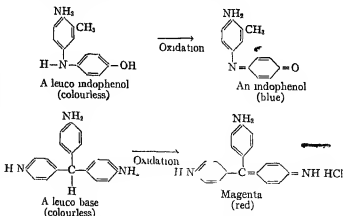
Early in the development of the industry it was found that many synthetic dyestuffs known at the time, when treated with a reducing agent (e.g., with hydrogen) lost their colour. The resulting colourless bodies, known as leuco dyes or leuco bases contained a larger percentage of hydrogen than the dyestuffs and could be converted into the latter by reversal of the process, i.e., by oxidation. In the years from 1865 to 1910 much work was done by dyestuff chemists, particularly in Germany and Switzerland, to clear up the problem of why one compound is coloured, whereas a very near relative is colourless, O. N. Witt, A. Hantzsch and R. Nietzki being the leaders in this work.

As early as 1876 Witt propounded a theory of colour which not only has withstood all criticism levelled against it, but has been strengthened with the discovery in subsequent years of many new classes of compounds useful for dyeing. Witt assumed that colour is dependent upon the presence of groups of atoms, held together by valence bonds in certain specified ways, in the organic chemical molecule. He termed the colour-giving group the chromophore, and the compound containing it the chromogen. The chromogens of themselves are not dyestuffs, Witt argued these only being formed by the introduction into the molecule of one or more additional groups of atoms which are capable of salt forming properties, and which may be either basic or acidic. In time, certain of these groups came to be known as auxochromes, the most common ones being NH_2 , $\text{N}(\text{CH}_3)_2$ and OH .

One of the simplest examples to illustrate Witt's theory is found in the relationship existing between benzene, hydroquinone and benzoquinone.



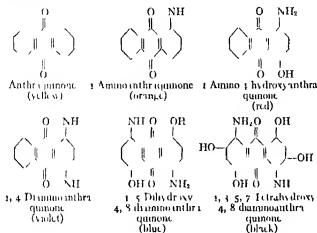
The first two of these substances are assigned so called Kekulé structures with alternating double and single bonds in the ring, whereas benzoquinone is assigned the paraquinoid structure in order that the valencies of the carbon atoms to which the oxygen atoms are attached may be satisfied. Thus, by the shifting of bonds, colour is produced. The paraquinoid structure is therefore the chromophore, and all compounds containing this grouping should be coloured, according to Witt's assumption. Such is generally the case, although a few exceptions have been noted. Some further similar examples are given below.



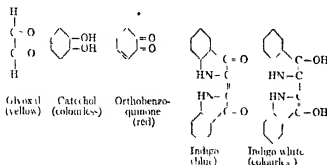
In the given examples, the indophenol which is blue in colour is not a dyestuff, whereas magenta, red in colour, is a dyestuff. This seeming contradiction follows from the fact that many

coloured compounds are not useful as dyestuffs since they may have no affinity for fibres of various sorts or since they may have poor fastness properties when dissolved in an organic solvent to colour it. The indophenol cited has little or no affinity for natural or synthetic fibres. On the other hand, it could be used to colour gelatine but the colour would be entirely too fugitive for commercial use.

The effect of auxochromes in modifying the colour of a compound with the paraquinoid chromophore can be illustrated by the example of anthraquinone and such of its derivatives as are listed below.

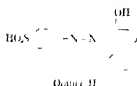


Although the paraquinoid chromophore is the most common one in the dyestuff industry, several other important types are also recognized. One of these is the indigo, which occurs in nature and in a large number of further cases of closely related structure. The orthoquinoid chromophore, characteristic of *o*-benzoquinone is similar to the indigo but is much less important since it occurs in only a few dyestuffs of commercial importance. Moreover, some compounds of the diphenyl series containing the grouping $O=C-C=$ characteristic of both the indigos and orthoquinoids are also coloured, the relationship being shown in the following examples:



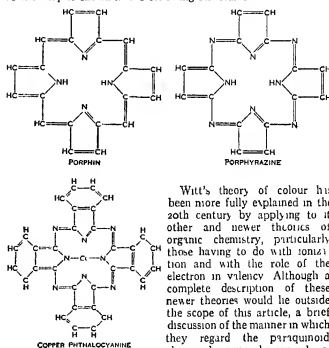
It will be noted that when the $O=C-C=$ grouping is changed into $HO-C=C$ the product is no longer coloured.

Only one other grouping is of extreme importance in the dyestuff industry. It is responsible for colour in a large series of compounds made by the diazotization and it can be expressed as $R-N=N-R'$ where R stand for substituted hydrocarbon radicals of the benzene, toluene, naphthalene and phthalene series, the most common substituent group being NH_2 , OH , SO_3H and CO_2R . An example of a simple azo dyestuff made from sulphuric acid and beta-naphthol is shown below, the chromophore



In the given example, the function of auxochromic groups is illustrated in two directions. First, diazo compounds will not react with hydrocarbons of the benzene series themselves to yield dyestuffs, substituent groups such as $-NH_2$ and $-OH$ must be present if dyestuffs are to be produced. Second, the group SO_3H is not necessarily an auxochromic group. In orange II it merely imparts water solubility to the product. If aniline is substituted for sulphuric acid, an oil soluble dyestuff, made and sold as such, results. (See *Azo Compounds*, below.)

It was not until the fourth decade of the 20th century that coal-tar derivatives based on the chromophore present in the natural colouring matters of the chlorophyll and haem classes were manufactured and sold commercially as dyestuffs and pigments. All of them belong to the phthalocyanine class and contain the porphyrine chromophore, porphyrin being the parent structure present in the above mentioned natural products. The most important dyestuff of the group is copper phthalocyanine. The relationship is shown in the following structures:

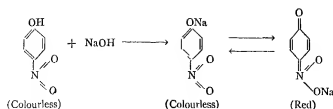


Witt's theory of colour has been more fully explained in the 20th century by applying to it other and newer theories of organic chemistry, particularly those having to do with ionization and with the role of the electron in valency. Although a complete description of these newer theories would be outside the scope of this article, a brief discussion of the manner in which they regard the paraquinoid chromophore may be given here.

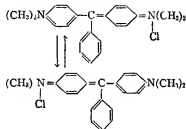
As may be seen from a consideration of the examples mentioned above, paraquinoid compounds result in general from the oxidation of substances with structures of a certain type. As has been noted, these latter substances are termed leuco compounds or leuco bases in the dyestuff industry, and up until the decade 1900-10, they and their oxidation products (the dyestuffs) were considered to be made up of molecules to which unique structure could be assigned. But in the first decade of the 20th century Hantzsch introduced the concept of tautomerism into the theory, thus, he explained the change of colour that takes place upon the conversion of pyriminophenol into its sodium salt by assuming that two forms of the phenol exist in equilibrium with each other, the one nonquinoid, colourless and a very weak acid, the other one quinoid, red in colour and a very strong acid. Upon the addition of alkali, Hantzsch argued, salts of the strong acid are formed almost exclusively, such quinoid salts he assumed to be red.

On reversal of the process by the addition of acids the equilibrium again shifts back and the colourless nonquinoid form of the free nitrinophenol predominates.

(The "classical" structures given here in which each nitrogen atom forms five covalent bonds, are the ones employed by Hantzsch. Although newer theories hold that the maximum covalency of nitrogen is four [see VALENCE] the replacement of these structures by their modern counterparts would in no way affect the present discussion.)

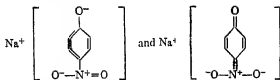


A rather different theory, which, however, likewise admitted the possibility of variable structure, was advanced in 1907 by A. Bayer, who suggested that the colour of a dye-stuff such as malachite green is caused by the oscillation of an anion from one end of the molecule to the other. The type of oscillation thus proposed for malachite green is illustrated by the equation

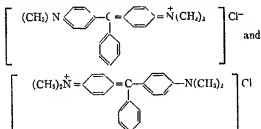


(in which again the "classical" structures, a nitrogen atom forming five covalent bonds, are employed). It will be noted that each of these two structures contain one quinoid ring.

The theories of Hantzsch and of Bayer suffered from the fact that, at the time at which they were proposed, the distinction between covalent and electrovalent bonds was not fully realized. Somewhat later, however, in 1914, E. Q. Adams and L. Rosenstein advanced the theory that, since the observed colours of substances of the present type might be properties of their ions and not of any postulated un-ionized molecules, the transitions among the structures in question involve only redistributions of valence bonds and of electric charges, and do not require the movement of any atoms or ions. Thus, with the sodium salt of pyranthiophenol, the two structures proposed by Hantzsch might be replaced by the two corresponding ones



(which are given here in modern rather than classical form). If the theory of Adams and Rosenstein is correct there is no necessity to postulate, with Hantzsch, the existence of an un-ionized red quinoid form. Similarly, with malachite green, the two structures proposed by Bayer might be replaced by



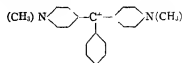
In these two cases, the sodium and chloride ions are considered to have nothing directly to do with the production of colour. Adams and Rosenstein, moreover, suggested that the colours of ions like the ones under discussion are caused by rapid oscillations of the ionic charges back and forth between the extreme positions characteristic of the various structures. In this way, they were able to avoid the necessity of assuming, with Bayer, that a relatively heavy, and hence relatively immobile, anion is able to vibrate with

the extremely high frequency necessary to account for the absorption of visible light.

Further contributions to the theory of colour were made by J. Stieglitz (1924), who employed more or less the same approach as Adams and Rosenstein. The modern period may be said, however, to have started in the 1930s with the development of the theory of resonance. According to this theory the actual distribution of electric charge in any molecule or ion is always intermediate among the distributions characteristic of any given structure that may be written and of all the further structures that can be derived from the first by merely a redistribution of valence bonds and electric charges. Thus, the actual distribution of charge in the anion of *p*-nitrophenol is considered to be some sort of average of the distributions not only in the two above structures but also in several further structures, such as

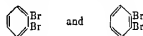


Similarly, the distribution of charge in the cation of malachite green is considered to be some sort of average of the distributions illustrated not only in the two above structures but also in several further structures, such as



It is a corollary of the theory, which cannot be discussed further here, that the so-called "resonance" among these various structures leads to increases in the wave lengths at which the absorption of light occurs. If these increases are sufficiently great, the absorption of light may come into the region of the visible spectrum so that the substances are coloured.

That some such phenomenon occurs in organic compounds, there can be no doubt. F. A. Kekulé, who postulated the ring structure for benzene, was forced to accept the concept of a shifting of valencies, even in this substance, although he did not comprehend the nature of the shifting. He saw that if no such shifting occurred, two orthodibromobenzenes should exist



However, only one form exists, at any rate, no second form has ever been isolated.

In this connection it is pertinent to note that diphenylene ethylene, an unsubstituted hydrocarbon of the benzene series, and 2, 4, 6, 8, 10, 12-tetradecehexamene, a straight chain compound of carbon and hydrogen, are coloured. The important point, therefore, in colour formation seems to be the presence of a "conjugated" carbon chain, i.e. a chain of alternating single and double bonds between the carbon atoms that constitute the skeleton of a compound. Such a skeleton, present in each of the compounds of carbon and hydrogen mentioned above, permits the phenomenon called resonance to such an extent that both substances absorb light in the visible ranges of the spectrum. Yet they are nonionic. Moreover, in some instances, a coloured neutral molecule gives rise to a less deeply coloured, or even colourless, ion. For example, the intense yellow colour of a solution of *p*-nitrodimethylaniline in aqueous alcohol is largely discharged by the addition of hydrochloric acid, thus, the *p*-nitrodimethylanilinium ion must be



colourless, or nearly so. The reader must therefore be careful not to conclude that resonance, and hence colour, are properties

of only ions, since actually resonance is considered always to occur both in ions and in the corresponding neutral molecules. Most commonly, however (and in particular, in all the foregoing examples), the data are in at least qualitative agreement with the supposition that the depth of the colour of a substance is increased by any structural change which permits a more effective resonance.

Although the presence of the chromophore and auxochrome groups in organic compounds used as dyestuffs increases the possibility of resonance and thus brings about selective absorption of light in the visible ranges of the spectrum, all colourless organic compounds, too, show this same selective absorption, but in the invisible ranges of the spectrum. In some cases such selective action is exceedingly strong and plainly apparent. Highly refined anthracene and chrysene for example pure white in colour, exhibit marked bluish fluorescence, which results from the selective absorption of ultra violet light.

Two terms in general use in dyestuff chemistry should be defined here. Any change in the structure of a compound which shifts its absorption of light to longer wave lengths (i.e., toward the red end of the spectrum) is termed *hypochromic* whereas any change that shifts it in the opposite direction is termed *hyperchromic*. But care should be used in the application of the two terms, for, there are cases in which the effects are perceptible only when a colouring matter is applied to a particular fibre under certain conditions. A change in the molecular structure of a compound may give a hypochromic effect when a dyestuff is applied to wool and yet give no effect at all, or even an opposite effect, when it is applied to cotton or to a synthetic fibre. The terms, therefore, are exact only if reference is made to the absorption spectra of coloured compounds when determined under exactly similar conditions.

It has been noted that coloured compounds are not necessarily dyestuffs, and that a product which will dye one material satisfactorily may not dye another. The problem why various fibres absorb and hold certain coloured compounds designated as dyestuffs has never been satisfactorily solved. Both silk and wool contain basic and acidic groupings in their molecular structures and the presence of such groups doubtless accounts for the fact that these materials are more readily dyed than cellulose fibres which contain only weakly acidic groupings. The vast majority of dyestuffs, too, contain basic or acidic groups in their molecular structures, many contain both.

Numerous theories have been advanced to account for the mechanism of dyeing, and it is clear that the process must be (1) purely physical adsorption, (2) actual chemical union or (3) a combination of both. Theories advanced in the decade between 1935 and 1945 stressed hydrogen bonding, and were based on relationships existing in the linear distances between reactive groups in fibre and dyestuff molecules. When these distances are approximately equal, the theory assumes, hydrogen bonding can occur; when grossly unequal, combination is impossible. This molecular-spring¹⁰ conception of the dyeing mechanism agrees in many cases with observable facts, and explains why a given organic compound may be utterly useless as a dyestuff for cotton or wool and yet be a very valuable colouring matter for acetate silk or some other synthetic fibre. But much work remains to be done before the theory can be generally accepted.

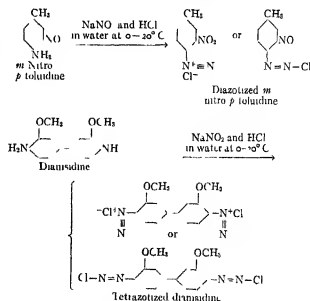
The fastness of a dyestuff on any fibre is in general, directly proportional to the chemical stability of its molecule against destructive agents such as oxygen, light, heat and certain salt solutions, or combinations of these. Chemically, the azo compounds for example are relatively unstable as compared with the indigos and anthraquinones. The latter are therefore in general, the faster dyestuffs on textile fibres. Copper phthalocyanine is an extremely stable substance, withstanding heat up to 900° F. without decomposition and resisting the action of oxidizing agents that would destroy other organic compounds. It is, therefore, an extremely fast colouring matter.

Processes for Making Dyestuffs.—Just as in the case of intermediates there are but a relatively few simple organic chemical processes used to convert intermediates into dyestuffs. These

processes, which may be termed "basic dyestuff processes," are applicable to a wide variety of intermediates. For example, each product in the large series of closely related compounds termed indophenols can be subjected to the action of sodium sulphide and sulphur, and a correspondingly large series of products, known as sulphur dyestuffs, can be thereby obtained. The process is commonly known as thionation. Other processes generally in use are diazotization, condensation, oxidation, halogenation and esterification.

Of all these basic dyestuff processes, thionation is the only one that is not clearly understood by the dyestuff chemist, i.e., the only one in which he does not know the exact nature of the products resulting from the application of the process. In this process, compounds composed of giant molecules, and incapable of being crystallized and thoroughly purified, are formed, in many cases mixed products are obtained. The process, which can be carried out with or without the use of a solvent, is applicable not only to indophenols but also to a wide variety of intermediates, and to another series of compounds termed azines (See *Sulphur Dyes* below).

Diazotization consists in the treatment of an amine with nitrous acid, the latter generally being obtained, and the process being carried out, by the treatment of sodium nitrite with hydrochloric or sulphuric acid in the presence of the amine which has been dissolved or dispersed in cold water. The resulting diazonium salts are relatively unstable (hence, the use of cold water) and extremely reactive. Some are relatively insoluble at temperatures at which the process is carried out, whereas others are very soluble. In some cases, one amino group per molecule is so transformed, in other cases, two, in the latter event, the process is called tetrazotization. The following examples will illustrate the reaction. Two possible structures of the diazo and tetrazo compounds are shown, the latter one in each instance being analogous to the structure assigned to the dyestuffs that result from the subsequent condensation reaction (see below).



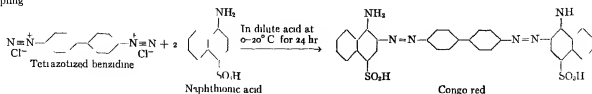
The dyestuff chemist generally writes the structures of the diazonium compounds as $\text{R}-\text{N}=\text{N}-\text{Cl}$, for, as will be shown later, the structures of the azo dyestuffs made from these intermediates are doubtless $\text{R}-\text{N}=\text{N}-\text{R}'$, where R and R' are residues of the benzene, toluene, xylene or naphthalene series containing one or more auxochrome groups. The alternative structure $\text{R}-\text{N}=\text{N}^+-\text{Cl}^-$ is however, generally considered to be the more nearly correct and it is the one universally employed in the scientific literature.

Condensation is the most widely diversified of the dye making processes, for many types of compounds will condense with other compounds or even with themselves.

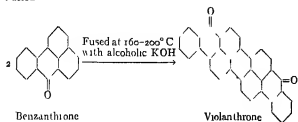
In some cases condensation occurs readily, in fact, when two intermediates are stirred together in cold water, in others condensation requires drastic conditions of reaction, particularly of temperature. Frequently, condensing agents such as dehydrating materials and "acid acceptors" (*i.e.*, weak bases like sodium

methane $H-C\equiv(C_6H_5)_3$). By the condensation for example of one mole of benzaldehyde with two moles of dimethylaniline the colourless compound tetramethyldiaminotriphenylmethane is formed. When this product is oxidized in acid solution to the corresponding carbinol, a loss of water occurs and there is ob-

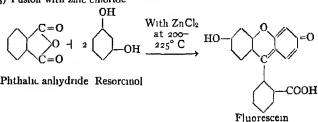
(1) Coupling



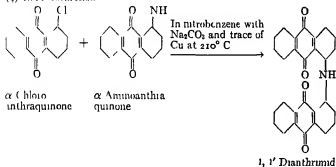
(2) Fusion



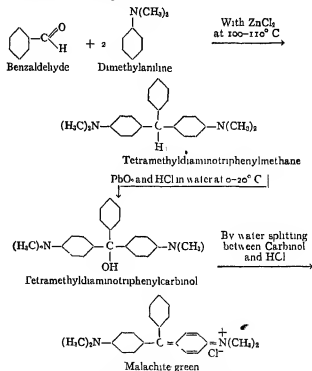
(3) Fusion with zinc chloride



(4) Imide formation



tained the intensely green dyestuff malachite green. The oxidation of the triphenylmethane compounds, generally termed leuco bases, is normally brought about by means of freshly prepared lead peroxide, PbO_2 , but other oxidizing agents can be employed, atmospheric oxygen in some cases being sufficient. Malachite green is made in the following manner



acetate) are required to facilitate the process, and, on occasion catalysts must be used to bring about condensation. The following examples will not only illustrate these reactions, but will explain actual processes by which many dyestuffs are made from intermediate products.

The condensation process illustrated by (1) in the foregoing examples, and designated as coupling, is generally carried out at temperatures between 0°C and 20°C , and under weakly acid or alkaline conditions. The time for the completion of the reaction may vary from one hour to five days, depending upon the reactivity of the diazo or tetrazo compounds and of the intermediates with which they are being coupled. The products are azo dyestuffs.

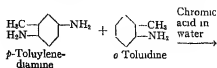
The fusion of benzanthrone to violanthrone, as illustrated by (2), is generally carried out under anhydrous conditions and with the addition of a material to lower the melting point of the caustic potash. Anhydrous alcohol or aniline is used for this purpose.

In order that complete reaction may be obtained between resorcinol and phthalic anhydride as illustrated by (3), anhydrous zinc chloride must be used. The product obtained, fluorescein, is tinctorially among the most powerful of the coal tar dyes, inasmuch as extremely low concentrations of its sodium salt exhibit intense yellow colour with a greenish fluorescence.

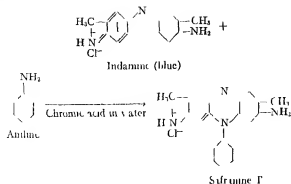
The process by which condensation of a chloroanthraquinone with an aminoanthraquinone as illustrated by (4) was not discovered until 1903. The reaction, named for F. Ullmann, who discovered it, is best brought about by heating the intermediates together in a high-boiling solvent, such as dichlorobenzene or nitrobenzene, and in the presence of an acid acceptor and of a trace of copper or of one of its salts as a catalyst.

The process of oxidation is employed for the manufacture of a large group of dyestuffs whose parent compound is triphenyl

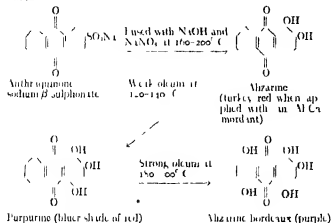
Frequently, oxidation is employed to bring about condensation, *i.e.*, to tie together molecules of two or more intermediates by the removal of hydrogen. A perfect example of this procedure is found in the manufacture of safranine T, where molecular quantities of *p*-toluylenediamine, *o*-toluidine and aniline are oxidized together to form the dyestuff, the first step in the process being the formation of the imdiamine



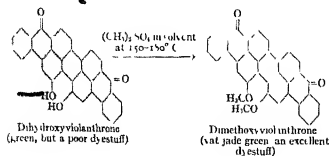
¹ Strictly speaking, the products are anthraquinonyl amines but the dyestuff literature invariably refers to them as imides.



In dyestuffs derived from anthraquinone, the hydroxyl group ($-OH$) plays an extremely important role in colour formation. In some cases this group is introduced by fusion of the sulphonic acids with $NaOH$ or $Ca(OH)_2$ although in others it is obtained by direct oxidation. When anthraquinone β -odium sulphonic acid is fused in an oxidizing mixture of sodium hydroxide and sodium nitrate, 1,2-dihydroxyanthraquinone, the dyestuff known for centuries as *alizarine* results. If this compound is further oxidized by means of alkali (forming sulphuric acid), a reaction discovered by Reine Robin in 1902, there is obtained a range of dyestuffs the shade of which varies with the number of hydroxyl groups introduced.

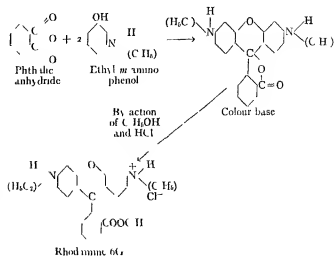


In a number of cases in dyestuff manufacture, hydroxyl (OH) and carboxyl ($COOH$) groups have to be protected, that is, rendered nonionic, in order to obtain desired properties of dyeing or fastness. The reaction by which this is accomplished is generally termed esterification, although (theoretically) it would be a more exact term when the reaction is applied to hydroxy compounds. Dihydroxyviolanthrone is a poor dyestuff being fugitive to light and bleaching agents. However if the hydroxyl groups are ethylated by means of dimethyl sulphate the dimethyl ether, an exceedingly fast green dyestuff, sold under the name of *yade green*, is obtained. (See *Anthraquinone Compounds*.)

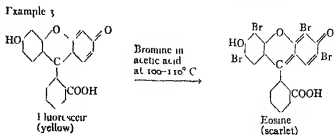
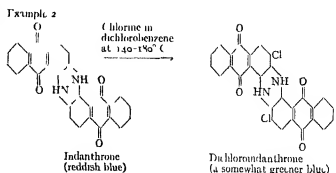
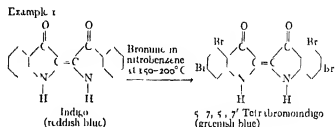


Esterification can also be illustrated by the process by which rhodamine 6G is made. Here two moles of ethyl-*m*-aminophenol are condensed with one mole of phthalic anhydride and the thus obtained base is esterified with ethyl alcohol, sulphuric or hydro-

chloric acid being used as the esterification catalyst. With the latter acid the reactions are as follows:



By halogenation is meant the introduction of chlorine or bromine into a dyestuff molecule. Usually in the carrying out of the process, the dyestuff is dissolved or suspended in a solvent such as acetic acid, dichlorobenzene or nitrobenzene, and the chlorine or bromine is added directly at ordinary or elevated temperature. The process invariably brings about a marked change in the shade of a dyestuff, and thus the halogen atoms can be considered as auxochromes. Halogenation is most widely applied in the manufacture of indigo and anthraquinone dyestuffs although it was applied as early as 1874 in the preparation of eosine by the bromination of fluorescein to its tetrabrom derivative.



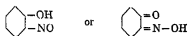
In the case of the anthraquinone vat colouring matters, it is usually impossible to represent with certainty the position of the hydrogen atoms entering the molecule. But in the particular example given for anthraquinone derivatives an accurate representation can be made, since dichloroanthrone can be made by another method whereby the positions of the chlorine atoms are definitely established. The product is the fastest, bright blue dye-stuff known for dyeing cellulose fibres, cotton dyed with it can be subjected to the action of dilute hypochlorite solutions without materially changing the shade of the dyeings.

Classification—It has already been shown that the hydrocarbon skeleton of the dyestuff molecule is primarily responsible for the existence of colour. This skeleton, therefore, affords a basis for chemical classification. The auxochromic groups (those the skeleton to give the molecule distinctive properties which, among other things, determine the method by which the dyestuff is applied). A dyestuff molecule of almost any class may be given basic or acidic properties by the introduction of amino (NH) or $\text{N}(\text{CH}_3)_2$, sulphonic (HSO_3) or hydroxyl (OH) groups, and these properties influence the methods of dyeing as well as determine the shade and fastness properties of the dyestuff. Because of these facts, the dyestuffs will be classified in two ways: (1) according to chemical structure, and (2) according to methods of application.

CHEMICAL STRUCTURE AND COMMERCIAL ASPECTS

Since their introduction and original use in the 19th century, a number of synthetic dyestuffs belonging to miscellaneous classes have become obsolete in the 20th century. For this reason, only those classes common in world trade subsequent to the ending of World War I are included here. The system of chemical classification employed by the United States Tariff Commission, taken from the authoritative *Colour Index*, a publication of the Society of Dyers and Colourists of England, is used in this article.

Nitroso Compounds—Typical structure



This class of compounds having the orthoquinoid chromophore is relatively unimportant, only a few members being made and used. These dyes are derived by the action of nitrous acid upon phenols or naphthols and their sulphonic acids. The products are used in the form of their insoluble sodium salts as pigments. Such salts are generally termed "lakes" and are employed in the paint or ink trade.

Nitro Compounds—Typical structure



This class is also relatively unimportant, naphthol yellow S being its best-known member. This dyestuff is made by the action of nitric acid upon nitroso 1-naphthol 2, 7 disulphonic acid, and is marketed as the disodium or dipotassium salt of 2, 4-dinitro 1-naphthol-7 sulphonic acid, which has the following structure.

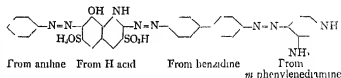


Azo Compounds—Typical structure $\text{R}-\text{N}=\text{N}-\text{R}'$, in which R and R' stand for substituted phenyl, tolyl, xylyl and naphthyl radicals. Numerically, this is by far the largest class of dyestuffs, almost 600 individual products being listed in the *Colour Index*

as against a total listing of 1,200 for all classes of synthetic colouring matters. A very shade of colour from the lightest yellow to the deepest black can be obtained from the members of this class, and because of wide variations in chemical constitution the dye-stuffs of the group exhibit a wide range of properties, particularly as to methods of dyeing, applicability to various fibres, fastness, etc.

When the chromophore grouping $-\text{N}=\text{N}-$ occurs but once in the molecule, the products are termed monoazo dyes, when twice, diazo, and thrice triazo. A few products containing four of the azo linkages and termed tetraazo are known but they are relatively unimportant. The simpler dyestuffs of the group, the monoazos, are generally yellows, oranges and reds, whereas the diazos and triazos are generally browns, greens, blues and blacks.

As far as production and sales in world commerce are concerned, direct black E is the most important dyestuff in the azo group. About 6,700,000 lb. were sold in the United States alone in 1949, the average sales price being 10 cents a pound. It is used primarily for the dyeing of cotton in full black shades. No mordant is required for such dyeings, hence, the term "direct." It is made from four intermediates, benzidine, H acid (1-amino 8-naphthol 3, 6 disulphonic acid), aniline and *m* phenylenediamine, and contains three azo linkages. The following figure will illustrate the manner in which the dye molecule is built up.

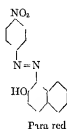


In making this dyestuff, benzidine is first tetrazotized and coupled with a molecular proportion of H acid in acid solution. Aniline is then diazotized and coupled to the opposite side of the H acid molecule in alkaline solution. Finally, *m* phenylenediamine is coupled under alkaline conditions with the free diazonium group in the benzidine nucleus. The reaction mass is then made slightly acid, and the dyestuff is obtained by filtration, a sufficient concentration of sodium chloride or sodium sulphate—resulting from the use of both alkaline and acid conditions—being present to render the dyestuff insoluble. In many cases in the manufacture of azo dyestuffs, sodium chloride or sodium sulphate must be added at the end of the process to bring about separation of the product from solution. This procedure is termed "salting out."

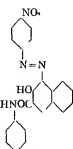
Direct black E also illustrates an extremely important principle which characterizes certain of the azo dyestuffs. In 1884 it was found that colouring matters which contained the benzidine nucleus were "substantive" to cotton, i.e., that they could be used in the dyeing of cotton without the assistance of a mordant. Congo red, a diazo compound made by coupling two moles of naphthionic acid to one mole of tetrazotized benzidine, was the first dyestuff of the class. Within 20 years, at least 100 of these direct colourings were brought into world commerce, direct black being discovered in 1901. The dimethyl and dimethoxy derivatives of benzidine, called toluidine and dianisidine, respectively, imparting this same substantivity to the azo dyestuffs derived from them, became intermediates of extreme importance in the dyestuff industry.

In the decade following World War I, another class of azo dyestuff came into prominence. As early as 1880 it had been found that cellulose fabrics could be dyed in brilliant red shades by first impregnating cloth with β naphthol and then passing it through a cold solution of diazotized nitroaniline, the coupling of the two intermediates taking place on the cloth. Alternatively, the β naphthol could be applied to the cloth in patterns, in which case prints could be obtained. But the dyestuff, called para red, in spite of its insolubility in water, was somewhat fugitive to light and washing. Nevertheless, it became the parent of a line of comparatively fast dyestuffs, for, in 1912, it was discovered that dyeings and prints of a brilliant red shade and of considerable fastness could be obtained if the anilide of 3-hydroxy 2-naphthoic acid was substituted for β naphthol in the process. The dyestuff

formed in this manner is called naphthol red, its relationship to para red being as follows



Para red



Naphthol red

Thus, the amide of 3-hydroxy-2-naphthoic acid became the first of a long series of arylumino hydroxynaphthoic acids which were later developed. The Germans called such intermediates naphthols, Imperial Chemical Industries, Ltd., in England brentthols, and du Pont and Celco in the United States naphthamils and naphthols respectively.

The three largest selling compounds of the group, is of the end of World War II, were



Amide of 3 hydroxy 2 naphthoic acid

Naphthol AS
or
brentthol AS
or
naphthamil AS
or
naphthol AS



ortho Toluidide of 3-hydroxy 2 naphthoic acid

Naphthol AS D
or
brentthol AS D,
etc

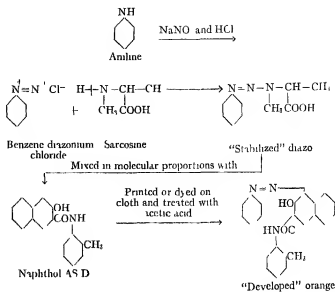


β Naphthylamide of 3 hydroxy 2 naphthoic acid

Naphthol AS SW
or
brentthol AS SW,
etc

When these products were first used for the dyeing and printing of fabrics, aromatic amines and their salts (for example, diaminobenzene or 4-chloro-2-aminotoluene hydrochloride) were marketed with them, to be diazotized and coupled with them where and when the dyestuff was to be applied. This method of application has continued. But later another group of products was added to the line, the dyestuff manufacturers marketing the amino derivatives in the form of their diazo salts sufficient stabilization for commercial usage being achieved generally by the formation of double salts of the diazo compounds. For this purpose inorganic materials such as zinc chloride can be used. The textile mills were thus relieved of the necessity of diazotizing the amino compounds, a simplification much desired by them.

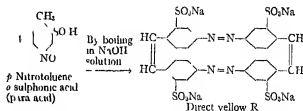
In the decade 1930-40 another innovation along this line became prominent in the printing of textile fabrics, for it was found that diazo compounds can be "stabilized" to so great an extent that they may be marketed safely in the form of mixtures with the arylumino hydroxy-naphthoic acids. When applied to fabrics by regular textile dyeing or printing methods, such products give no colour until the impregnated fabric is subjected to treatment with an acid whereby the stabilized diazo salt is broken down and the active diazo group is regenerated. When this occurs, coupling immediately takes place with colour formation. In this case stabilization is achieved by treating the diazo compounds with secondary amines containing a water-solubilizing group, sarcosine being an ideal substance for the purpose. The reaction taking place can be illustrated as follows



In Germany the Interessen Gemeinschaft Farbenindustrie (the I.G.) marketed these mixed products under the name of rapidogens, in England Imperial Chemical Industries, Ltd., called them brentogens, and in the United States the du Pont company called them drigenes. A full range of shade from light yellow to deep black in azo dyestuffs of this class was available in world commerce at the conclusion of World War II.

Many of the azo dyestuffs are valuable only when applied with a chromium mordant. Obviously, therefore, it would seem to be advantageous to combine the chromium with the dyestuff molecule and to market the thus formed chromium complexes. In the decade 1920-30 a full range of such products came into world trade, and at the conclusion of World War II, the line had achieved a prominent position in the dyestuff industry. The Society of Chemical Industry of Switzerland called the products neolans, the German I.G., palatine fasts, Imperial Chemical Industries in England ultralans, and Celco and du Pont in the United States, calco fasts and chromacils, respectively. The exact chemical structure of the compounds had not been definitely established by 1950 although it seemed fairly certain that the chromium is bound by hydroxy groups in the dyestuff molecule.

The stilbene series comprises a special class of dyestuffs containing the azo group. These products are made, without the employment of the diazo reaction, by the intramolecular rearrangement and self condensation of *p*-nitrotoluene *o*-sulphonic acid. When this acid is submitted to the action of aqueous caustic soda, a yellow dyestuff, direct yellow R, is formed.



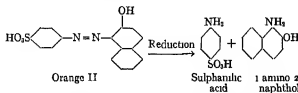
By modification of the treatment of *p*-nitrotoluene *o*-sulphonic acid with caustic soda, a variety of these stilbene dyestuffs can be obtained. They dye cellulose fibres directly and are faster to light than other azo dyes. They also behave differently with reducing agents, for instead of being at once split into colourless compounds they give at first hydrazo compounds which can be reoxidized to the stilbene dyestuff.

Another class of azo dyestuffs should be mentioned briefly. This is the group of azo derivatives made and sold for the purpose of colouring oils. The members of the group are simple monoazo compounds, oil yellow, for example, being diazotized aniline coupled with dimethylaniline, and oil red, diazotized α -naphthyl-

amine or mixed xylenes coupled with β naphthol. They contain no water solubilizing groups and are not useful, therefore, in the dyeing of textiles. In the United States, large quantities of these azo dyestuffs are produced and used for the colouring of gasoline.

The property possessed by azo dyestuffs of being readily transformed by strong reducing agents into colorless compounds is of great value in the printing of textiles. In the production of so-called "discharge" or "foulard" styles, materials consisting of cotton, silk or artificial fibres, which have been dyed in solid shades with appropriate azo dyes, are printed with a thickened reducing agent which may or may not contain an indigo or anthraquinone vat dyestuff. When the cloth is then steamed, the azo dyestuff is discharged, leaving a white pattern upon a coloured ground, or, if a vat colour was incorporated into the reducing agent, a coloured pattern upon a coloured ground of another shade.

This property of easy reduction possessed by the azo dyestuffs is extremely valuable in other directions, affording as it does (1) an accurate method for the measurement of the concentration of dyestuff either in solution or on a fibre, and (2) a relatively simple method for determining the intermediates used to build up azo dyestuffs. Under the action of reducing agents the azo linkage $-N=N-$ is broken with the formation of two amino compounds which usually can be separated and identified. Thus, orange II, the formula for which has already been given, splits into sulphonic acid and 1 amino 2 naphthol.

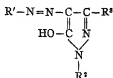


The azo dyestuffs and the arylaminohydroxynaphthoic acids occupy such an important position in commerce that a few statistics as to production and sales should be considered. The figures given in Table I are taken from a report of the Tariff Commission of the United States, the only country publishing such detailed information. It can be assumed that in world commerce the importance of the 12 products listed is proportional to production and usage in the United States. Moreover, a rough approximation of world production of these 12 products might be obtained by multiplying the United States production by four.

TABLE I—U.S. Production and Sale of Azo Dyestuffs, 1949

| Dyestuff | Production (in thousands of pounds) | Sale | | |
|---------------------|--|--------------------------------------|------------------------------------|------------------------------|
| | | Quantity (in thousands of pounds) | Value (in thousands of dollars) | Value (Dollars per pound) |
| Chrysoidine Y | 466 | 457 | 248 | 54 |
| Sudan I | 119 | 348 | 287 | 83 |
| Orange II | 1,478 | 2,316 | 547 | 41 |
| Chrome blue black R | 501 | 498 | 261 | 53 |
| Acid black 20L | 1,573 | 1,410 | 850 | 60 |
| Direct fast scarlet | 684 | 778 | 1,081 | 1,40 |
| Blamarch brown R | 750 | 758 | 513 | 68 |
| Developed black BH | 2,068 | 2,033 | 2,054 | 51 |
| Direct black 38 | 6,411 | 6,700 | 2,800 | 40 |
| Direct brown 3G | 701 | 721 | 363 | 50 |
| Naphthol AS | 395 | 343 | 2,100 | 1,30 |
| Naphthol AS SW | 360 | 377 | 989 | 2,62 |

Pyrazolone Compounds—Characteristic grouping

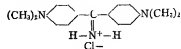


where R' is a substituted benzene or naphthalene nucleus, R² is a substituted or unsubstituted benzene nucleus and R³ is CH₃ or COOH

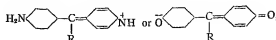
The most important dyestuff of this comparatively small class is tartrazine, a bright lemon yellow, which is made by the condensation of two moles of phenylhydrazine sulphonic acid with one mole of dioxytartaric acid in acid solution. Xylene light yellow, made by coupling diazotized sulphonic acid to dichloro sulpho-phenyl-methylpyrazolone, and chrome red B, made by coupling

diazotized 1 amino-2-naphthol-4 sulphonic acid to phenylmethylpyrazolone, are the two other important dyestuffs of the class.

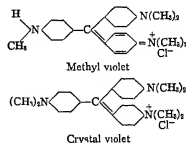
Ketamine Compounds—Only one dyestuff, auramine, belonging to this class is of commercial importance. It is made by heating together a mixture of tetramethyldiaminodiphenylmethane, sulphur and ammonium chloride under pressure of gaseous ammonia. The dyestuff, used primarily for dyeing paper pulp in bright yellow shades, possesses the following structure



Triphenylmethane Compounds—Characteristic grouping



in which R stands for a substituted or an unsubstituted benzene or naphthalene nucleus. Crystal violet and methyl violet are the best known and most widely used dyestuffs of this class, the first being made by the action of phosgene upon dimethylaniline, the latter simply by the oxidation of dimethylaniline, usually by means of cupric salts. They are used primarily in the paper industry, either for colouring paper pulp or for the coating of copying paper, i.e., carbon paper.



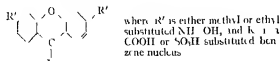
The triphenylmethane dyestuffs are characterized by brilliant and intense shades of red, violet, blue and green. They have basic, acidic and substantive properties according to the auxochromic groups they contain. As a class they are rather deficient in fastness to light, and frequently also to washing and to alkalis, by which they are partly decolorized. This loss of colour is attributed to a change of type from a quinoid to a carbonyl structure, and it can be diminished by the introduction of a chlorine atom or a sulphonic or other group into one of the benzene nuclei in the ortho position to the central carbon atom. Thus, setoglaurine, made from o-chlorobenzaldehyde and dimethylaniline, is a somewhat faster dyestuff than malachite green, which, as has been shown, is made from benzaldehyde and dimethylaniline.

Other important basic dyestuffs of this class are magenta, the brilliant greens and the Victoria blues, while the most important acidic members are the acid greens, acid violets, patent blues, the acid glucanines and xylene blues. A few compounds of the class are especially valuable as chrome-mordant dyestuffs and they are generally designated as the chrome azurols and the chrome cyanines. Their chromium fixing property is attributed to the presence of carboxyl groups in the molecules.

In Table II are given the production and sales of six important dyestuffs of this class in the United States.

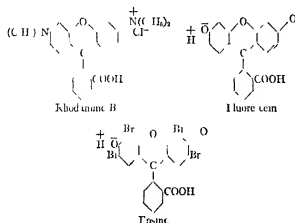
TABLE II—U.S. Production and Sale of Triphenylmethane Dyestuffs, 1949

| Dyestuff | Production (in thousands of pounds) | Sale | | |
|-------------------|--|--------------------------------------|------------------------------------|------------------------------|
| | | Quantity (in thousands of pounds) | Value (in thousands of dollars) | Value (Dollars per pound) |
| Malachite green | 215 | 272 | 447 | 1,64 |
| Acid glucine blue | 646 | 840 | 800 | 1,02 |
| Methyl violet | 2,247 | 1,702 | 630 | 84 |
| Crystal violet | 812 | 718 | 1,344 | 1,89 |
| Acid violet | 97 | 143 | 286 | 1,37 |
| Victoria blue B | 154 | 198 | 414 | 2,14 |

Xanthene Compounds—Characteristic grouping

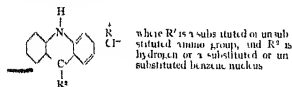
This class, made up of both basic and acidic members, comprises several of the most brilliant dyestuffs available in commerce. They differ from the triphenylmethines in that two of the benzene nuclei of the molecule are joined by an oxygen bridge, and to this characteristic can be attributed their greater resistance to oxidizing and reducing agents, and therefore their fastness to all sorts of soap and mangle (mechanical action whereby a woollen fabric is softened and felted). The basic members, the fluoresceins, are made by the condensation of methyl or ethyl substituted aminophenols with phthalic anhydride, whereas the acidic members, the rhodamines, result from the condensation of resorcinol with phthalic anhydride or with chloro-substituted phthalic anhydrides. The red rhodamines, of little commercial importance, are sulphonic acids of the basic members of the series.

The two most important members of the class are rhodamine B and eosine (though, as has been observed, fluorescein became a highly important product in World War II). The relationship of the three compounds is illustrated as follows:



Although the rhodamines are used primarily for the dyeing of silk in brilliant pink and red shades and for the preparation of water-soluble salts which are used as pigments, eosine itself is used almost exclusively for the latter purpose, its acid salt being an extremely bright bluish red pigment with a high, bronzy over-tone (reflection). The rhodamines, in especially purified forms, are also used in the cosmetic trade. Any given lipstick or face powder, for example, is most likely to be coloured with a rhodamine or a pigment derived from a rhodamine.

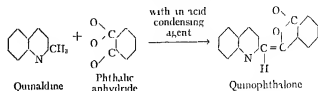
The phloxins and rose bengals are bromo and iodo derivatives, respectively, of the condensation products of chlorophthalic anhydrides and resorcinol. They are no longer of any considerable commercial importance.

Acridine Compounds—Characteristic grouping

This is a small class of yellow and orange dyestuffs with basic properties which are used mainly for the dyeing of leather although members of the class are occasionally printed on textiles. The chief representatives are phloxine, acridine orange and acridine yellow. Proflavine and acriflavine, members of the class, are useful in medicine as local antiseptics, but they are not used as dyes. The members of the group are more resistant to the action

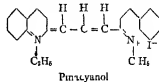
of reducing agents than the azos, the triphenylmethines and the xanthenes, and are therefore not readily decolorized by sodium hydrosulphite.

Quinoline Class—No characteristic grouping can be given for the dyes of this class, though the quinoline nucleus is common to its members. Only one or two representatives of the group are useful for the dyeing of textiles. These are the quinoline yellow made by condensing quinoline (2-methylquinoline) or a derivative of this compound with phthalic anhydride and sulphonating the resulting quinophthalones, for example:



From the fact that either the mono- or disulphonic acid of quinophthalone yields unsubstituted phthalic acid upon oxidation it appears that sulphonation takes place in the quinoline nucleus of the compound.

A number of dyestuffs belonging to this class are of primary importance in the art of photography. These products, designated as the cyanines, are characterized chemically by structures in which two nitrogen atoms, members of heterocyclic ring systems, and in which the chain joining the nitrogen atoms passes through 1 part of each ring. Pseudoaniline, for example, discovered in 1905, and made by condensing two moles of ethyl quinaldinum iodide with formaldehyde, has the following structure:



The value of the cyanines in the art of photography is based on their properties of sensitizing silver bromide emulsions to various wave lengths of light. Thus, by increasing the chain length between the quinoline nuclei in dyestuffs possessing the foregoing structure, sensitivity is shifted toward the red end of the spectrum, and by decreasing the chain length, the sensitivity is shifted in the opposite direction. Moreover, either one or both of the quinoline nuclei can be replaced by other ring systems in which the nitrogen atoms are part of the ring, for example, by (1) thiazole, (2) benzothiazole and (3) 4-alkylquinoline.



Thus, by varying the nuclei in the cyanine and the chain length between the nuclei dyestuffs can be prepared which sensitize photographic emulsions in the invisible as well as in the visible ranges of the spectrum.

Azine Compounds—Characteristic grouping

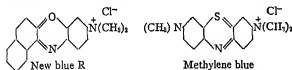
This class contains both basic and acidic dyestuffs with shades ranging from red to blue, the basic members including the red saframines and the blue or black spirit-soluble indulines and nigrosines, and the acidic members including the rosindulines, the water-soluble indulines and nigrosines, the indocyanines and the acid cyanines. Perkin's mauve, the first dyestuff manufactured from coal tar, is a member of this class, and is closely related to safranine, the method of preparation and formula of which have already been given. The safranines are used primarily for the printing

of cheap cotton fabrics and for the dyeing of paper pulp, while the indulines and nigrosines are employed primarily for the dyeing of leather, the spirit soluble brands being the dyestuffs mainly employed in black shoe finishes.

Aniline black, an insoluble dye formerly employed widely in the cotton industry but now largely supplanted by other colouring matters is a member of this class. It was formed by impregnating cloth with an aniline salt and then subjecting the material to the action of a strong oxidizing agent such as a chlorate or a chromate, the fastness of the black dyes or prints being dependent upon the vigour of the oxidation.

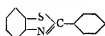
In general, it can be said that the azines result from the oxidation of various aryl amines, nigrosine, for example, being prepared by oxidizing a mixture of aniline and aniline hydrochloride, by means of either nitrobenzene or a nitrophenol at 180–200° C.

Oxazine and Thiazine Compounds—These classes are closely related to the azines the former having an oxygen atom and the latter a sulphur atom in place of one of the nitrogen atoms in the azine structure. Only a few dyestuffs of these classes are important commercially. New blue R (Meldola's blue) is a representative oxazine, while methylene blue is a thiazine. The former is made by the condensation of *p*-nitrosodimethylaniline and β naphthol, while the latter results from the oxidation of a mixture of dimethylaniline and dimethyl *p* phenylenediamine in the presence of sodium thiosulphate. The dyestuffs have the following formulas:

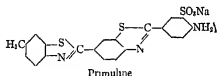


Other dyestuffs of the oxazine class are nile blue, the galocyanines and the anthracyanines. The brilliant alizarine blues are thiazines. The colour of the blue and black dyestuffs of the sulphide class is attributed to the thiazine chromophore, although the complete structure of the compounds is not known.

Thiazole Compounds—Characteristic grouping

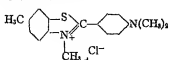


One of the most important dyestuffs of this class is primuline, in which the thiazole group occurs twice.

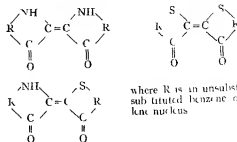


It is made by the sulphonation of the product which results when *p* toluidine and sulphur are heated together at temperatures of 220°–270° C, the 'primuline base' usually being directly distilled under vacuum from the reaction mass. The dyestuff can be applied to cotton without a mordant, whereupon dyeings of a primrose yellow shade are obtained, or, inasmuch as the molecule contains a free amino group, the dyestuff can be diazotized on the fibre and coupled there with a suitable second component. Thus, with β naphthol, a brilliant red is obtained on cotton, the colour being fast to washing.

In the manufacture of primuline base varying amounts of dehydrothio *p*-toluidine are formed as a by product. On occasion, however, the primuline base is the by product, for, by the methylation of dehydrothio *p* toluidine, the brilliant yellow dyestuff, thio flavine T, another thiazole, particularly useful as the source of an important yellow pigment, is produced.

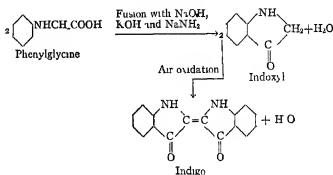


Indigoid Compounds—Characteristic groupings



Until 1905 this class of dyestuffs was represented only by indigo itself, its isomeric indorubin, and its sulphonic acid indigo carmine. Prior to the beginning of the 20th century, indigo was obtained by fermentation of the expressed sap of the *Indigofera tinctoria* and other similar plants growing in India, Java, etc. indorubin always being associated with the more important dyestuff. The manufacture of synthetic indigo in Germany, perfected in the last few years of the 19th century, was an economic upheaval of the first order, for in India alone more than 1,500,000 acres of land were devoted to the culture of the indigo plant. By the time World War I began, the synthetic product had almost completely supplanted the natural, Germany and Switzerland supplying the great bulk of world requirements.

In the years between 1880 and 1900, a number of methods were developed by the Germans for the synthesis of indigo, but none of these was economically successful until the phenylglycine-sodamide process was perfected in 1896–97. In this process, phenylglycine is fused in a mixture of caustic soda, caustic potash and sodamide, the function of the latter substance being to bind the water formed in the fusion and thus to maintain anhydrous conditions in the reaction mass. An almost quantitative yield of indoxyl is obtained by this method, and this substance in turn is quantitatively converted into indigo by simply aerating the "indoxyl fusion mass" (fusion mass suspended in a large volume of water), atmospheric oxygen being sufficient to effect dyestuff-formation from the indoxyl sodium salt. The reactions involved are as follows, the indoxyl being shown as the free acid for simplification.



During World War I the manufacture of indigo was undertaken in Great Britain and the United States, and, following that war, both of those nations began exporting the dyestuff. Table III will illustrate the growth and decline of the manufacture of indigo, 20% paste, in the United States, the only country where data on production and value are available.

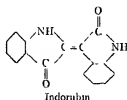
TABLE III.—U S Production and Value of Indigo, 20% Paste

| Year | Production (in thousand pound-) | Value (Dollars per pound) |
|------|------------------------------------|------------------------------|
| 1916 | none | — |
| 1917 | 275 | 1.42 |
| 1918 | 1,054 | .88 |
| 1919 | 8,851 | .59 |
| 1920 | 18,173 | .74 |
| 1921 | 20,122 | .10 |
| 1922 | 21,533 | .14 |
| 1923 | 13,614 | .17 |
| 1924 | 11,133 | .10 |
| 1925 | 13,396 | .21 |

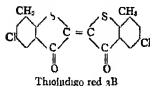
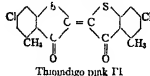
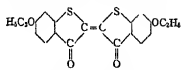
As of the beginning of World War II, Germany, Switzerland, France, Italy, the U.S.S.R., Japan and the United States were all producing their own requirements of indigo, the three principle exporting countries being Germany, Great Britain and the United States, with the bulk of the exports going to China. In the United States particularly, the importance of the dyestuff began a rapid decline in the decade 1920-30, for faster colouring matters began to be preferred even at a somewhat increased cost per yard of material dyed.

By the halogenation of indigo, chloro and bromo derivatives can be obtained, and several of these have become important dyestuffs in commerce. Thus 533,000 lb of tetrabromindigo 16% paste, given various names depending upon the manufacturer, but generally named bromindigo blue 2B, were sold in the United States in 1949.

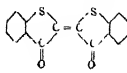
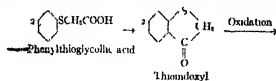
Indorubin, whose sulphonic acid was once used as a red colouring matter for wool, of itself never became an important dyestuff. The same holds true for many products with the indorubin configuration which have been synthesized. Its relationship to indigo can be understood from its chemical structure.



In 1906 thiondigo, the first of a large series of indigoid dyestuffs containing sulphur and giving orange, red and brown shades, was discovered by P. Friedländer in Germany. The relationship between these compounds and the true indigos can be seen by the formulas of the three most important dyestuffs in the series.



These thiondigo dyestuffs are most usually prepared by the ring closure of a thioglycolic acid to a thiondoxyl, and the oxidation of the thiondoxyl to the dyestuff by means of a mild oxidizing agent.



The relative importance of two of these thiondigo dyes can be realized by a consideration of their sales volume and value as against indigo itself in the United States in the year 1949.

TABLE IV—U.S. Production and Sale of Thiondigo Dyestuffs, 1949

| Dyestuff | Sale or production (in thousand pounds) | Value (Dollars per pound) |
|------------------------------|--|------------------------------|
| Indigo 10% paste | 13 106 | 21 |
| Thiondigo red 3B 10% paste | 208 | 1.34 |
| Thiondigo orange R 10% paste | 511 | 1.40 |

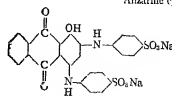
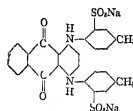
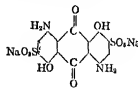
Anthraquinone Compounds—Characteristic grouping



This important class of dyestuffs contains acidic, mordant fixing and vat dyeing members. All groups, however, are characterized by the fastness of their members to destructive agents such as light, hundering and oxidizing agents. The older members, comprising the alizarines, purpurines, alizarine cyanines and alizarine blues (mostly hydroxy derivatives of alizarine itself) at one time were highly important mordant fixing dyestuffs, but since the advent of other cheaper classes of colouring matters with satisfactory fastness properties their importance in world commerce has diminished almost to the vanishing point. The formulas and method of manufacture of several of these dyestuffs have already been given.

With aluminum, chromium or iron hydroxides, the hydroxy-anthraquinones produce colours which vary with the hydroxide employed. Thus, the typical dyestuff alizarine yields with aluminum a red, with chromium, a maroon, and with iron, a purple. When fixed with a compound mordant of aluminum, calcium and a fatty acid, the celebrated turkey red is produced. This colour was originally dyed by the use of madder, the ground root of the *Rubia tinctorum*, which contains alizarine, and which up to about 1875 was grown in large quantities for this purpose. The synthesis of alizarine from anthracene by C. Grube and C. Liebermann in 1868 laid the foundation for the artificial manufacture of this dye stuff, and also for the great developments in anthraquinone chemistry which have since followed. In a few years the natural colouring matter was entirely replaced by the synthetic, the manufacture of which was effected by oxidizing anthracene to anthraquinone, converting this into its β sulphonic acid and fusing the latter with caustic soda.

The acidic members of the anthraquinone class are represented by alizarine red, alizarine acid blues, including the blue black B acid alizarine green, alizarine sapphrol, alizarine rubinol, alizarine direct blue and alizarine cyanine green. These products are used mostly for the dyeing of wool, with or without a mordant, although one of them, alizarine sapphrol, is used widely for the dyeing of paper. Following is the chemical structure of three important dyestuffs of this class.

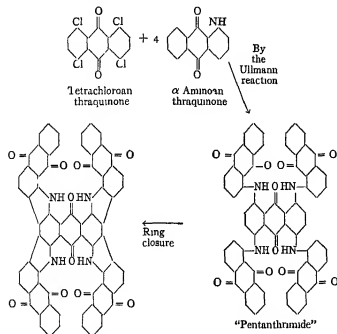


The production, sale and value of these three products in the United States in 1949 were as given in Table V

TABLE V—U.S. Production and Sale of Anthraquinone Dyestuffs, 1949

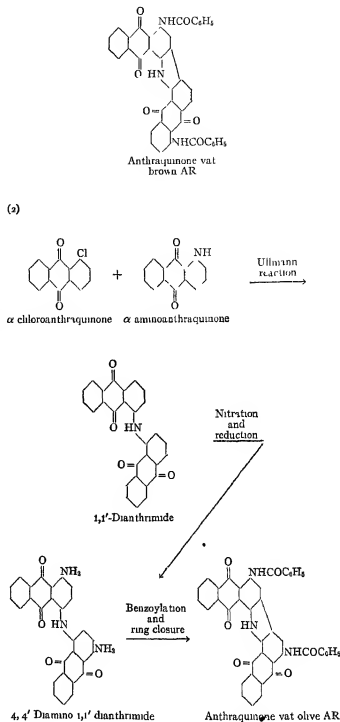
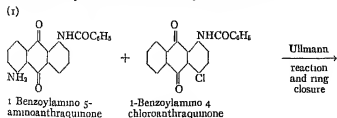
| Dyestuff | Production (In thou sand pounds) | Sales (In thou sand pounds) | Value (Dollars per pound) |
|-------------------------|--|-----------------------------------|---------------------------------|
| Alizarine saphirol | 878 | 653 | 13 |
| Alizarine cyanine green | 21 | 238 | 2.61 |
| Alizarine blue black B | 102 | 170 | 1.93 |

The vat colouring matters of the anthraquinone series are the fastest dyestuffs known. For this reason, since World War I they have assumed the most important place, as far as dyestuffs are concerned, in the world textile industry. As of the conclusion of World War II, these dyestuffs were being manufactured in Germany, France, Italy, the USSR, Great Britain, Japan and the United States. No other single synthetic dyestuff with the exception of indigo was ever produced in greater quantities than anthraquinone vat khaki 2G during the years of World War II. In the United States alone, production reached approximately 1,000,000 lb of the 10% paste per month, with a sales value of \$1.10 to \$1.20 per pound, the product being used chiefly for dyeing cotton cloth in fast khaki shades. At this price range, the value of this dyestuff in a yard of cotton cloth dyed to the average olive drab shade was approximately five cents, about four pounds, being required per 100 yd of such cloth. Vat khaki 2G is made by the condensation of four moles of α aminoanthraquinone with one mole of 1,4,5,8-tetrachloroanthraquinone by the Ullmann reaction, and the ring closure of the resulting compound called "pentanthrimide" by fusion with anhydrous aluminum chloride.



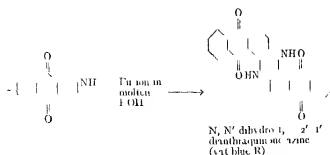
Anthraquinone vat khaki 2G

Closely related to vat khaki 2G are vat brown AR and vat olive AR, both of which, too, were produced in enormous quantities during World War II. The following series of reactions will illustrate one method by which each of these dyestuffs are made



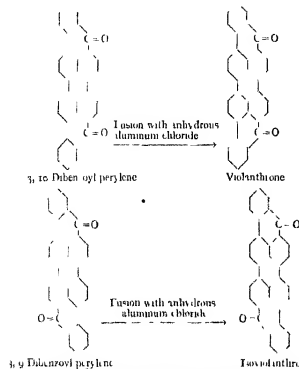
It will be observed that vat brown AR and vat olive AR are isomeric products, dyeing cotton in entirely different shades because of the different positions of the benzoylamino groups.

The first vat dyestuff derived from anthraquinone to be marketed commercially was discovered by R. Bohn in 1901. It was made by the fusion of β aminoanthraquinone in molten caustic potash. The product of the reaction, illustrated below, is a blue powder which dyes cotton and linen fibres in bright blue shades of exceptional fastness. The dyestuff was first marketed by the Badische company under the name of indanthrene blue R. Its monochloro derivative, a somewhat greener shade of blue, soon made its appearance under the name of indanthrene blue GCD, and subsequently its dichloro derivative became an important article of commerce under the name of indanthrene blue BCS.



Other important members of the class are violet green and dark blue BO (violetthione) whose structure and methods of manufacture have already been given. In addition there are at least so other dyestuffs belonging to this class which are of extreme importance in the world textile industry. On the majority of these patents have expired and therefore, the products are widely manufactured (see *Nomenclature* above).

Two violet dyes of the anthraquinone class violetthione and its isomer, isovioletthione, are of particular interest chemically because of the fact that they are nothing more than quinones derived from hydrocarbons of their molecular weight. The structures of these two compounds were proven by A. Zinke and R. Scholl, who synthesized them from two benzoyl derivatives of perylene as follows:



The constitution of perylene itself is also proven by R. Scholl, who synthesized it from 8, 8' diiodo 1, 1' dinaphthyl as follows:



In general it can be said that after 1900, dyestuff chemists more fully explored the field of the anthraquinone vat dyestuffs than any other.

In Table VI are given the production and sales value of a number of the important anthraquinone vat dyestuffs in the United States in 1949:

TABLE VI—U.S. Production and Sale of Anthraquinone Vat Dyestuffs, 1949

| Dye stuff | Production (in thousand pounds) | Value (Dollars per pound) |
|----------------------------|------------------------------------|------------------------------|
| Vat dark blue BO 15% paste | 11 | 1.9 |
| Vat dark green 10% paste | 5,295 | 1.0 |
| Vat blue RS 10% paste | 1,161 | 1.22 |
| Vat blue C (D) 15% paste | 1,775 | 1.2 |
| Vat olive K 15% paste | 1,159 | 1.01 |
| Vat brown R 12% paste | 861 | 1.7 |
| Vat black 2F 10% paste | 800* | 1.32 |

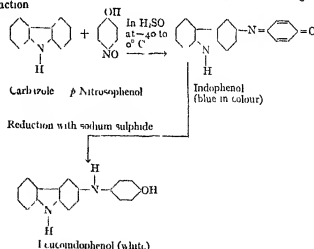
*Approximate figure

Phthalocyanine Class—The structure of compounds belonging to this class has already been given (see *Theoretical*, above). The metallic phthalocyanines are prepared primarily by two methods. Copper phthalocyanine, for example, is made (1) by heating together a mixture of anhydrous cuprous chloride, ordinary nit and phthalonitrile (o dicyano benzene) or (2) by heating together a copper salt, urea and phthalic anhydride. The products, insoluble in water and intensely blue in colour, are used mostly as pigments. Although sulphated copper phthalocyanine is occasionally used as a bright blue dyestuff for the direct dyeing of cotton and rayon.

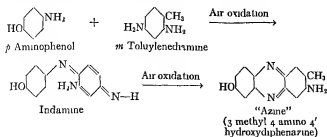
By the chlorination of copper phthalocyanine, various chloro derivatives can be obtained, the most important ones being the compounds containing 12.66 chlorine atoms in the molecule. These products are intensely green in colour. Moreover, they are remarkably stable. For these reasons they, too, have become of extreme importance in the pigments industry.

The production of phthalocyanine blue in the United States in 1949 was 609,000 lbs. with a sales value of \$3.36 per pound.

Sulphide Class—As has been previously noted, a large class of dyestuffs can be made by subjecting various intermediates and products to the action of sulphur, or sodium sulphide, or both, the process being known as thionation. Furthermore, in some cases the reaction is carried out by simply heating the intermediates and sulphur together, whereas in others, solvents such as water and alcohol are employed. By this reaction, sulphide colouring matters were once made from materials such as sawdust, straw or sulphite cellulose, but these dyestuffs have long since been replaced by others derived from definite benzene, toluene and naphthalene intermediates. Thus, by heating ("baking") sulphur and *m*-toluylenediamine together at temperatures from 230° to 260° C. and treating the reaction product with aqueous sodium sulphide, a deep brown dyestuff, used in large quantities for the dyeing of cotton, is obtained. By subjecting dimethophenol or a mixture of dimethophenol and trimethophenol (picric acid) to the action of aqueous sodium sulphide in which sulphur has been dissolved (sodium polysulphide), deep black cotton dyestuffs are manufactured in large quantities, the shade of the black dyings becoming progressively redder with increasing amounts of picric acid. By boiling under reflux in alcoholic solution of sodium polysulphide and the leuconidophenol derived from carbazole, an important blue cotton dyestuff, generally named hydron blue, is obtained, the leuconidophenol being made by the following reaction:



Finally, by thionating in ethyl alcohol the azine derived through the indamine from *p*-aminophenol and *m*-toluylenediamine, bordeaux coloured dyestuffs are obtained, the reactions leading to the azine being illustrated as follows



Formulas for the sulphide dyestuffs cannot be written, for in no case has the constitution of the compounds been clearly established

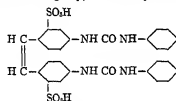
The production and sales value of the most important of the sulphide dyes in the United States in 1949 were as shown in Table VII

TABLE VII—U.S. Production and Sale of Sulphide Dyestuffs, 1949

| Dyestuff | Production (In thousand pounds) | Value (Dollars per pound) |
|----------------|------------------------------------|------------------------------|
| Sulphur black | 9 365 | 51 |
| Sulphur blue | 3 305 | 40 |
| Sulphur brown | 2 798 | 38 |
| Sulphur green | 1 266 | 73 |
| Sulphur yellow | 459 | 45 |

White Dyestuffs—In the early years of World War II, the German I.G. filed patent applications in a number of European countries on the use of certain derivatives of diaminosulbene disulphonic acid as white dyestuffs. The applications covered the use of the products (1) in washing compositions to improve the brightness of textile fibres washed therewith, (2) in papermaking for brightening the pulp, (3) in textile printing for whitening the discharged parts of the prints, and (4) in plastics and extruded synthetic fibres for whitening these materials.

Nothing much was done with the development during the years of the war. At its conclusion, however, possibilities in the foregoing directions evoked great interest in Switzerland, Great Britain and the United States. In Germany the products had been designated as the blankophors, in those other countries they began to appear in 1946 as articles of commerce under various trade names. Thus, blankophor R, which might be considered a representative product of the group, is the compound and is made by



the condensation of two moles of phenylisocyanate with one mole of diaminosulbene disulphonic acid. Other members of the group are made by condensing substituted aromatic carbonyl chlorides with diaminosulbene disulphonic acid.

These whitening compounds are dyestuffs in the sense that they are substantive to fibres just as the coloured dyestuffs are substantive. Their virtue as whitening agents lies in the fact that they strongly absorb ultra-violet light and emit a large part of this energy in the visible regions of the spectrum. By 1947 they were finding important uses in textile and related fields.

METHODS OF APPLICATION

In the previous section the synthetic dyes were classified from the standpoint of their chemical structure. It is now proposed to classify them according to their dyeing properties which, as has been pointed out, are dependent to a great degree upon these structures. In the different categories, representatives of several chemical classes will frequently be found.

Basic Dyes—The basic dyes are salts, usually hydrochlorides and sulphates, of coloured bases containing amino or substituted amino groups such as NH_2 , $\text{N}(\text{CH}_3)_2$, $\text{NH C}_2\text{H}_5$, etc. They dye materials of animal origin—wool, silk, leather, feathers, etc.—directly from a neutral bath, but they have little or no affinity for materials of vegetable origin. However, they can be applied to fibres such as cotton or linen by the use of mordants, tannin and a metallic salt such as ferric emetic, or a synthetic agent such as a sulphurized phenol, being used for this purpose. The function of the mordants in this case is to produce water-insoluble complexes of the dyestuffs which are held mechanically or chemically by the fibres. If material so dyed is boiled with dilute caustic soda saturated with salt, the complexes are broken and the dye base is released. It can then be extracted from the dyed material by means of dilute acid. This affords an easy method of determining if a fibre of vegetable origin has been dyed with a basic dyestuff.

The affinity of these colouring matters for materials of animal origin is doubtless caused by chemical combination between the amino groups of the dyestuff and carboxylic acid (COOH) groups in the silk, wool, etc. Consequently, the maximum affinity for these fibres is exerted in a neutral or slightly alkaline bath, and this characteristic explains why these dyestuffs can readily be removed from such fibres by boiling the dyed materials with weak acids.

The best test for distinguishing basic dyestuffs from other classes is the formation of an insoluble coloured compound upon adding tannic acid and sodium acetate to a solution of the dyestuff. The most important members of this class are magenta, methyl violet, malachite green and brilliant green of the triphenylmethanes, rhodamines B and 6G of the xanthenes, safranin of the azines, Meldola's blue of the oxazines, methylene blue of the thiazines and chrysoidine and Bismarck brown of the azos.

Acid Dyestuffs—These dyestuffs are salts, usually the sodium salts, of coloured compounds containing acidic groups, especially the sulphonic acid group, SO_3H . They dye animal fibres, silk and wool particularly, directly from an acidified solution, and they, therefore, find their chief outlets as colouring matters for these materials. However, a number of them are much used in the form of their insoluble salts as pigments, the barium salt precipitated upon a mineral base being most generally employed. Certain acid dyestuffs of the azo class, the lake reds and lithol reds, are manufactured especially for this purpose.

Most of the important acid dyes are azos, triphenylmethanes or anthraquinones. Metanil yellow, orange II, the acid scarlets and amido naphthol red 6B are azos, alkali blue, soluble blue, the patent blues, the acid violets and acid greens are triphenylmethanes, and alizarine sapphires, alizarine insol, alizarine cyanine green and alizarine rubinol are anthraquinones. With the exception of the anthraquinone derivatives, these dyestuffs are relatively fugitive, and they, therefore, have gradually given way to superior products.

Mordant Dyes—These are coloured compounds which of themselves have either little affinity for fibres of various sorts or poor fastness qualities when applied, but which are capable of being used as dyestuffs when "fixed" upon materials by means of a third component used in the dyeing operation. This third component is termed a mordant. The most common ones in use are various chromium salts and tannic acid, although, as previously noted, a number of so-called synthetic mordants have been developed since 1900.

The role played by these mordants in the art of dyeing has never been fully established. In some cases cloth or yarn is treated with the mordant before the dye is applied, in others, the mordant is used along with the dye, while in still others, the dye is first applied and the dyed cloth or yarn is treated with the mordant. With a chromium salt as the third component, the three methods are referred to, respectively, as bottomchrome, metachrome and topchrome dyeing.

The dyestuffs applied with chromium as a mordant are usually characterized by the presence of a hydroxy group in the ortho position to a COOH , an SO_3H , an NH_2 or an $-\text{N}=\text{N}-$ group in the dyestuff molecule. There is much evidence to indicate that

vious metals form chelate compounds with such molecular structures (that is, ring compounds with co-ordinate valence in the ring), for example



which represents the metallic complex of alizarine with which Turkey red is dyed in part. These chelate compounds are generally insoluble in water, and the role of metallic salts as mordants has been attributed to this property. Yet there is more to the mordanting operation than the formation of insoluble compounds, for as has already been shown, certain chromium containing dyestuffs which are water soluble have become important commercial

With the dyestuffs containing basic radicals such as NH_2 , N^+CH_3 or $\text{N}^+\text{CH}_2\text{CH}_3$, tannic acid forms relatively insoluble tan-
nates in practically all cases. Before the advent of the vat dye stuffs and the naphthols, cotton was commonly dyed or printed with the basic dyestuffs and a tannin mordant, the triphenyl methane and azo colouring matters being generally used for the purpose. But the shades thus produced were somewhat inferior in fastness to those obtained with the vat dyestuffs and with the insoluble azo dyes derived from the arylamino 2-hydroxy 3-naphthol acids.

Although many mordant dyestuffs are not greatly altered in shade by combination with the mordant, in some cases a complete change of colour is produced. Thus, the yellow alizarine gives a red and purple, respectively, with aluminium and iron salts as mordants, whereas the red azo dyestuffs derived from chromotrope acid (1, 8 dihydroxy naphthalene 3, 6 disulphonic acid) are changed into blues and bracks when a chromium salt is used as the mordant.

Direct Dyes—These are colouring matters which dye cellulose fibres from a neutral or alkaline solution without the application of a mordant. They dye animal fibres in a similar manner and also from an acid bath. Like the acid dyestuffs, they are sodium salts of sulphonic acids, but although in the case of the acid dyes the free acid is combined with the fibre, with the direct dyes the metallic cation is absorbed along with the organic anion. For this reason these dyestuffs are sometimes referred to as salt dyes. Here again the reason for this affinity has never been fully explained. (See *Theoretical*, above.)

The direct dyestuffs are mainly used for the dyeing and printing of cellulose materials (including rayon) and wool. Certain of them when applied to the latter materials are faster than the acid dyestuffs. A few contain mordant fixing groups and can be dyed upon wool with a chromic mordant or fixed upon cotton with a metallic salt. Certain of these dyestuffs are sold in the form of their soluble complex compounds (chelate compounds) for dyeing cotton directly in shades with good resistance to light.

At least 100 direct dyes are of commercial importance, and, as has already been noted, most of them are derived from benzidine, toluene or diamidine by the diazo reaction. Orange and brown purpurine and direct black are the most important divisions of this class. Others are derived by coupling suitable compounds with amino or carbonyl derivatives of J acid (2-amino-5-naphthol 7-sulphonic acid). Among these are the benzoflavonols, the rosanilines and the diazo brilliant carles. The tubane and tubale dyestuffs, already discussed, are the most important direct dyes commercially.

Developed Dyes.—This term is applied to those colouring matters which are formed on the material being dyed, generally by the diazo reaction. Para red, the first dyestuff of this class, the naphthols and the products derived from purpurine have already been discussed. They are used primarily for dyeing cloth in solid

shades which will be partly discharged, or over which other colours will be printed in patterns by the discharge process. (See *Azo Compounds*, above.)

Sulphide Dyes.—All dyestuffs made by the process of thionation, previously discussed, belong to this class. The products are insoluble in water, but when acted upon by aqueous sodium sulphide (Na_2S) or sodium sulphhydrate (NaSH) solutions, they become soluble in water and substantive to cellulose fibres. Although the nature of the sulphide dyestuffs is not known exactly, it is believed that their solubility and dyeing properties can be attributed to a chain of sulphur atoms (S-S), in the molecule, which, upon reduction with sodium sulphide, yields metallic mercaptide groups (SN^-CH_2). After the dyestuff has been applied, oxidation reverses the process with the formation of the S-S linkage again, atmospheric oxygen being sufficient to bring this about.

The sulphide dyes are used primarily for dyeing cotton, either in the raw state, as yarn, or in the piece, that is, after the yarn has been woven into cloth. Their fastness properties vary with their chemical constitution, hydron blue and sulphur fast black 2NCl derived, respectively, from carbazole and *p*-hydroxy-phenyl *p*-naphthylamine, being, in this respect, the outstanding dyestuffs of this class. In general, their fastness properties fall between those of the direct and vat dyestuff. The sulphide dyes are rarely printed.

Vat Dyes.—This term is applied to those colouring matters, which, like the sulphide dyes, are insoluble in water, but which upon alkaline reduction, usually by means of caustic soda (NaOH) and sodium hydrosulphite ($\text{Na}_2\text{S}_2\text{O}_4$), a much more powerful reducing agent than sodium sulphide, (Na_2S), pass into solution in the form of the sodium salt of their leuco compounds. Invariably they possess two or more C=O groupings, which, upon reduction in this manner pass into C=ONa . Atmospheric oxygen is again sufficient to reverse the reaction, and thus the insoluble dyestuff is precipitated from a "vat" (that is, a solution of the sodium salt of the leuco compound) when the vat is blown with air. The same reaction takes place when cellulose fibres which have been dyed in the vat are exposed to air.

In general, the vat dyestuffs can be divided into two classes, the indigoids (including the thionindigoids) and the anthraquinoids. Many examples of these dyestuffs have already been given. Because of their insolubility in water, they are usually marketed in the form of pastes (that is, finely divided dyestuff particles suspended in water), such pastes varying from 5% to 25% dyestuff solids depending upon the nature of the individual product and the use to which it is to be put. On the other hand, methods have been developed for the manufacture of these dyestuffs in the form of dry powders, which are readily wetted, and which, when stirred into water, result in colloidal suspensions of dyestuff particles.

The vat dyestuffs can be either dyed or printed. In the latter operation, the reducing agent, usually a formaldehyde hydrosulphite complex, and the alkali are included with the dyestuff in the printing gum (i.e., the paste made with a starch or a natural gum) which is used as a vehicle in the printing operation. When the prints thus obtained are subjected to the action of moist steam at $98^\circ\text{--}102^\circ\text{C}$, the dyestuff is vatted and the pattern is fixed.

The vat dyestuffs, too, can be applied to cotton in the raw state, to cotton yarn or to cotton goods in the piece. In World War I a truly tremendous yardage of various ducks and twills was dyed with the vat dyes by the latter method in England and the United States (See *Anthraquinone Compounds*, above.) Also during World War II methods were developed in the United States whereby these dyestuffs can be applied to wool with satisfactory results, up to that time such a procedure was impossible by the vating method because of the destructive action of strong alkali upon animal fibres.

However, shortly after the conclusion of World War I, a line of so called "solubilized vat dyestuffs" made its appearance in world markets. This development was made possible by the fact that comparatively stable compounds can be formed by subjecting the C=ONa grouping in a leuco vat dyestuff to the action of sulphur trioxide in the presence of a tertiary base such as pyridine. The sodium salts of the sulphuric acid esters ($\text{C=O-SO}_3\text{Na}$) of the

reduced vat dyestuffs are thus obtained, and these, possessing water solubility, can be used for dyeing silk or wool as well as cellulose fibres. When such dyings are acted upon by an oxidizing agent, the ester is split, with the formation of the original insoluble vat dyestuff having the grouping $=C=O$.

The anthraquinoid vat dyestuffs are the finest synthetic colouring matters known, particularly to the action of bleaching solutions. Yarn dyed with these products can be woven in patterns or stripes into fabrics made of unbleached cotton yarn, and then the whole fabric can be bleached with strong bleaching agents such as hypochlorite without a material change in the shade of the coloured patterns or stripes. Sharper and cleaner results in partly coloured fabrics are obtained in this manner.

As of the conclusion of World War II, no methods had yet been developed whereby the vat dyestuffs could be applied to acetate silk or to other synthetic fibres, with the exception of rayon. As is well known, the latter material is regenerated cellulose, it can therefore be dyed and printed with all classes of dyestuffs that are used for cotton or linen.

Dyes for Synthetic Fibres—With the increased usage of synthetic fibres such as acetate silk (cellulose acetate), and, in the United States especially, nylon and vinylon, the problems of dyestuff chemists multiplied in proportion to the importance of the fibres, since the greater number of dyestuffs used in the colouring of silk, wool or cellulose fibres possess no affinity for these synthetic materials (see *Theoretical*, above). In Germany, on the other hand, *Zellwolle* (casein fibre) offered no difficulty, for this material possesses dyeing properties similar to those of wool.

In general, it can be said that the dyestuffs which have been developed for acetate silk are useful also in dyeing other synthetic fibres such as nylon and vinylon. The first of these colouring matters were the onamines, which are soluble derivatives of insoluble azo or anthraquinone compounds, and are formed from the latter by the introduction of CH_3SO_2Na groups in the molecule. These groups are split off from the products during the dyeing operation, leaving the insoluble dyestuff absorbed within the fibre. Later, methods were developed for converting various coloured amino anthraquinones into such finely divided condition that the compounds, although insoluble in water in the ordinary sense of the term, could be used for the direct dyeing of these synthetic fibres from soap solutions. Here again the anthraquinone compounds give the fastest dyes, 1-amino-4-hydroxyanthraquinone, a red, and 1, 4, 5, 8-tetraaminoanthraquinone, a blue, being representative dyestuffs of this class. In addition to dyeing fast shades upon the synthetic fibres, these dyes have the further advantage of possessing no affinity for cotton, linen or rayon. They can therefore be employed together with direct dyes for producing two colour effects upon fabrics woven from these fibres together with those of synthetic origin.

Food Dyes—This class of dyes has been developed particularly in the United States, where an agency of the government officially "certifies" as to the purity of factory lots of a selected number of synthetic dyestuffs which are allowed to be used in foods, confections, soft drinks, etc.

The most important of these "permitted" dyestuffs are naphthol yellow S, ponceau 3R, tartrazine, Guineo green and indigotine (indigo disulphonic acid).

Dyes for Rubber and Plastics—Coloured articles made from rubber or synthetic plastics are common in commerce. The colouring of rubber is brought about by the use of pigments (see below) either in the latex from which the rubber articles are formed, or in the rubber itself during the "milling" operation prior to vulcanization. It is therefore necessary in methods of this kind for the pigments to be composed of finely divided particles, which distribute themselves evenly throughout the rubber being coloured.

Plastic articles are likewise coloured with pigments, the colouring matter, in finely divided condition, being incorporated into the raw materials from which the plastic articles are moulded.

Pigments—By a pigment is meant a colouring material that does not dissolve in, or combine with, the substance being coloured. Pigmentation, therefore, is the even distribution of finely

divided coloured particles throughout such a substance.

Many coloured compounds which are closely related to the synthetic dyestuffs have become important pigments in commerce and, in some cases, the pigments are made from the dyestuffs. Thus, the basic dyes such as malachite green, crystal violet, the rhodamines, etc., containing NH_2 or $N(CH_3)_2$ groups, can be rendered insoluble in ordinary vehicles by precipitating them as their phosphotungstic or phosphomolybdic salts. On various water- or oil-insoluble metallic salts of the acids do exist containing carbonyl ($COOH$) or sulphonic (SO_3H) groups can be prepared, the lead, calcium, barium and aluminum compounds being most generally employed.

Such insoluble dyestuff derivatives are termed "lakes," and they are largely used in the paint, paper and printing ink industries.

In some cases, pigment products are manufactured, which, except for the absence of solubilizing groups, could be used as dyestuffs. The most important of these are the hansa yellows derived from benzidine or substituted benzidines and various acetoacetyl derivatives of aryl amines, such as aceto acetamide or aceto aceto- α -toluidide, by the diazo reaction.

Copper phthalocyanine blue and copper phthalocyanine green could also be included in this class.

A number of the water-insoluble vat dyestuffs, both indigo and anthraquinoids, are useful in commerce as pigments. Thus, in the United States the blue dyestuffs, indanthrone (vat blue RS) and its monochloro derivative (vat blue GCD), are used in substantial quantities in paints and lacquers for automobiles. Here fastness to sunlight and heat is of extreme importance, and these colouring matters will persist for long periods of time without showing the unsightly effect termed "bronzing."

Dyestuff Standardization—In marketing dyestuffs, the manufacturer invariably establishes what in the industry is termed a "standard" for each individual product sold. All subsequent production is brought to conformity in strength and shade with individual standards. In this way the purchaser is assured of uniform dyes or prints, he knows what per cent of dyestuff, based on the weight of the material to be dyed, to use in order to obtain a required shade with a given depth of colour.

The process used to bring dyestuffs, as they are manufactured to such uniformity, termed "standardization," consists, in the case of dyestuffs which are sold as powders, in first grinding the crude product to a fine powder, then agitating the powder in a machine called a "mixer" until a uniform and representative sample can be taken for "dye test."

A weighed amount of the sample and varying weighed amounts of the standard are then dyed on skeins. The crude dyestuff is then judged by these comparative dyes to be, say, 10% or 15% stronger than the standard. An inert material such as dextrose, sugar, common salt or anhydrous sodium sulphate is then added to the crude dyestuff in the mixer, and, after agitating again for uniformity, another sample is taken. The process is then repeated until the strength of the standard is matched. Few dyestuffs are sold at the strengths they possess as they come from the manufacturing processes.

In case of slight variations in shade from the standards, correction is made by adding, to the lot or batch of dyestuff being standardized, small amounts of other dyestuffs of the same class. For example, if a lot of benzopurpurine, a red of the direct dyestuff class, is found to be slightly bluer in shade than the standard, small amounts of an orange direct dyestuff might be added. The expert dyer chooses such "shading" dyestuffs, as they are called, with extreme care, since such blending of two shades leads, many times, to loss of brilliancy in the dyestuffs he is standardizing.

In spite of this fact, a large percentage of dyeing done on textiles, paper, leather, etc., is done with a mixture of dyestuffs. In these cases, of course, only dyes of the same dyeing class can be mixed. This mixing is usually done where the dyestuff is applied. Yet there are many ready mixed brands of dyestuffs in world markets.

The standardization of dyestuffs sold in the form of pastes is

carried out in exactly the same manner as in the case of powders, the wet "filter cakes" as they come from the dye making process being placed in the maver. Here water or a water-soluble liquid such as glycerine or diethyleneglycol, is the diluent rather than materials such as salt or sugar.

Occasionally, these dyestuffs, after standardization, are dried down in the form of flasks or pellets.

Many other tests may be applied to dyestuffs before standardization is completed. The rate of solution and the amount of insoluble material present are sometimes determined. Again the products may be examined for the presence of minute quantities of "grit" which would scratch the soft copper rollers, suitably engraved, from which dyestuffs are printed in patterns.

Thus, the chemical synthesis of dyestuffs is far from being the whole of dyestuff manufacture. Competition in this field has forced these concerns engaged in the business to higher and higher standards of production, particularly as to purity and cleanliness of the dyestuffs marketed.

HISTORICAL

In 1856 W. H. Perkin, a young English chemist, was working as an assistant to the noted German chemist, A. W. Hofmann, who, in 1842, had become the director of the Royal College of Chemistry in London. Both were interested in the chemistry of quinine, and during the Easter vacation while Hofmann was off on a vacation, Perkin attempted to synthesize the substance by oxidizing a mixture of aniline and toluidine with sulphuric acid and sodium dichromate. He did not understand at the time the exact nature of the material which was being oxidized.

It was only natural, therefore, that an unexpected product was obtained from the reaction—a black tar, which on treatment with alcohol gave a purple coloured solution from which silk and wool could be dyed in violet shades.

Perkin called the material mauve and almost immediately set up a small plant at Greenford Green, London, for its manufacture. It was the first synthetic or coal tar dyestuff manufactured commercially. From this accidental discovery and small private venture, the enormous synthetic dyestuff industry of the modern world has developed.

Before many years, other colours were added to the line. Nicholson found the first of the many alkali blues in 1857, and in 1858 Hofmann discovered magenta. These first colours, obtained by the oxidation of various amino compounds, belonged to the classes of dyestuffs recognized later as the azines and triphenylmethanes. The first azo dyestuff, aniline yellow, was discovered in 1859 by P. Gresser, who a year earlier had developed the diazo reaction. Safranine T also was first synthesized in 1859, and in 1863 T. Martius made Bismarck brown, these early synthetic dyestuffs are the only ones which survive as really important items in modern usage.

In 1868 the first of the natural dyestuffs of vegetable origin, alizarine, was synthesized from anthracene by Perkin in England and by H. Caro, Graebe and Liebermann in Germany. The latter group's application to cover the process reached the British patent office on June 25, 1869, and Perkin's was received just one day later. Two wholly independent investigators had arrived almost simultaneously at identical solutions of the problem.

From this time forward certain landmarks stand out in the development of the enormous diversity of synthetic dyestuffs available to mankind in the 20th century.

- 1860 Discovery of osone by Caro
- 1871 Discovery of erythrosine by Caro
- 1879 Discovery of bluish violet by Nicholson
- 1880 The completion of the Bayer synthesis of indigo
- 1884 Discovery of crystal violet by Caro and Klein and first used for direct dyestuff by Reuter
- 1888 Discovery of the hydroxy l amines by Hohl and Schmidt
- 1891 Discovery of the first aniline derivative of commercial importance by A. G. Reib
- 1897 The development of the sodamide process for the manufacture of synthetic indigo by the Badische company in Germany
- 1901 The discovery of indanthrone and flavanthrone, the first important anthraquinone vat dyestuffs, by Bohn
- 1904 Discovery of violanthrone, another anthraquinone vat dye-

- 1906 The first synthesis of thionindigo by Friedlander
- 1920 The discovery of jade green, one of the most important of the anthraquinone vat dyestuffs by W. Davis, J. Thompson and A. Thomas
- 1927 The discovery of copper phthalocyanine by H. de Diesbach and E. von der Weid

The number of dyestuffs synthesized in the many organic chemical laboratories in the world has run into the hundreds of thousands. However, comparatively few of these have reached commercial production and usage, less than 1,000 of importance being commonly in use in the world.

In order for a new dyestuff to be commercially successful, it must possess some outstanding property of fastness, ease of application, or an adaptability to a new material or fibre. It has happened in a number of instances that particular dyestuffs, for which no commercial use could be found when originally synthesized, have become important items for the dyeing of new fibres such as *Zellwulle*, acetate silk or nylon.

Commercial—The business begun by Perkin in England in 1857 spread in time to Germany, Switzerland, France, Italy, the U. S. S. R., the United States and Japan.

Developments in Germany, England and the United States, the three largest producing countries as of the beginning of World War II, will be briefly outlined.

In the years from 1862 to 1873, a half dozen establishments were founded in Germany, primarily to undertake the manufacture of synthetic dyestuffs. Thomas H. Norton, an agent for the United States department of commerce, in his report to that department in 1916, designated them as the "six leading German companies."

- Meister, Lucius and Bruning, founded in 1862
- Bayer and Co., founded in 1862
- Kalle and Co., founded in 1861
- Badische Aniline and Soda Manufacturing Co., founded in 1866
- Cassella and Co., founded in 1870
- Berlin Company for Aniline Manufacture, founded in 1873

In addition to these, Norton also listed the "seven smaller German companies," three of which had been in other chemical manufacturing activities prior to the beginning of the synthetic dye stuff business.

- Carl Jager, founded in 1833
- Griesheim Elektron, founded in 1842
- Wulff, Dahl and Co., founded in 1842
- Weiler-ter-Meer, founded in 1877
- Muhlheim, founded in 1879
- Griesheim Chemical Works, founded in 1881
- Leipzig Aniline Manufacturing Co., founded in 1882

As early as 1904 a merger of chemical manufacturing interests began in Germany, the 13 concerns drawing together into two great groups, the one headed by Badische and Bayer, the other by Meister, Lucius and Bruning, the Cassella Co. and Kalle. In 1916 the two groups drew up a closely knit cartel agreement, allocating production and dividing up markets not only in Europe, but throughout the world, for, at the beginning of World War I, the Germans had come to possess a virtual world-wide monopoly on the manufacture of synthetic organic chemicals.

In 1925-26 the two groups merged into the Interessen Gemeinschaft Färbendindustrie, the notorious German I. G., by far the wealthiest and most powerful chemical manufacturing combination in the world at the time.

In spite of the lead taken by the Germans, the manufacture of coal tar dyestuffs became a sizable industry in Great Britain after the establishment of Perkin and Son in 1857. Chief among the manufacturing concerns in that country were Simpson, Maule and Nicholson, established in 1860, to become Brook, Simpson and Spiller in 1869, the latter absorbing Perkin and Son in 1874. Reid, Holliday and Sons, originally established in 1830, which took up the manufacture of dyestuffs in 1860, I. Levinstein, Ltd., founded in 1864, the British Alizarine Co., founded in 1882, Claus and Rée, founded in 1891, with which Brook, Simpson and Spiller later affiliated to become Claus and Co. in 1907, and Morton's Sundour Fabrics, which began dyestuff manufacture in 1914, this branch of the business becoming Scottish Dyes, Ltd.,

in 1918

In 1917 Claus and Co. affiliated with I. Levinstein, and in 1919 this group was joined by British Dyes, Ltd., which had been formed from Read, Holliday and Sons, Ltd., in 1915. The new combination was known as the British Dyestuffs Corporation, Ltd. But in 1927, inasmuch as the group by that time had come to include a wide diversity of chemical manufacturing, its name was changed to Imperial Chemical Industries, Ltd.

This was joined in 1928 by Scottish Dyes, Ltd., and, finally, in 1931 by the British Alizarine Co. Thus by the latter year, the manufacture of synthetic dyestuffs in Great Britain had been gathered under a single directorship, and the group had become a division of Imperial Chemical Industries, Ltd.

Prior to World War I only seven small concerns manufactured synthetic dyestuffs in the United States, the largest one being the Schoellkopf Aniline and Chemical Works of Buffalo, N.Y., founded in 1879. Among the others were the Bayer Company of America, a subsidiary of the Bayer Co., Ger., established primarily to manufacture pharmaceuticals, the W. Beckers Aniline and Chemical Works and the Consolidated Color and Chemical Co.

As of 1914, the average monthly number of wage earners in the entire U.S. synthetic dyestuff industry was only 398, and the value of all production was but \$2,470,000.

During World War I the properties and assets of the Schoellkopf Works, Beckers and certain smaller companies became the foundation of the National Aniline & Chemical Co., Inc., later to become a subsidiary and ultimately the National Aniline Division of the Allied Chemical & Dye Corp. In 1916 E. I. du Pont de Nemours & Co. entered the field. Shortly thereafter the Newport Co. and the Calco Chemical Co. took up the manufacture of dye stuffs. As a result of these ventures during the war, the foundation was laid for the building of a truly great synthetic dyestuff industry in the United States. In 1931 the dyestuff branch of the Newport Co. was taken over by du Pont, and in 1939 the Calco Co. was absorbed by American Cyanamid, to become the Calco division of that company.

When the United States entered World War I, the property and patents of the Bayer Company of America were seized by the alien property custodian. Later these assets were sold, those pertaining to dyestuffs to the Grasselli Chemical Co., which formed a 100% owned subsidiary, the Grasselli Dyestuffs Corp.

About 1923 a 49% interest in this corporation was sold to the Bayer Co. of Germany. Thus, with the formation of the German I.G. in 1926, this concern acquired, through Bayer, a 49% interest in the Grasselli Dyestuffs Corp. In 1928 the remaining 51% interest was sold to the I.G., which by this time had set up in the United States a selling organization called the General Dyestuffs Corp., the manufacturing end of the business, thus partly acquired, being called the General Aniline Corp.

In 1939 these activities were merged with the Agfa Anso Co. to become the General Aniline and Film Corp. When the U.S. entered World War II, the assets of this corporation were seized by the alien property custodian and the business was put under U.S. management.

Other smaller manufacturers of synthetic dyestuffs in the United States included the Cincinnati Chemical Works, the American Aniline Co., the Young Aniline Co., the Dow Chemical Co. and the Pharma Chemical Co. National Aniline, General Aniline, American Cyanamid and du Pont were the big four. Thus, up to 1950 there had been no merging of the business in the United States as there was in Germany and in Great Britain.

At the conclusion of World War I, the annual capacity of the world to produce synthetic dyestuffs was about 260,000 tons, an increase of about 66% over that of 1913.

With the return of Germany made dyestuffs to the market, overproduction and severe competition were everywhere experienced, and each of the producing countries adopted measures to protect their home industries.

Italy and France created high import duties. Japan subsidized the industry and instituted a licence system of import controls. Great Britain by a proclamation in 1919 prohibited imports ex-

cept under licence from the board of trade. A test case however, resulted in a judgment that this procedure was illegal, and throughout 1920 there were no restrictions, dyes to the value of £7,500,000 being imported. This severe blow to the British industry was followed shortly by a world-wide slump in trade.

The dyestuffs (Import Regulations) act was passed, becoming operative on Jan. 15, 1921, whereby for a period of ten years the importation of dyestuffs and intermediates was prohibited except under licence from the board of trade. This act was continued by amendments until 1934, when it was rewritten without time limitation, but in 1942 it was suspended for the duration of World War II. At the conclusion of the war the licence system was again imposed.

With the rapid growth of the industry in the United States during the years of World War I, governmental action was taken to protect it. By an act of congress in 1916, duties on imports of dyestuffs were fixed at 15% ad valorem, plus live cents per pound specific duty, the act to run for five years. Later, imports were prohibited altogether except under licence from the war trade board. By the Tariff act of 1922, duties for two years were fixed at 60% ad valorem, plus seven cents per pound specific duty after which the ad valorem duty was to be reduced to 45% while the specific duty was to be continued at seven cents per pound, the ad valorem duty being based upon the selling price in the United States. By the Tariff act of 1930, these duties were continued, with the exception of those on indigo and sulphur black, which were reduced to 20% ad valorem and three cents per pound.

In 1936, by a trade agreement with Switzerland, the duties were reduced to flat 40% ad valorem, applicable to every country except Germany, which continued to pay the duties specified in the act of 1930. In spite of this fact, the greater part of the imports of dyestuffs into the United States from 1936 until the beginning of World War II came from that country.

However, as a result of that war Germany lost its position. In each of the years 1948 and 1949 less than 1,000,000 lb. of dyes were imported into the United States, and of these imports, Switzerland accounted for more than 95%.

Table VIII discloses the extent of the world's dyestuff business over a period of about 20 years, and the extent to which after World War I, the virtual monopoly in the industry enjoyed by Germany was broken. The table also indicates the effects of World War II upon world production.

TABLE VIII—World Production of Dyestuffs
(In thousands of pounds)

| Country | 1920 | 1927 | 1949 | 1950 |
|----------------|---------|---------|----------|---------|
| Germany | 165,300 | 164,000 | 40,110 | 65,401 |
| United States | 111,431 | 132,145 | 139,380 | 203,271 |
| United Kingdom | 35,768 | 61,655 | 100,000* | † |
| Soviet Union | 9,160 | 51,000 | † | † |
| Japan | 20,210 | 59,468 | 14,444 | 10,180 |
| France | 18,100 | 27,100 | 34,275 | 11,050 |
| Italy | 15,384* | 27,548* | 20,010 | 18,000 |
| Switzerland | 24,300* | 27,170 | 25,000 | † |

*Ratunated
†Figures not available

The export of dyestuffs from various countries for the years 1938 and 1950 is given in Table IX, 1950 being the last year for which figures are available.

TABLE IX—Exports of Dyestuffs
(In thousands of pounds)

| Country | 1938 | 1950 |
|----------------|--------|--------|
| Germany | 60,648 | 28,051 |
| Switzerland | 14,566 | 21,701 |
| United Kingdom | 8,919 | 7,225 |
| France | 9,450 | 9,074 |
| United States | 8,470 | 24,357 |
| Japan | 18,611 | 3,211 |
| Italy | 2,331 | 2,559 |

The importance of the various chemical classes of dyestuffs in the United States can be understood from production and sales

equations of free motion may involve the addition of new equations to fully describe the collisions, connections and constraints produced by the coupling. In the formulation and solution of these equations the laws of mechanics (see MECHANICS) play an important part. When two bodies are in contact or are joined in some way, the nature of the coupling is manifest. When there is electromagnetic or gravitational action between them the nature of the coupling is obscure, yet the idea of energy is useful in deriving relations for a set of electrified conductors and in many other cases of invisible coupling. The aim in dynamics is to describe the configuration and motion of an interacting material aggregate by the values and rates of change of a suitably chosen set of co ordinates. These final equations must be derived from prescribed initial values or conditions and a set of equations of motion which in one form of the theory express the rates of change of the co ordinates uniformly in terms of the co ordinates and the time at which these quantities are estimated. The number of co ordinates is generally finite but may be large, as in the dynamical theory of gases. It is often convenient to regard the total set of bodies as divided up into separate dynamical systems coupled together. A system need not be restricted to a conservative one for which the total energy or total mass remains constant.

Force—In the search for equations which will describe observed phenomena, mathematicians have used the idea of force to express the fact that terms in different equations are related. Names such as *mass*, *inertia* and *self induction* have been associated with terms which are also in the equations of motion of a system when it is free, while other names have been associated with terms that describe the different types of forces or couplings between different systems. Frictional and deflecting forces generally differ in character from attractions and repulsions. Surface and body forces describe mathematically a supposed difference between contact action and action at a distance.

Change of Axes—With a change of axes of reference some terms may enter into the equations of motion or may disappear from them. When local axes are used special names are given to forces which are definitely associated with the earth's rotation about its axis. Meteorologists speak, for instance, of the *deflecting force* of the earth's rotation. *Centrifugal force* is the name given to a certain type of term associated with rotation, not necessarily the rotation of the earth. When a body moves and spins at the same time it is advantageous to follow the motion of a set of rectangular axes fixed in the body and to use angles introduced by Leonhard Euler (1707) to specify the relation of these axes to another set regarded as fixed.

The Problem of Several Bodies—The difficulty of the problem of three bodies was realized when Alexis Clairaut made his investigations of 1743-40 on the motion of the moon under the influence of the attractions of the earth and sun, and when the great mathematicians of the 18th century devoted much time to lunar theory and to the perturbed motions of the planets. Efforts to overcome the many difficulties led to development of analytical dynamics, a vast subject which now includes ballistics, celestial mechanics, dynamics of a particle, rigid dynamics and the theory of vibrations.

Theory of Impact—The simplifying assumption of a momentary contact between two bodies and a discontinuous transition from one state of motion to another was used by John Wallis and Christopher Wren in 1668 and by Christiaan Huygens in 1669 to work up mathematically the results of experiments on impact. When laws of motion were formulated by Sir Isaac Newton the equations for this simple case contained only the inertia terms and expressed that each body moved uniformly before and after impact. Supplementary equations for the transition expressed the law of conservation of the total linear momentum and an empirical relation between relative velocities before and after impact involving a physical constant, the coefficient of restitution. An investigation of the complicated processes of contraction and expansion in an actual impact was thus avoided. In the dynamics of gases the simple theory of impact is insufficient and use is made of analysis for the two body problem.

Dynamics of a Particle—In this subject use is made of the

simplifying assumption that one body at least is so small in comparison with one of the others that it may be treated as a mass point or particle. The motion of a projectile under gravity provided one important problem and a second one came when Johannes Kepler announced his three laws of planetary motion early in the 17th century and Newton derived them by solving his equations of motion. The law of areas expressed a principle now known in a general form as the principle of the conservation of angular momentum.

Another great problem was that of the motion of a pendulum, and when Huygens tried to render the motion really isochronous by introducing a constraint, mathematicians studied the constrained motion of a particle under gravity. Surfaces and curves as guides received special attention and Huygens' study of the cycloid as a guide was followed by the occurrence of this curve alone in the solution by Jacques Bernoulli of a problem of isochronism proposed by Gottfried Wilhelm Leibniz.

The curve of swiftest descent sought by Jacques Bernoulli was found by his brother Jean to be also a cycloid. Mathematicians became much interested in minimum problems. A principle of least time was formulated by Pierre de Fermat and a principle of least action was announced by Pierre Maupertuis, elucidated by Euler and Joseph Louis Lagrange and finally included in the more comprehensive method of William Rowan Hamilton.

Theory of Vibrations—A third important simplifying assumption was introduced by Brook Taylor about 1715 when he discussed the vibration of a stretched string by a theory of small oscillations. This gave for the periodic motion a linear differential equation with end conditions which determined the different possible modes of vibration. Jean Bernoulli learned the analysis enthusiastically and started a general theory of small oscillations which was developed by his son Daniel and his compatriot Euler who, with Maupertuis, form a celebrated trio of his pupils. The famous problem of the light string loaded at equal intervals was most useful in illustrating the effects of coupling and the relation between the number of particles and the number of independent modes of vibration. When the string hung from a fixed point and vibrated about a vertical position it was a compound pendulum and its oscillations in the limiting case of many loads became those of a heavy chain. Much attention was given to this problem by Joseph Louis Lagrange in his *Mechanique Analytique* of 1788. Similar analysis has been developed for acoustical, electrical and mechanical filters. The theory of small oscillations is of much importance in the study of vibration dampers for engines and of the torsional oscillation of shafts.

Steady Motion—A fourth simplifying assumption suggested by Newton's work became important in 1738 when Daniel Bernoulli considered the steady motion of a fluid. His relation between velocity, density and pressure along a stream line was much like a statement of the principle of the conservation of energy. Steadily rotating gravitating fluid occurred in the tidal theory of Colin Maclaurin (1742) and in the theory of the earth's figure of Alexis Clairaut (1743). Maclaurin's idea of level surfaces was made more definite by Clairaut's use of a force function V constant on such surfaces and related to the pressure p by equations now known as the fundamental equations of hydrostatics. The rotating system is, in fact, static relative to a set of moving axes.

Rigid Dynamics—Interest in the dynamics of a rotating projectile was aroused by the publication in 1743 of *New Principles of Gunnery* by Benjamin Robbins. The German translation by Euler with comments was translated into French and English.

In 1743, J. le Rond d'Alembert gave in his *Traité Dynamique* a form of the principle of virtual work which now bears his name (see MECHANICS). In the applications each small part of a rigid body is regarded as a dynamical system with its own mass and equations of motion. There is supposedly a cancellation of internal forces when the individual equations of motion are combined so the final equations for the whole body contain only inertia terms and resultants of body and surface forces. The equations of moments, however, involve resultant couples and inertia terms having factors known respectively as moments of inertia about the co ordinate axes and products of inertia about pairs of

co ordinate planes. Principal axes chosen so that the products of inertia vanish are usually suitable moving axes for the specification of the motion of a spinning body. Rates of turn ($\omega_1, \omega_2, \omega_3$) about these axes that will give just the right spin at each moment are connected with the moments (L, M, N) of the driving couple by Euler's equations

$$A\omega_1' - (B-C)\omega_2\omega_3 = L, \quad B\omega_2' - (C-A)\omega_3\omega_1 = M, \quad C\omega_3' - (A-B)\omega_1\omega_2 = N,$$

where A, B, C are the moments of inertia about the principal axes. Suitable extensions of these equations for a body with one point fixed give the motion of an arbitrarily moving rigid body and are most useful in the dynamics of the ship, locomotive, aeroplane and balloon. The influence of a ship's motion on the rate of a watch led in 1765 to the gimbal suspension of a marine chronometer (see CHRONOMETER) and when this mode of suspension was extended to a flywheel in 1810 (see GYROSCOPE) the general equations became still more important. Simeon D. Poisson added to the theory of moving axes in his *Traité de Mécanique* (2 vols., 1811 and 1813) in which he derived Euler's equations and in later work on the deviation of falling bodies and projectiles caused by the rotation of the earth. The full significance of the terms in the equations of motion that are introduced by this rotation was indicated by Gaspard G. de Coriolis in 1835. The motion of a rigid body about a fixed point was represented geometrically by the rolling of an associated ellipsoid in a fixed plane in Louis Poincaré's *Théorie Nouvelle de la Rotation des Corps* of 1834 which was republished in 1851 when Foucault's experiments with the gyroscope created great interest in the subject.

Lagrange's Equations.—In the theory of small oscillations the force function V is regarded as a potential energy which is a minimum and zero in a state of equilibrium specified by zero values of a set of generalized co ordinates q_1, q_2, \dots, q_n . In a disturbed state V is represented approximately by a positive quadratic form in q_1, q_2, \dots, q_n while the kinetic energy T is expressed as a homogeneous quadratic form in the rates of change $\dot{q}_1, \dot{q}_2, \dots, \dot{q}_n$ of the generalized co ordinates. Lagrange then found that the equations of motion in the generalized co ordinates are identical with equations derived by the calculus of variations from a time integral of the quantity $L = T - V$. The equivalence of these variational equations with the usual equations of motion in Cartesian co ordinates has been proved by actual change of variables for a very general type of dynamical system even though some of the equations of transformation express conditions of constraint. Indeed, in choosing q_1, q_2, \dots, q_n the aim is to satisfy the conditions of constraint automatically. Thus, for a particle constrained to move on a surface

$$r = f(q_1, q_2), \quad y = g(q_1, q_2), \quad z = h(q_1, q_2)$$

the parameters q_1, q_2 may be used as generalized co ordinates which are two in number instead of three. Since V depends only on x, y and z it is a function of q_1, q_2 while T is a quadratic function of \dot{q}_1, \dot{q}_2 with coefficients depending on q_1 and q_2 . Lagrange's equations are then

$$\left(\frac{d}{dt} \right) \left(\frac{\partial L}{\partial \dot{q}_i} \right) - \frac{\partial L}{\partial q_i} = 0, \quad r = 1, 2$$

The particles and the surface form a coupled system but the surface is treated as so massive that its motion may be neglected.

In general, L is called the kinetic potential and n the number of degrees of freedom of the dynamical system. Lagrangian mechanics has an important physical significance. Thus in the work of Alfred Borchers (1859) on variational principles in hydrodynamics L is a pressure integral.

Perturbations and stability.—From 1770-1870 Pierre Simon de Laplace enriched dynamics by work on celestial mechanics, the tides, and the stability of the solar system. Developing earlier work of Clairaut, d'Alambert, Euler and Lagrange on the theory of perturbations, Laplace modified the existing theory of forced oscillations by supposing the free vibrations of the mechanical system to be damped whether they were vibrations about a state of equilibrium or about a state of steady motion. Attention was then fixed on the final periodic state sustained by

the periodic driving force. A resulting dynamical theory of the tides partially justified the older equilibrium theory. The theory of forced oscillations of a system with natural damping is quite important in the theory of structures and in the theory of electric circuits. In acoustics it forms a basis for the theory of resonators and the theory of reverberation.

Laplace considered the possibility of the occurrence of secular terms (with factors linear in the time) in the solution of the dynamical equations for the solar system. Such terms would imply a continued departure from an existing state of motion or instability. He showed that the solution of a linear differential equation with periodic coefficients is not generally periodic. His approximate solution with secular terms was replaced eventually by terms with exponential factors, a result which was generalized in 1883 (*Annales Ecole Normale*, Paris) by Gaston Floquet. Laplace's work on the solar system was continued by George William Hill about 1873 and was applied about 1883 to the problem of maintaining acoustical vibrations by John William Strutt (afterwards Lord Rayleigh). The conditions under which periodic or undamped natural vibrations can occur are now important for the production of sound, radio waves and other useful effects. A knowledge of these conditions is important also in the design of aircraft, locomotives, ships and all kinds of controls.

Stability was much studied when the development of the steam engine emphasized the need of regulation. The centrifugal governor of Huygens for the regulation of clocks, modified for water wheels and windmills, was adapted to the steam engine by James Watt (1788) after his flywheel of 1782 gave insufficient safety. Modifications of the centrifugal governor included springs or frictional devices such as the ring of Joseph von Fraunhofer or the dashpot of Sir George Airy. The theory of Airy (*Mem.*, Roy. Astron. Soc. London, 1840) and James Clerk Maxwell (*Trans.*, Roy. Soc. London, 1868) for existing governors required conditions that each root of an algebraic equation should have a negative real part. Edward John Routh expressed the conditions in a useful form and in 1877 gained the Adams prize for his *Treatise on the Stability of Motion*. Further important applications of the conditions were visualized in 1893 (*Schweizerische Bauzeitung*), when Aurel Stodola worked on the regulation of water turbines and in 1895 (*Math. Ann.*) when Adolf Hurwitz expressed the necessary and sufficient conditions in determinantal form. The conditions for equations up to the eighth degree occurred in studies of the stability of arc lights, aircraft, locomotives, electrical machines and coupled gyroscopes.

Kinetic stability imposed by gyroscopic forces or oscillations was studied by William Thomson (later Baron Kelvin of Largs) and Percy Guthrie Tait in their *Natural Philosophy*. Later work by Paul Appell (1904), Sir Horace Lamb (*Proc.*, Roy. Soc. London, 1908), Andrew Stephenson (*Phil. Mag.*, 1908) and Emile Jouguet (*Comptes Rendus Acad. Sci.*, Paris, 1931) should be mentioned. Jouguet has continued Stodola's work on the secular stability of the rotors of turbines.

An important paper on stability was published by Alexander Liapounoff in 1892 and was translated into French (*Annales*, Univ. Toulouse, 1904). In 1902 he gave applications to the rotating gravitating mass of fluid whose stability was being examined by Henri Poincaré and Sir George Darwin.

Analytical Dynamics.—The powerful analysis developed for dynamics is now a necessary equipment of many research workers in dynamical astronomy, statistical mechanics and chemical physics. One important step was the use by Poisson and others of the notation $p_r = \partial L / \partial \dot{q}_r$ for the components of generalized momenta which occur in Lagrange's equations. Poisson added much to the theory of these equations and, like Lagrange, introduced a bracket symbol for a sum of functional determinants. The Poisson bracket (u, v) is formed from any two functions of the set of variables $(q_1, q_2, \dots, q_n, p_1, p_2, \dots, p_n)$ and each determinant is taken with respect to a pair of variables such as (q_r, p_r) having the same index r . Poisson's brackets are useful in the formulation of the necessary and sufficient conditions that a transformation of variables from (p_r, q_r) to (P_r, Q_r) may be a contact transformation, a type much used in dynamics, optics and the theory of

compressible fluids In 1809 Poisson found that his bracket expression sometimes derived a new integral of the equations of motion from two known integrals This theorem played a role in the new dynamics created by William Rowan Hamilton in 1834 when he extended to dynamics his successful use of a characteristic function and a partial differential equation in geometrical optics

Hamilton's Canonical Equations—For a conservative system Hamilton's canonical function (*Trans of the Royal Irish Academy, Dublin, 1834-35*)

$$H = \sum p_i q_i' - L$$

is the total energy $T+V$ When in H the quantities q_i' are expressed in terms of the p_i 's and q_i 's by means of the equations defining the p_i 's it is found that with arbitrary variations $\delta p_i, \delta q_i$ of the $2n$ quantities p_i, q_i ,

$$H = \sum (q_i' \delta p_i - p_i' \delta q_i)$$

or

$$q_i' = \partial H / \partial p_i, \quad p_i' = -\partial H / \partial q_i, \quad i = 1, 2, \dots, n$$

These $2n$ equations of the first order may be contrasted with Lagrange's n equations of the second order While Lagrange's equations may be used to describe the motion of a representative point in a space S_n , Hamilton's canonical equations give the motion of a representative point in a space S_{2n} This second representation was used successfully in the kinetic theory of gases by Ludwig Boltzmann (1858 & 1871) and in statistical mechanics by Willard Gibbs (1902) who called the integral

$$\int \delta p_1, \delta p_2, \delta p_3, \delta q_1, \delta q_2, \delta q_3$$

the extension in phase, and interpreted a theorem of Joseph Liouville (*Journal de Mathématiques Pures et Appliquées*, 1838) as a conservation of extension in phase for an element of phase space moving with the dust of representative points

The Hamilton Jacobi Partial Differential Equation—An important feature of Hamilton's dynamics is that the canonical equations are associated with a partial differential equation

$$\partial S / \partial t + H(q, \partial S / \partial q_i) = 0$$

in the $n+1$ independent variables q_1, q_2, \dots, q_n, t The function H on the right depends on q_1, q_2, \dots, q_n and the n partial derivatives of H with respect to these variables This equation and the associated canonical equations are of great importance in quantum theory, celestial mechanics and statistical mechanics

There are many ways of solving a partial differential equation of the first order and any method which furnishes a complete integral

$$S = S(q_1, q_2, \dots, q_n, a_1, a_2, \dots, a_n, t)$$

containing n arbitrary constants a_1, a_2, \dots, a_n , can be used with advantage to form equations

$$p_i = \partial S / \partial q_i, \quad b_i = -\partial S / \partial a_i$$

expressing the a 's and b 's in terms of the variables p_i, q_i, t and incidentally providing solutions of the canonical equations Furthermore, the transformation from the quantities (q_i, p_i) to the quantities (a_i, b_i) is a contact transformation, being characterized by a relation of type

$$\sum b_i da_i = \sum p_i dq_i - H dt - dS$$

Contact transformations play a large part in analytical dynamics and in 1895 Sophus Lie pictured the motion of a dynamical system as a succession of infinitesimal contact transformations In the theory of perturbations H may be replaced by a new function $H+K$ where K is a "perturbation function" The new variables $(a_i + f_i, b_i + f_i)$ are then related to K by the equations

$$f_i a_i = -\partial K / \partial b_i, \quad f_i b_i = -\partial K / \partial a_i$$

and vary during the motion if K is not constant This exhibits the perturbed orbit as the gradual modification of an orbit within the group of orbits appropriate to the unperturbed system This form of solution is particularly important when K is small in comparison with H

When a dynamical system is specified by a system of differential equations of type

$$\dot{x}_r = F_r(x_1, x_2, \dots, x_n, t) \quad r = 1, 2, \dots, n$$

as in the work of Hamilton, Liapounoff, Poincaré and George D Birkhoff, the eventual behaviour for large values of t is needed Poincaré uses the term "stabilité à la Poisson" for a particular type of stability which has been exemplified by the studies of Jean Chazy, Paris (*Comptes Rendus Acad Sci, Ann Ecole Normale*, 1921) on the eventual behaviour in the problem of three bodies Birkhoff's idea of recurrent system (*Bull Soc Math, France*, 1912) is helpful in elucidating this behaviour In this order of ideas there is an important ergodic theorem which is useful in the kinetic theory of gases The idea of an adiabatic invariant has also become prominent and its relation to dynamics is well presented in an address by Tullio Levi Civita (*J Math Phys, Mass Inst Tech*, 1934)

The Principle of Safety First—A curve in S_n which Lagrange's differential equations are satisfied may be called a "natural orbit" and compared with a neighbouring curve or orbit for which the differential equations are not satisfied to ascertain if a particle moves so as to avoid blows as far as possible and get minimum action In Hamilton's principle contemporaneous points are compared, δ denoting a legitimate variation, $\delta \int_{t_0}^{t_1} L dt = 0$

A form of this principle, much used by Jacobi (1836), produced interest in the deduction of physical equations from variational principles In electrodynamics, Franz Neumann and Rudolph Clausius were pioneers In 1864 James Clerk Maxwell used Lagrange's equations to formulate equations of the electromagnetic field The view was tentatively adopted that a theory based on a general variational principle was dynamical but opinions differed regarding the generality of different proposed principles The principle of virtual work introduced by Jean Bernoulli and extended by d'Alembert, was used by Lagrange as a foundation for the whole of mechanics When Carl Friedrich Gauss (1829, *J f d reine und angewandte Mathematik, Werke*, vol 5) introduced his principle of least constraint, Hamilton, his principle of varying action and Heinrich Hertz, his geometric principle (*Werke*, 1895) There was some choice in the meaning of the word dynamical favourite variational principles lost some of their appeal when Routh (1873) pointed out that Lagrange's equations require modification for a rolling motion—that is, for a nonholonomic system, in the terminology of Hertz

About 1880, however, Jacques and Pierre Curie (*Paris, Comptes Rendus Acad Sci, Oeuvres*, P Curie) found that electric charges form on certain compressed crystals, and in 1881 Gabriel Lipmann suggested that dynamically there should be a reciprocal effect in which compression is produced by electric charge When this was discovered the view prevailed that relations between many physical phenomena may be found by studying the properties of the single function L Joseph Larmor (*Math & Phys Papers*, 1884) proposed least action as fundamental in both dynamics and physics Joseph John Thomson (1886) applying dynamics to physics and chemistry found many reciprocal relations Albert Einstein, Erwin Schrodinger, Charles Darwin and many others used least action to justify general equations for new theories of gravitation and quantum mechanics Yet doubts are felt The diffusion of heat or matter, the propagation of waves and all dissipative processes introduce difficulties unless a system losing matter or energy is regarded as incomplete The difficulties regarding non holonomic motion have been further discussed by Norman Macleod Ferrers (*Quart J of Pure and Applied Math*, 1873), Carl Neumann (*Sachsische Akad der Wissenschaften Sitzungsberichte*, Leipzig, 1888), George Hamel (*Zeitschrift für Mathematik und Physik*, 1904), Otto Holder (*K Ges d Gottingen Nachrichten Math Phys Klasse*, 1896), Paul Appell (1903), Philip Jourdain (*Quart J of Pure and Applied Math*, 1904) and E Delassus (1913) Ferrers was the first to publish Routh's modification of Lagrange's equations

$$(d/dt)(\partial L / \partial \dot{q}_r) - \partial L / \partial q_r = \sum A_r q_r$$

where the nonintegrable equations of connection are $\sum A_r dq_r = 0$

Mixed Equations—Routh also formed a function R resembling L for some freedoms and H for others If primarily

$$R = L - \sum_{r=1}^n p_r \dot{q}_r$$

and R is later expressed in terms of $p_1, p_2, \dots, p_m, q^{m+1}, q^{m+2}, \dots, q_1, q_2, \dots, q_n$, then

$$R = \sum_{r=1}^m (p_r \dot{q}_r - q_r \dot{p}_r) + \sum_{r=m+1}^n (p_r \dot{q}_r + p_r \dot{q}_r)$$

$$q_r' = -\partial R / \partial p_r, \quad p_r' = \partial R / \partial q_r, \quad r = 1, 2, \dots, m$$

$$p_r = \partial R / \partial q_r', \quad p_r' = \partial R / \partial q_r, \quad r = m+1, m+2, \dots, n$$

The first m equations are Hamiltonian with R in place of H , the others are Lagrangian with R in place of L . "Routh's function" R was used by Routh when L does not involve q_1, q_2, \dots, q_m explicitly but does contain q_1', q_2', \dots, q_m' . Then p_1, p_2, \dots, p_m remain constant during motion and q_1, q_2, \dots, q_m are called ignorable or cyclic coordinates. The method is useful for the gyroscope and top. The dynamics of systems with gyroscopic coupling is important in the theory of control.

Dissipative Systems—In 1873 Lord Rayleigh wrote the equation of damped vibration

$$m\ddot{q}'' + k\dot{q}' + sq = f(t)$$

in the generalized Lagrangian form

$$\delta p / dt - dL / \delta q + \delta R / \delta q' = f(t)$$

where

$$T - V = L = \frac{1}{2} m (\dot{q}')^2 - \frac{1}{2} k q^2, \quad p = \partial L / \partial \dot{q}', \quad F = \frac{1}{2} k (q')^2$$

and called F the dissipation function. The idea was extended to n variables q_1, q_2, \dots, q_n and to functions T, V, F expressible as quadratic forms homogeneous in q_1', q_2', \dots, q_n' respectively. Terms implying mass coupling, frictional coupling and spring coupling then appeared in the equations of motion as in the general equations for a system of electric circuits.

Various couplings, particularly those of frictional type, have been much studied, particularly in Germany, the United States and England on account of applications to scientific instruments and the stabilization of ships and aeroplanes.

The question whether dissipative dynamical systems can be derived from variational principles of the favourite type has been disputed. Principles which give additional equations are easily found by using multiplied forms of the desired equations added together under the integral sign. Thus the foregoing equation for q and the additional equation

$$m\ddot{q}'' - k\dot{q}' + sq = 0$$

may be derived from the principle

$$\delta \int_0^1 Q [m\ddot{q}'' + k\dot{q}' + sq - f(t)] dt = 0$$

$Q = ge^{kt}$ is a solution of the additional equation when q satisfies $m\ddot{q}'' + k\dot{q}' + sq = 0$ and in this case insertion of the value of Q in the principle permits a reduction to the form

$$\delta \int_0^1 [s\dot{q}^2 - m(\dot{q}')^2] e^{kt} dt = 0$$

Bodies of Variable Mass—Of interest now for rockets, this subject was treated extensively in 1897 (*Fortschritte d. Math.*) by J. Meschtschersky who refers to earlier work by Arthur Cayley, Hugo Gylden and Hugo von Seeliger. Variation of mass of a balloon in flight, owing to loss of ballast was an early problem of practical importance, others occurred in astronomy. R. Lehmann-Filhes (1895) considered a type of motion in which the central attracting mass varies slowly in proportion to the time. The orbit was a shrinking ellipse of constant eccentricity. Poincaré found similar results for a planet of slowly varying mass. More general results were obtained by Carlo Maderna (Acad. Lincei, Rome, 1921) and by Edgar Odell Lovett (*ibid.*, 1922) and Giuseppe Armellini (*ibid.*, 1922) the latter being interested chiefly in a planet gaining mass by accretion. H. Vogt (1925) directed attention to the problem of the binary star, whose youthful members lose energy fast by radiation, as observations seemed to indicate that the relative orbit of such a pair is less in size and eccentricity than the corresponding orbit for older stars of similar masses. Thus hard problem induced Armellini to investi-

gate special cases and Levi Civita indicated the relation of the problem of variable mass to the theory of adiabatic invariants.

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DYNAMISM (Gr. *dynamis*, power), is the name coined by A. Van Gennep for that attitude of the primitive mind towards the sacred or occult which involves a prevailing sense of its peculiar power or *mana*. He is careful not to impute to the savage a theology in which any clear distinction is drawn between the impersonal and the personal aspects of the divine—as contrasted with advanced religion, which, as may be seen in Buddhism and Christianity respectively, may emphasize the one aspect almost to the exclusion of the other—but suggests dynamism as a term that may be used for classifying any phase of primitive religion in which *mana*, rather than soul or moral personality, receives emphasis as the leading attribute of that which is worshipped.

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DYNAMITE, a high explosive consisting essentially of nitroglycerine absorbed in an inert solid material in order to reduce its sensitivity to shock. The most frequently used absorbent is kieselguhr (an infusorial earth), and an average composition is nitroglycerine 75%, kieselguhr 25%. Gelatine dynamite consists of nitroglycerine 75%, nitrocellulose 6%, potassium nitrate 16%, and small quantities of wood meal and chalk. (See EXPLOSIVES)

DYNAMO-ELECTRIC MACHINES see ELECTRIC GENERATOR, MOTOR, ELECTRIC, and ELECTRICAL ARTICLES

DYNAMOMETER, an instrument for measuring force exerted by men, animals and machines. (Gr *dynamus*, strength, and *meteron*, a measure) The name has been applied generally to all kinds of instruments used in the measurement of a force, as for example electric dynamometers, but the term specially denotes apparatus used in connection with the measurement of work, or in the measurement of the horsepower of engines and motors. If P represent the average value of the component of a force in the direction of the displacement, s , of its point of application, the product Ps measures the work done during the displacement. When the force acts on a body free to turn about a fixed axis only, it is convenient to express the work done by the trans formed product $T\theta$, where T is the average turning moment or torque acting to produce the displacement θ radians. The apparatus used to measure P or T is the dynamometer. The factors s or θ are observed independently. Apparatus is added to some dynamometers by means of which a curve showing the variations of P on a distance base is drawn automatically, the area of the diagram representing the work done, with others, integrating apparatus is combined, from which the work done during a given interval may be read off directly. It is convenient to distinguish between absorption and transmission dynamometers. In the first kind the work done is converted into heat, in the second it is transmitted, after measurement, for use.

Absorption Dynamometers—Baron Prony's dynamometer (*Ann Chim Phys* 1821, vol 19), which has been modified in various ways, consists in its original form of two symmetrically shaped timber beams clamped to the engine shaft. When these are held from turning, their frictional resistance may be adjusted by means of nuts on the screwed bolts which hold them together until the shaft revolves at a given speed. To promote smoothness of action, the rubbing surfaces are lubricated. A weight is moved along the arm of one of the beams until it just keeps the brake steady midway between the stops which must be provided to hold it when the weight fails to do so. The general theory of this kind of brake is as follows—Let F be the whole frictional resistance, r the common radius of the rubbing surfaces, W the force which holds the brake from turning and whose line of action is at a perpendicular distance R from the axis of the shaft, N the revolutions of the shaft per minute, ω its angular velocity in radians per second, then, assuming that the adjustments are made so that the engine runs steadily at a uniform speed, and that the brake is held still, clear of the stops and without oscillation, by W , the torque T exerted by the engine is equal to the frictional torque Fr acting at the brake surfaces, and this is measured by the statical moment of the weight W about the axis of revolution, that is—

$$T = Fr = WR \quad (1)$$

Hence WR measures the torque T .

If more than once force be applied to hold the brake from turning, Fr and therefore T , are measured by the algebraical sum of their individual moments with respect to the axis. If the brake is not balanced, its moment about the axis must be included. Therefore, quite generally,

$$T = \Sigma WR \quad (2)$$

The factor θ of the product $T\theta$ is found by means of a revolution counter. The power of a motor is measured by the rate at which it works, and this is expressed by $T\omega = \frac{T \times 2\pi N}{60}$ in foot-pounds

per second, or $\frac{T \times 2\pi N}{33,000}$ in horsepower units. The latter is commonly referred to as the "brake horsepower." The maintenance of the conditions of steadiness implied in equation (1) depends upon the constancy of F , and therefore of the coefficient of friction μ between the rubbing surfaces. The heating at the surfaces, the variations in their smoothness, and the variations of the lubrication make μ continuously variable, and necessitate frequent adjustment of W or of the nuts. J. V. Poncelet (1788–1867) invented a form of Prony brake which automatically adjusted its grip as μ changed, thereby maintaining F constant

The principle of the compensating brake devised by J. G. Appold (1800–1865) is shown in fig. 1. A flexible steel band lined with wood blocks, is gripped on the motor flywheel or pulley by a screw A , which, together with W , is adjusted to hold the brake steady. Compensation is effected by the lever L inserted at B . This has a slotted end, engaged by a pin P fixed to the framing, and it will be seen that its action is to slacken the band if the load

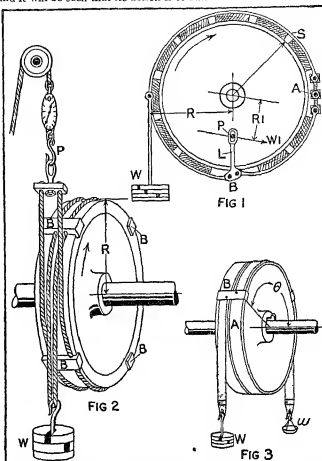


FIG 1—APPOLD COMPENSATING BRAKE FIG 2—KELVIN ROPE BRAKE
FIG 3—THOMSON SELF ADJUSTING BRAKE

tends to rise and to tighten it in the contrary case. The external forces holding the brake from turning are W , distant R from the axis, and the reaction, W_1 , say, of the lever against the fixed pin P , distant R from the axis. The moment of W_1 may be positive or negative. The torque T at any instant of steady running is therefore $\{WR \pm W_1 R_1\}$.

Lord Kelvin patented a brake in 1858 (fig. 2) consisting of a rope or cord wrapped round the circumference of a rotating wheel, to one end of which is applied a regulated force, the other end being fixed to a spring balance. The ropes are spaced laterally by the blocks B, B, B , which also serve to prevent them from slipping sideways. When the wheel is turning in the direction indicated, the forces holding the band are still W , and P , the observed pull on the spring balance. Both these forces usually act at the same radius R , the distance from the axis to the centre line of the rope, in which case the torque T is $(W - P)R$, and consequently the brake horsepower is $\frac{(W - P)R \times 2\pi N}{33,000}$. When μ

changes the weight W rises or falls against the action of the spring balance until a stable condition of running is obtained. The ratio $\frac{W}{P}$ is given by $e^{\mu\theta}$, where $e = 2.718$, μ is the coefficient of friction and θ the angle, measured in radians, subtended by the arc of contact between the rope and the wheel. In fig. 2, $\theta = 2\pi$. The ratio W/P increases very rapidly as θ is increased, and therefore, by making θ sufficiently large, P may conveniently be made a

small fraction of W , thereby rendering errors of observation of the spring balance negligible. Thus this kind of brake though cheap to make is when θ is large enough an exceedingly accurate measuring instrument, readily applied and easily controlled.

It is sometimes necessary to use water to keep the brake wheel cool. Engines specially designed for testing are usually provided with a brake wheel having a trough-shaped rim. Water trickles continuously into the trough and the centrifugal action holds it as in inside lining against the rim where it slowly evaporates.

Fig. 3 shows a band brake invented by James Thomson, suitable for testing motors exerting a constant torque (see *Eng. News*, Oct. 2, 1880). To maintain a constant compensation for variation of μ is made by inversely varying θ . A and B are fast and loose pulleys, and the brake band is placed partly over the one and partly over the other. Weights W and w are adjusted to the torque. The band turns with the fast pulley if μ increases, thereby slightly turning the loose pulley, otherwise it rests until θ is adjusted to the new value of μ . This form of brake was also invented independently by J. A. M. L. Carpentier, and the principle has been used in the Ruffard brake. A self-compensating brake of another kind was used by Marcel Deprez, as described with Carpentier's in 1880 (*Bulletin de la société d'encouragement Paris*). W. E. Ayrlton and J. Perry used a band or rope brake in which compensation is effected by the pulley drawing in or letting out a part of the band or rope which has been roughened or in which a knot has been tied.

In an effective water brake invented by W. Froude (see *Proc. Inst. M. E.*, 1877), two similar castings A and B , each consisting of a boss and circumferential annular channel, are placed face to face on a shaft, to which B is keyed, A being free (fig. 4). A ring tube of elliptical section is thus formed. Each channel is divided into a series of pockets by equally spaced vanes inclined at 45° . When A is held still, and B rotated, centrifugal action sets up vortex currents in the water in the pockets, thus a continuous circulation is caused between B and A , and the consequent changes of momentum give rise to oblique reactions. The moments of the components of these actions and reactions in a plane to which the axis of rotation is at right angles are the two aspects of the torque acting, and therefore the torque acting on B through the shaft is

measured by the torque required to hold A still. Froude constructed a brake to take up 2,000 h.p. at 90 r.p.m. by duplicating this apparatus. This replaced the propeller of the ship whose engines were to be tested and the outer casing was held from turning by a suitable arrangement of levers carried to weighing apparatus conveniently disposed on the wharf. The torque corresponding to 2,000 h.p. at 90 r.p.m. is 116,772 foot pounds, and a brake 5 ft. in diameter gave this resistance. Thin metal sluices were arranged to slide between the wheel and casing, and by their means the range of action could be varied from 300 h.p. at 120 r.p.m. to the maximum. The form of the Froude brake developed by Hearn and Froude is widely used. It is especially convenient for measuring the torque of high speed engines.

Osborne Reynolds in 1887 patented a water brake (see *Proc. Inst. C. E.*, 99, p. 167), using a Froude's turbine to obtain the highly resisting spiral vortices, and arranging passages in the casing for the entry of water at the hub of the wheel and its exit at the circumference. Water enters at E (fig. 5) and finds its way into the interior of the wheel, A , driving the water in through the air passages K , K . Then following into the pocketed chambers V_1 , V_2 , it is caught into the vortex, and finally escapes at the circumference, flowing away at F . The airways k , k , in the fixed vanes establish communication between the cores of the vortices and the atmosphere. From $\frac{1}{2}$ to 30 h.p. may be measured at 100 r.p.m. by a brake wheel of this kind 18 in. in diameter. For other speeds the power varies as the cube of the speed.

The casing is held from turning by weights hanging on an attached arm. The cocks regulating the water are connected to the casing so that any tilting automatically regulates the flow, and therefore the thickness of the film in the vortex. In this way the brake may be arranged to maintain a constant torque, notwithstanding variation of the speed. In G. I. Alden's brake (see *Trans. Amer. Soc. Eng.*, vol. 11) the resistance is obtained by turning a cast iron disk against the frictional resistance of two thin copper plates, which are held in a casing free to turn upon the shaft, and are so arranged that the pressure between the rubbing surfaces is controlled, and the heat developed by friction carried away, by the regulated flow of water through the casing. The torque required to hold the casing still against the action of the disk

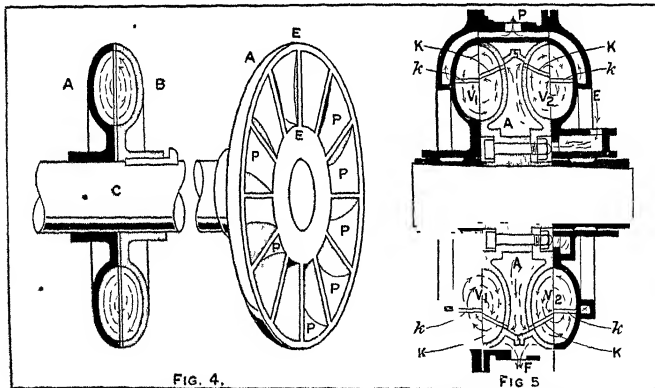


FIG. 4.—DIAGRAMMATIC ILLUSTRATION OF THE HYDRAULIC BRAKE. FIG. 5.—FROUDE REYNOLDS HYDRAULIC BRAKE.

measures the torque exerted by the shaft to which the disk is keyed

Transmission Dynamometers.—The essential part of many transmission dynamometers is a spring whose deformation directly measures the magnitude of the force transmitted through it. For many kinds of spring the change of form is practically proportional to the force, but the relation should always be determined experimentally. Gen A J Morn (see *Notice sur divers appareils dynamométriques*, Paris, 1841), in his classical experiments on traction, arranged his apparatus so that the change in form of the spring was continuously recorded on a sheet of paper drawn under a style. For longer experiments he used a "Compteur" or mechanical integrator, suggested by J V Poncelet, from which the work done during a given displacement could be read off directly. This device consists of a roller of radius r , pressed into contact with a disk. The two are carried on a common frame, so arranged that a change in form of the spring causes a relative displacement of the disk and roller, the point of contact moving radially from or towards the centre of the disk. The radial distance x is at any instant proportional to the force acting through the spring. The angular displacement, θ , of the disk is made proportional to the displacement, x , of the point of application of the force by suitable driving gear. If $d\phi$ is the angular displacement of the roller corresponding to displacements, $d\theta$ of the disk, and ds of the point of application of P , a , and C constants, then $d\phi = \frac{x d\theta}{r} = \frac{a}{r} P ds = C P ds$, and therefore

$$\phi = C \int_{s_1}^{s_2} P ds, \text{ that is, the angular displacement of the roller}$$

measures the work done during the displacement from s_1 to s_2 . The shaft carrying the roller is connected to a counter so that ϕ may be observed. The angular velocity of the shaft is proportional to the rate of working. Morn's dynamometer is shown in fig. 6. The transmitting spring is made up of two flat bars linked at their ends. Their centres s_1, s_2 , are held respectively by the pieces A, B, which together form a sliding pair. The block A carries the disk D, B carries the roller R and counting gear. The pulley E is driven from an axle of the carriage. The dynamometer car used by railway engineers to measure the tractive resistance of trains is essentially a development of the Morn apparatus. The pull exerted by the engine on the train passes through a spring. The deflection of the spring is carried through a mechanism to a pencil working on a drum driven continuously from the axle of the car itself. The curve drawn by the pencil then shows the tractive force in terms of the distance. A second pencil electrically connected to a clock traces a time line on the diagram, with a kick at definite intervals of time. A third pencil traces an observation line in which a kick can be made at will by pressing any one of the electrical pushes placed about the car, and a fourth draws a datum line. Other lines are also traced recording events of interest. The spring of the dynamometer car is usually made up of flat plates, spaced by distance pieces nibbed into the plates at the centre and by rollers at the ends. The draw bar is connected to the buckle, which is carried on rollers, the ends of the spring resting on plates fixed to the under frame. The gear operating the paper roll is driven from the axle of an independent wheel which is let down into contact with the rail when required. This wheel serves also to measure the distance travelled. A Morn disk and roller integrator is usually connected with the apparatus, so that the work done during a journey may be read off. A detailed account of a railway dynamometer car will be found in the *Railway Engineer*, Dec 1923.

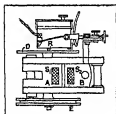


FIG. 6—TRACTION DYNAMOMETER

In spring dynamometers designed to measure a transmitted torque, the mechanical problem of ascertaining the change of form of the spring is complicated by the fact that the spring and the whole apparatus are rotating together. In the Ayrtton and Perry transmission dynamometer or spring coupling of this type, the relative

angular displacement is proportional to the radius of the circle described by the end of a light lever operated by mechanism from the spring connected parts. By a device used by W E Dalby (*Proc Inst C E*, 1897-98, p 132) the change in form of the spring is shown on a fixed indicator, which may be placed in any convenient position. Two equal sprocket wheels, Q_1, Q_2 , are fastened, the one to the spring pulley, the other to the shaft. An endless band is placed over them to form two loops, which during rotation remain at the same distance apart, unless relative angular displacement occurs between Q_1 and Q_2 (fig. 7) as a result of a change in form of the spring. The change in the distance d is proportional to the change in the torque transmitted from the shaft to the pulley. To measure this, guide pulleys are placed in the loops guided by a geometric slide, the one pulley carrying a scale, and the other an index. A recording drum or integrating apparatus may be arranged on the pulley frames.

Every part of a machine transmitting force suffers elastic deformation, and the force may be measured indirectly by measuring the deformation. The relation between the two should in all cases be found experimentally. G A Hirn (see *Les Pandynamomètres*, Paris, 1876) employed this principle to measure the torque transmitted by a shaft. Signor Rost used a telephonic method to effect the same end, and mechanical, optical and telephonic devices have

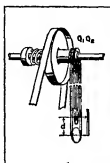


FIG. 7—DALBY TRANSMISSION DYNAMOMETER

been utilized by the Rev F J Jervis-Smith (See *Phil Mag*, Feb 1898). H Frahm (*Zeitschrift des Vereins deutscher Ingenieure*, May 31, 1902), during an important investigation on the torsional vibration of propeller shafts, measured the relative angular displacement of two flanges on a propeller shaft, selected as far apart as possible, by means of an electrical device (*Engineering*, Feb 6, 1903). These measurements were utilized in combination with appropriate elastic coefficients of the material to find the horsepower transmitted from the engines along the shaft to the propeller. In this way the effective horsepower and also the mechanical efficiency of a number of large marine engines, each of several thousand horsepower, have been determined. The method of deducing the power transmitted from observations based on the elastic deformation of the parts is specially useful in turbine driven engines because the steam engine indicator from which the indicated horsepower is calculated cannot be used with a turbine.

In the Thring-Hopkinson torsion meter, the twist between points on a short length of the propeller is observed. A cylindrical sleeve is gripped to the shaft at one end and is free from the shaft at the other end so that there is relative motion of twist between the free end of the sleeve and the shaft. This relative motion is utilized to give angular displacement to a mirror which reflects light from a fixed source to a fixed scale and flashes an image to the scale once per revolution. At moderate speeds the intermittent images appear continuous to the eye and so a continuous indication is given on the scale of the relative twist of the ends of a length of shaft equal in length to the sleeve. As the torque increases the twist increases and the angular displacement of the mirror increases and the indication on the scale shows the instantaneous amount of twist. From the twist the torque on the shaft can be calculated.

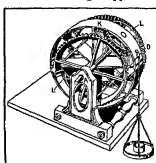


FIG. 8—TRANSMISSION DYNAMOMETER

In the Moullin torsion meter the relative twist of a defined length of the shaft is made to alter the self-induction of a coil mounted upon and rotating with the shaft. An alternating current is supplied to the coil through brushes and slip rings, and the variation of this current depends upon the variation of the self-in-

duction of the coil so that current variation is thereby related to twist of shaft. Meters placed in series with the coil are calibrated to read torque directly. A description of this instrument will be found in the first report of the Marine Oil Engine Trials committee together with some records taken on the shaft of the "Sycamore" when under trial. In the Ford torsion meter the relative twist of a definite length of shaft alters the slip on a transducer mounted on the shaft with the result that there is a variation of the e.m.f. of the secondary circuit. This variation is related to the twist and therefore to the torque on the shaft.

The difference in the tensions in the driving and slack sides of a driving belt has been used as the basis of transmission dynamometers. For examples, reference may be made to the W. Froude belt dynamometer (*Proc Inst M E*, 1885) and to the Hefner Alteneck dynamometer (see *Elektrotechnischen Zeitschrift*, 1884, 7).

When a shaft is driven by means of gearing the driving torque is measured by the product of the resultant pressure P acting between the wheel teeth and the radius of the pitch circle of the wheel fixed to the shaft. Fig. 3, which has been reproduced from

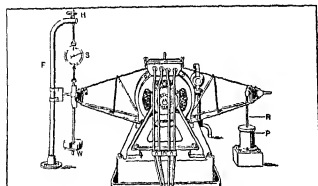


FIG. 3—ELECTRIC CRADLE DYNAMOMETER

J. White's *New Century of Inventions* (Manchester 1825) illustrates possibly the earliest application of this principle to dynamometry. The wheel D keyed to the shaft overcoming the resistance to be measured, is driven from wheel N by two bevel wheels L, L', carried in a loose pulley K. The two shafts though in a line, are independent. A torque applied to the shaft A can be transmitted to D, neglecting friction, without change only if the central pulley K is held from turning, the torque required to do this is twice the torque transmitted.

The torque acting on the armature of an electric motor is necessarily accompanied by an equal and opposite torque acting on the frame. If, therefore, the motor frame is mounted so that it is free to turn, and it is prevented from turning by the application of a torque, this applied torque T , measures the armature torque.

The rate at which the motor is transmitting work is then—
$$\frac{T \times 2\pi n}{550}$$

H.P., where n is the revolutions per second of the armature.

Electric dynamometers based on this principle are widely used to measure the power of high-speed engines. Fig. 9 is an illustration of the electric dynamometer coupled to the Ricardo experimental gasoline engine. The engine shaft is coupled to the armature of the dynamo. The dynamo frame is held in ball bearings only and is thus free to turn about the axis of the armature shaft. Attached to the dynamo frame are light arms. The arm to the left carries a scale pan W and is hooked to a spring balance suspended from a fixed support F and adjustable in position vertically by the hand wheel H. The arm to the right is connected to the piston of a dash pot P by the vertical rod R. Small oscillations are controlled by the dash pot. When the engine is running under load weights are added to W, and the hand wheel H is adjusted to keep the pointed end of the arm at the centre of the scale on the fixed support. The load, derived from W and the spring balance reading multiplied by the pyramidal distance of its line of action from the axis of revolution measures the reaction T against which the armature is turned. A method designed by F. W. Lancaster to test the efficiency of worm gears may be classed as a dynamometer since friction losses in a worm and wheel is measured directly by weigh-

ing the reaction the friction produces. A description of this interesting machine, set up in the National Physical Laboratory will be found in Appendix Q of a paper entitled "Worm Gear," read before the Institution of Automobile Engineers, Proceedings session 1912-13.

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DYNAMOTOR, an electrical machine which when set in motion by mechanical means generates electricity, and which without any alteration, is capable of doing mechanical work when supplied with an electric current. Its action is thus reversible (See **ELECTRIC GENERATOR AND MOTOR**).

DYNAPHONE, one of the latest additions to the resources of the modern orchestral composer. Described, not too enlighteningly, as "an apparatus for the emission of sound waves," it has been utilized by the French composer, Arthur Honegger, in a ballet entitled *Rose et mal*.

DYNASTY, a family or line of rulers, a succession of sovereigns of a country belonging to a single family or tracing their descent to a common ancestor (Gr. *dynasteia*, sovereignty). The term is particularly used in the history of ancient Egypt as a convenient means of arranging the chronology.

DYNE, the unit of force in the centimetre gram second system. It is the force which, acting on one gram of mass, produces an acceleration of one centimetre per second per second. It is $1/1000$ the gravitational unit of force which is the weight of one gram of mass, g being the acceleration due to gravity (See **GRAM** [**GRAMME**], **MECHANICS**, **PHYSICAL UNITS**).

DYOTT, THOMAS W. (1771-1861), U.S. glass manufacturer was born in England. Nothing is known of his early life until his arrival in the United States toward the end of the 18th century. He soon established himself in Philadelphia, where he set himself up in what became an immensely successful shoe shining enterprise, the first of its kind in the city. It is not known exactly when he entered the patent medicine business, but in that field, too, the enterprising Dyott was soon successful. His medicines, with which he claimed to be able to cure all human ailments, were used throughout the entire United States. About 1812 he took, with no authority but his own title of doctor of medicine. Dyott soon began to advertise the sale of bottles, as well as medicines, and about 1818 he became the agent for a number of glass manufacturers. There is some dispute about the year in which he first began to manufacture glass himself, the date sometimes being put as early as 1822, but in any case he probably did not purchase the Philadelphia and Kensington Glass Works until 1833. He enlarged and improved the plant and was soon manufacturing bottles of every description, introducing a number of designs which were later copied extensively and still later being collectors' items. Dyott's downfall was caused by the failure of the bank he had established as a part of his model community, Dyottville, or, as it was sometimes called, Temperanceville, because Dyott would not hire any worker until he had taken a temperance pledge. When the bank failed in the late 1830s, Dyott was proclaimed a "fraudulent bankrupt" and the Kensington works fell into other hands while Dyott served a prison sentence. He died in 1861.

DYRRACHIUM, CAMPAIGN OF (48 B.C.) Having destroyed Pompey's power in Spain Julius Caesar returned to Italy, and on Nov. 25, 49 B.C. set sail from Brundisium with seven legions for Paestum on the Euxine coast. Landing on Nov. 29, on Dec. 2 he besieged Dyrrachium which, however, he failed to capture. Though numerically weaker than Pompey he succeeded in cutting him off from his city, and then to staggered his convoys he drew a circle of trenches about 16 mi. in length round Pompey's army. Two divers from Caesar's camp informed Pompey of the weak-

position in his defenses, and acting on this information Pompey determined to attack his enemy's left flank, which rested on the coast. Caesar had built round Pompey's right flank a line of contravallation and one of circumvallation, between which was posted the ninth legion. Pompey's attack was made at dawn. He huddled a number of archers and slingers in rear of Caesar's men, and while these broke into the unfinished works he attacked them in front with 60 cohorts. The ninth legion, taken in front, flank and rear, broke in confusion and spread panic among the reinforcements which had been sent out by Marcellinus, near whose camp Antony checked the Pompeians by a bold counterattack. Caesar hearing of the disaster, moved rapidly with such cohorts as he could collect toward the scene of action, only to find that Pompey had established a new camp on his own original left flank. Nothing daunted, Caesar entrenched his men opposite to Pompey, and attempted to turn Pompey's left flank, but the attack failed. In this battle Caesar suffered a severe defeat, and not only were his losses considerable, but his loss of prestige was almost disastrous to his cause. Caesar's operations throughout this campaign, though daring in the extreme, were essentially faulty. By attempting to enclose a numerically superior adversary he was strong nowhere, and had Pompey known how to win victory as well as fight a battle Caesar must have been decisively defeated (See PHARSALUS, BATTLE OF).

DYSART see KIRKCALDY

DYSENTERY The term dysentery, the bloody flux of former times, denotes a symptom complex, the passage of blood and mucus in the stools, together with abdominal pain and straining. This combination is not confined to one distinct disease, is common to a number of conditions with ulceration and inflammation of the large intestine and is therefore determined by a variety of different microbial agents.

Types of Dysentery—Dysentery may be classified as follows.

Bacillary or Epidemic Dysenteries, for which the following organisms are responsible: (1) Shiga's bacillus (*Shigella shigae*) causes the most acute and fatal form in most tropical countries. (2) Schmutz's bacillus (*Shigella schmutzi*) closely resembles the former in its biochemical reactions and in many other respects. It produces usually a less serious clinical manifestation and accounted for 12% of cases during World War II. (3) Flexner's bacillus (*Shigella flexneri*) is a species divisible into several subtypes. It is common in temperate countries, as well as in the tropics, and produces a clinical disease of average severity. (4) Sonne's bacillus (*Shigella sonnei*) is common all over the world, especially in temperate countries, and spreads with great rapidity causing epidemics in infants and children, though it may produce severe dysentery in adults. It differs from all other dysentery bacilli in fermenting lactose, but produces its own specific antigens and agglutinins in the body.

Protozoal or Endemic Dysenteries—(1) Amoebiasis, or infection with the dysentery amoeba (*Endamoeba [Entamoeba] histolytica*, F. R. Schaudinn, 1903), includes (a) primary intestinal amoebiasis or amoebic dysentery and (b) secondary amoebiasis—hepatic amoebiasis—or amoebic abscess of the liver, lung, brain or spleen, sometimes also amoebic extraintestinal ulcers (of buttocks or perineum) and amoebic invasion of the skin. (2) *Balantidium coli*. The course and pathology of this disease resembles amoebic dysentery. This infection is rare in man, but common in animals, especially pigs and larger apes. (3) Coccidiosis, an infection with *Isospora hominis*, a rare disease of the intestinal tract of man. (4) Giardiasis (or lambliaosis), an infection of the small intestine with *Gardia intestinalis*, a protozoan flagellate, common in children and producing a mucoid diarrhoea. (5) Malarial dysentery, the passage of blood and mucus in the course of infection with the malarial parasite (*Plasmodium falciparum*), which congregates in the capillaries of the intestinal walls. (6) Leshmanian dysentery, an infection of the intestinal canal with the parasite of kala azar (*Leshmania donovani*), when these organisms are found in the pathological exudate in the faeces.

The Helminthic Dysenteries—A dysenteric syndrome is evoked by ulceration and inflammation, and subsequently by the forma-

tion of adenopapillomata in the intestinal tract by deposition of the eggs of certain trematode worms (or flukes) of the *Bilharzia* genus, which are those known as the bilharzial dysenteries. Of these the most important is *Bilharzia* (or *Schistosoma*) *mansoni* in Africa and South America. Two other species *B. haematobia* and *B. japonica*, may occasionally give rise to similar phenomena. Some other trematodes may evoke dysenteriform symptoms to a minor degree, such as the small fluke *Heterophyes heterophycis* (in Egypt), and those which inhabit the intestinal tract, and a much larger species *Pascalocephalus buski* (in China). Of the nematodes the most striking example is *Oxophogostomum apthomium*, which is commonly found in monkeys, but rarely in man, in Southern Nigeria and central Africa and on the Amazon river in Brazil. These worms, encyst in the mucous membrane of the large intestine, thereby giving rise to dysenteriform symptoms. A small nematode *Strongyloides stercoralis*, which is found in most tropical countries, has been accredited, on rather slender grounds with similar properties, although it does not appear to burrow into the mucous membrane.

This formidable list does not exhaust the known causes of dysentery. There are the various forms of colitis, which are found in civilized peoples all over the world, the exact aetiology of which still remains obscure. These include mucous colitis, a secretory neurosis of the large bowel, which gives rise to diarrhoea with the passage of much ropy mucus and occasionally, also of blood. Membranous colitis is an exaggerated form of this disorder in which casts of the mucous membrane appear in the stools, accompanied by blood and mucus. Idiopathic ulcerative colitis (*colitis gravis*) is a very severe and sometimes fatal, disease of the colon with the passage of bloodstained mucous discharges, eventually producing severe anaemia, toxæmia and death. It is mainly a disease of early adult life and is liable to remissions and sudden exacerbations. By reasons of its course and manifestations it is liable to be confused with the other forms of bacillary dysentery of which the cause is accurately known. Mercurial colitis is one of the clinical manifestations of mercurial poisoning and closely resembles the above, and a somewhat similar condition is sometimes observed in the uræmic state. Other familiar disorders, such as carcinoma of the large intestine, caecum, colon or rectum, occasionally produce dysenteric symptoms long before their serious nature can be recognized. Polyposis, or multiple adenomata of the large intestine may do the same, and simple polypi in the lower bowel may produce spasmodic contraction and passage of bloodstained mucus. Diverticulitis, a common affection of advancing age, lymphogranuloma of the rectum and Crohn's disease, or chronic cicatrizing enteritis, have also to be reckoned with. Intussusception of the small or large intestine may be associated with amoebic or bacillary dysentery, or, in small children, arise from irritation by a polypus. Submucous lipoma and Meckel's diverticulum may produce a tumour and blood and mucus in the faeces. Finally, tubercular ulceration of the large intestine and septic ulceration of the rectum due to internal haemorrhoids must be included.

Bacillary Dysentery—The bacillary dysenteries are characterized by inflammation of the mucous membrane of the large intestine and occasionally of the terminal portions of the ileum which may lead to superficial necrosis. The symptoms are provoked by efforts of the body to rid itself of the products of this destruction, together with absorption of the exotoxins elaborated by the various dysentery bacilli. Death takes place from dehydration and intoxication. The infection is spread in most tropical countries by contaminated water, food and most probably by the housefly (*Musca domestica*) in those hot countries where this insect abounds. Carriers of dysentery bacilli must also be taken into account. The healthy carrier (that is, one who excretes dysentery bacilli in healthy motions without having suffered from the disease) is rare, but the convalescent carrier is comparatively common. The incubation period varies from three to seven days.

The clinical course of bacillary dysentery is extremely varied and ranges from comparatively mild types to acute fulminating cases with intense toxæmia, in which death takes place within two to three days. The latter type has become increasingly

uncommon. In most tropical countries an explosive diarrhoea attacks most newcomers and is labelled in various places by appropriate synonyms. In Egypt it is familiar as "gippy tummy" and is usually due to *Shigella sonnei*. It is a fleeting but disagreeable disorder not attended by any serious aftereffects. In the acute type of bacillary dysentery the onset is abrupt and within a few hours there is fever with a temperature of 101°-105° F. The patient suffers from a severe toxæmia and dehydration soon becomes obvious. Sometimes there is vomiting. Within three or four hours violent diarrhoea sets in with severe colic and tenesmus. Blood and mucous discharges are continuous and there is usually incontinence. Abdominal pain and tenderness are severe. The colon is contracted painful and spastic. In children the onset may be heralded by convulsions. Chronic bacillary dysentery is in extremis exhausting, debilitating disease caused by chronic ulceration of the large intestine and was a common sequel in World War I but later became rare.

The complications of bacillary dysentery are dysenteric arthritis, which resembles rheumatoid arthritis but is of a more fleeting character, conjunctivitis, iritis, neuritis and sometimes glomerulonephritis. Occasionally there is peritonitis and massive intraperitoneal serous effusions. The disease is diagnosed by the character and appearance of the stools, the serous and blood-stained mucus, by the isolation on culture of the specific organisms (with special selective media are now employed (Lieson's deoxycholate citrate agar). The characteristic cellular exudate of the discharges as seen by microscopy such as pus cells and large histocytes derived from the mucosa, in this picture, are important. In doubtful cases sigmoidoscopy may be employed when the typical granular appearance of the mucosa is distinctive.

Treatment—The treatment of this group was revolutionized by the introduction of special sulfonamide drugs—sulfaguanidine, sulfaisocidine and sulfathiazine. The former practice of drenching the intestinal tract by saline purgatives has been abandoned. For any severe case rest in bed is imperative, as in *S. shigæ* infections the heart muscle may be damaged by the potent toxins of this organism. All food should be withheld for the first 48 hr, but plentiful draughts of water should be permitted. The usual treatment involves prescribed dosages of sulfaguanidine and if a patient does not respond it is usually advisable to change over to some other sulfonamide, such as sulfaisocidine. It was formerly thought that sulfaguanidine was bacteriostatic because of poor absorption, but it is now known that absorption takes place, though slowly, so that in overdose toxic symptoms may result, such as obstruction of the renal tubules by crystals, leading to suppression, various toxic rashes and sometimes acute psychosis. If sufficient fluid cannot be absorbed by the mouth then parenteral salinus should be given intravenously by drip transfusion. This will abolish the incidence of renal blockage which is especially dangerous in hot countries. Total and differential white blood counts should be made at suitable intervals to give warning of granulocytopenia, which may complicate sulfonamide therapy.

For pain and lack of sleep the physician should have no hesitation in giving morphia injections. Lavage of the lower bowel with hot saline is comforting to the patient and a suppository of cocaine affords relief of tenesmus. In *S. shigæ* infections antidyenteric antitoxin administered intravenously, if given within the first 24 hr, is still employed with good results. It is of great importance that patients with subacute or chronic bacillary dysentery should not be kept on semistarvation diet or they will develop evidence of hypoproteinaemia. It is therefore necessary to provide, after the fifth day a well balanced nutritious diet of high vitamin content, and with a sufficiency of animal protein.

Amoebic Dysentery—The *Endamoeba histolytica* is a protozoan which is essentially a tissue parasite and obtains its nourishment from the cells of the intestinal wall. It occurs in the human body in several stages. In the intestine, the trophozoite or tissue-invasive stage, is 20 μ to 30 μ in diameter, though minute stages 10 μ to 12 μ are often present. There is a characteristic nucleus and a labile protoplasm composed of an inner granular and an outer hyaline zone. By means of pseudopodia the parasite progresses and ingests food, mostly consisting of red blood cor-

pascles and tissue cells. *E. histolytica* has to be distinguished from *E. coli*, and three other species of nonpathogenic amoebae which inhabit the intestinal tract of man.

Cyst formation takes place for the purpose of transmission from one host to another. Before this occurs all food contained in the amoeba is thrown out, a thin cyst wall is formed, and there is one huge nucleus, constituting the precystic form. The cysts vary in size from 5 μ to 20 μ in diameter. They contain at first a single nucleus, which soon divides into four, the daughter nuclei separating and taking up separate positions at opposite poles. There are also in the cytoplasm chromatoid bodies and sometimes glycogen vacuoles which show up with iodine. The cysts are formed within the amoebic ulcers and are then passed out in the faeces. They remain viable for some days in water and apparently in this medium are passed on to another individual. Neither precystic forms nor cysts are produced in the metastatic lesions of amoebiasis.

Amoebic dysentery is usually much more chronic and insidious than is the bacillary disease. It also occurs as an endemic or sporadic infection. The incubation period is variable; it may be 60 days or longer, but in the Chicago outbreak of 1933 it was about a week, in some instances. Apart from individuals who manifest the symptoms of dysentery, there are many others in whom the cysts appear in the faeces and these are known as "carriers." In England there are a number of healthy people who harbour the cysts, though indigenous amoebic dysentery is rare. Therefore some believe that there are two strains of *E. histolytica*, one, the large strain, being highly pathogenic, the other, with low invasive powers, not being so.

The pathology of amoebic dysentery consists of ulceration of the large intestine as a result of invasion of the submucosa by *E. histolytica*. Amoebic granulomata are irregular erosions of the mucosa and formations of granulation tissue. The ulcers may be of a large size and solitary, with normal intervening mucosa or may become confluent. Multiple small ulcers covering the whole surface are known as "sea anemone" ulcers. The ulcerations are apt to conglomerate at the flexures.

The clinical picture in amoebic dysentery is extremely variable. It may constitute a trivial affliction or be very severe, it may be transient, or last for many years. Two chief types may be distinguished: one with insidious onset commencing with diarrhoea without much general disturbance, the other more acute with abdominal pain, colic and the passage of bloodstained mucous stools. Very acute fulminating attacks are rare. As a rule three or four stools are passed in the day. Incontinence and tenesmus are uncommon. The chronic type is much the more frequent and this manifests itself by frequent remissions and exacerbations with vague abdominal disturbances. There is usually tenderness and induration over the caecum in the right and over the sigmoid in the left iliac fossae. In contrast to the bacillary dysenteries, the faeces are much more offensive, contain much altered blood intermingled with the faecal contents, but in the later stages are dark and fluid and are aptly likened to anchovy sauce, but solid faeces with congealed blood and mucus may be passed when the process is quiescent. As a rule there is no fever, but nausea is often present. Vomiting is uncommon. The disease tends to recovery as a rule and is the outcome of the activities of the parasite and the recuperative powers of the intestine. Rare forms are those with fever and toxæmia which are probably due to secondary bacterial infection of the ulcerations. Death takes place either from perforation of the large intestine and consequent peritonitis, from intestinal haemorrhage or from gangrene of the bowel, especially at the site of the flexures. In the chronic stage, amoebic hepatitis frequently supervenes, there is a gradual loss of weight, the skin becomes dry and sallow and introspective neurotic manifestations make their appearance.

In amoebic dysentery there are often long periods of latency which may last a year, or even longer, and it is in these cases that liver abscess may intervene. In others the disease appears to be confined to the caecum (amoebic typhlitis) and may closely simulate appendicitis. Attention has been increasingly drawn to the "amoeboma." This is a tumour composed of hyperplastic granu-

tion tissue occurring at different sites, in the ileocaecal region, the transverse colon, sigmoid flexure or rectum, which closely simulates a malignant growth, and is apt to appear in chronic amoebic dysentery. It may also give rise to a local inflammation which complicates the clinical picture still further. Pericolic amoebic abscesses may also form, but are rare. Complications are amoebic hepatitis (fever, leucocytosis and hepatic pain) and amoebic abscess of the liver and of the lung, rarely of brain or spleen. Amoebic abscess of the epididymis has been reported, while fistulae of the buttocks, perianal amoebic ulcers and abscesses, and similar lesions of the cervix uteri in the female have been described. Amoebic invasion of the skin, producing gangrene, is apt to occur from a para-rectal abscess or from a liver abscess sinus, or to follow on abdominal operation in a subject who is infected with *E. histolytica*. Sometimes these accidents happen in those who have never suffered from clinical amoebic dysentery, but who harbour *E. histolytica* cysts in the faeces.

Apart from the information to be obtained from the history of the patient and character of the stools, absolute diagnosis is founded upon the detection of *E. histolytica* in the faeces. In the acute stage this is comparatively easy when the large active tissue invading trophozoites can be recognized with ingested red blood corpuscles. They are not always evenly distributed and those portions of the stools containing blood and mucus should be selected. The examination should be conducted while the excreta are warm, since these organisms soon deteriorate and die. It is often more practicable to make scrape preparations by a special instrument (Volkmann's spoon) directly from the rectal mucosa through a proctoscope or sigmoidoscope. In the chronic stages the cysts are found in the diarrhoeic faeces and are often present in enormous numbers, but they tend to vary from day to day and there may often be long periods during which they are absent altogether.

Sigmoidoscopy is most important. By means of this instrument the characteristic ulcers may be demonstrated. These are often of a small size and superficial character. There may be small submucous haemorrhages and, in the chronic stage, minute pittings with crateriform edges giving rise to what is known as the "puckered appearance." As a rule, amoebic lesions are visible in the lower rectum in the vicinity of Houston's valves and therefore can easily be seen through a simple proctoscope.

Treatment.—There is one drug, emetine, which is specific for amoebic dysentery. This is the alkaloid of ipecacuanha, which destroys the parasite in very dilute solutions (1:1,000,000). In the acute stages, emetine hydrochloride is injected deep subcutaneously. Although this method controls the acute manifestations, it does not eradicate the infection and has no effect upon *E. histolytica* cysts. For this purpose emetine bismuth iodide is given. This compound is decomposed in the intestinal tract into bismuth sulphide and emetine is liberated on the surface of the ulcers. It is best given in enteric or gelatine coated capsules. A new dispersible form has been prepared which is very efficacious. The dose is spread over a period of 10 to 12 days. The patient should be confined to bed on a light diet and the drug should be administered at 10 P.M. No food should be taken after 6 P.M. and a sedative should be taken one-half hour before the specific drug. Another amoebicidal drug is quinoxyl (yatren) given in the form of retention enemata. The bowel should be cleansed with a 2% sodium-bicarbonate solution beforehand. Other drugs are carbarsone, stovarsol and diodoquin. The latter, another quinoxyl compound, is useful in clearing up the "carrier" state. Other specific drugs in the treatment of the dysenteries are atabrine (mepacrine) in giardiasis, paludrine in malarial dysentery, neostibosan in leishmaniasis and sodium antimony tartrate in bilharziasis. (See also BACTERIAL AND INFECTIOUS DISEASES.)

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DYSON, SIR FRANK WATSON (1868-1939), Brit. astronomer, was born at Ashby-de-la-Zouch, Leicestershire, on Jun 8, 1868 and was educated at Bradford grammar school and Trinity college, Cambridge. In 1891, he became chief assistant at the Royal observatory, Greenwich, and in 1905 was made astronomer royal of Scotland, a position which he held until his return to Greenwich as astronomer royal of England (1910-33). From 1899 to 1905 he was secretary of the Royal Astronomical society. He was elected F.R.S. in 1901, subsequently serving on the council, and was in 1921 awarded the royal medal for his numerous contributions to astronomy, and especially for his important investigations of the distribution and movements of stars and the bearing of these upon the structure of the stellar universe. His observations of the spectrum of the corona and chromosphere during eclipses of the sun were published in *Determination of Wave Length from Spectra Obtained at the Total Solar Eclipses of 1900, 1901 and 1905* (1906). Knighted in 1915, he was created K.B.E. in 1926. He also wrote *Astronomy, a Handy Manual for Students and Others* (1912).

DYSPEPSIA, difficult or painful digestion, may be of nervous origin, the result of poor food habits, of reflex origin due to disorders of organs other than those of the gastrointestinal tract or to various diseases or disorders of the alimentary system. See also ALIMENTARY SYSTEM, DISEASES OF.

DYSPROSIUM (symbol Dy, atomic number 66, atomic weight 162.46, stable isotopes Dy^{160} [0.052%], Dy^{161} [0.090%], Dy^{162} [0.1%], Dy^{163} [21.1%], Dy^{164} [26.6%], Dy^{165} [24.8%], Dy^{166} [27.3%]) is a metallic element of the rare earth group. The name is from the Greek *dysprositos*, meaning hard to get at. In 1886 L. de Brossaudran deposited a sealed paper with the Académie des Sciences, it was opened at a later date and read at his request. It contained a statement that a new element possessing characteristic absorption spectra had been separated from cerite. The oxide was obtained fairly pure for the first time in 1906 by G. Urbain. The element occurs along with erbium, holmium, etc., in the minerals gadolinite, euxenite, xenotime, etc. It is usually obtained free from the neighbouring rare earths by a fractional crystallization of the bromates. Since 1945 rapid separations have been obtained by means of adsorption columns. It forms a white oxide (Dy_2O_3) which dissolves in many acids to form yellowish green solutions which show strong characteristic absorption spectra. Its salts are strongly paramagnetic. Minute amounts of its salts have been reduced to metal by means of thermo reduction with alkali metals. The metal crystallizes in the hexagonal close packed system ($a=3.578\text{Å}$, $c=5.648\text{Å}$) with a calculated density of 8.764. See RARE EARTHS. (F. H. Sp.)

DYSTELEOLOGY, a modern word invented by Ernst Haeckel (*Evolution of Man*) for the doctrine of purposelessness, as opposed to the philosophical doctrine of design (Teleology).

DYVEKE see s.v. CHRISTIAN II, KING OF DENMARK.
DZERZHINSKY, FELIX EDMUNDOVICH (1877-1926), Russian politician of Polish descent, was born at Vilna. He joined the Social Democratic party of Lithuania in 1895, and two years later was arrested and banished to Siberia for political agitation. In 1899 he escaped, was rearrested in the following year and in 1902 again escaped. After he had taken part in the revolution of 1905 there followed further years of banishment until 1912, when he returned to Warsaw, was arrested again and sentenced to nine years' hard labour. After the revolution of March 1917, he was released and became a member of the military revolutionary committee which organized the bolshevik revolution. In Dec. 1917 he organized and became chairman of the Cheka, or secret police after the war. He was appointed commissar of the home department in 1919. The organization of the Cheka was found to be so complete that it was possible to dispense with Dzerzhinsky's supervision and in 1921 he was transferred to the commissariat of transport, where

he carried out an exhaustive reform of the railways. In 1924, after the party dispute on policy at the time of Lenin's death, Dzerzhinsky was placed at the head of the supreme economic council. He died in July, 1926.

DZUNGARIA, **DSONGARIA** or **JUNGARIA**, a former Mongolian kingdom of central Asia, raised to its highest pitch by Kaldan or Busutu Khan in the latter half of the 17th century, but completely destroyed by Chinese invasion about 1757-59. It derived its name from the Dsongars or Songars, who were so called be-

cause they formed the left wing (*dson*, left, *gar*, hand) of the Mongolian army. Its widest limit included Kashgar, Yarkand, Khotan, the whole region of the T'ien Shan (or T'ien shan) mountains, and the greater proportion of that part of central Asia which extends from 35° to 50°N and from 72° to 97°E. The name, however, is more properly applied only to the later Chinese province of T'ien Shan pei lu and the country watered by the Ili. As a political or geographical term it has practically disappeared from the map.



E THE fifth letter of the alphabet, answers to Semitic **א**, Greek **Ε** or **Ϝ**, Latin **E** Forms in use at Corinth were **β** or **Β** The Lydian form was **Ϝ** and there was an alternative form **||** in use in the Faliscan and Latin alphabets The uncial form was from the 4th century A.D. rounded **Ϸ** and the cursive form was also rounded, **Ϸ** From these developed the Carolingian **Ϸ** from which the modern minuscule **e** is derived

The sound represented by the letter was a low front vowel corresponding, though inexact, to the sound of English **a** in *lake* The latter is a diphthong whereas **e** represented an unmixed vowel sound, such as that heard in French *tête* or *été* In Greek

ground of that formerly represented by **e**, so the latter moved upward, encroaching upon and occupying the territory of the sound of **i**, which became a diphthong The sound of English long **e** is now a close high palatal vowel, as in *be*, that of short **e** a more open and less high front vowel, as in *bed*, that has not to any great extent shifted from what may be called its original position (*cf.* the sounds of French *été* and English *bed*) When followed by **r** the sound is modified and is less high, as in *here* In the word *there* the vowel has the same sound as that of **a** in *here* In many English words a mute final **e** is employed as a device to mark the fact that the preceding vowel is long, e.g., *take*, *wine*, *stone* This occurs only when the final **e** is separated from the long vowel by a single consonant Again, in words such as *added*, *rotten*, the letter represents little more than a voice glide

In music, **E** is the fifth note of the musical alphabet and the third degree of the "natural scale" of **C** Its syllabic name, employed in France and Italy, is *mi*

EA (written by means of two signs signifying "house" and "water"), in the Babylonian religion was the god of wisdom and patron deity of Eridu, situated in ancient times at the head of the Persian gulf but now at some distance from the gulf Eridu "the good city," was one of the oldest settlements in the Euphrates valley, and is now represented by the mounds known as Abu Shahrein Whether **Ea** (or **A** **e**) represents the real pronunciation of his name we do not know The name is rendered by 'Aôis in the theogonies of Damascus and by Ωαννης in the fragments of Berossus All attempts to connect **Ea** with **Yah** and **Yahweh** are idle conjectures without any substantial basis The original Sumerian name of this god is En Ki, "lord of the earth," referring to his abode in the *Apsu*, or rather sea, from which springs and rivers were supposed to flow He is never connected with the salt water seas **Ea** is not found earlier than the 22nd century B.C. He is figured as a man covered with the body of a fish, and this representation, as likewise the name of his temple *E apsu*, "house of the watery deep," points decidedly to his character as a god of the waters (*see* OANNES) Of his cult at Eridu, which reverts to the oldest period of Babylonian history, nothing definite is known Incantations, involving ceremonial rites, in which water as a sacred element played a prominent part, formed a feature of his worship Eridu never played an important political rôle The prominence of the **Ea** cult led to the survival of Eridu as a sacred city, long after it had ceased to have any significance as a political centre, c. 2200 B.C. Myths in which **Ea** figures prominently indicate that **Ea** was regarded as the protector and teacher of mankind He is essentially a god of civilization, the creator of man and of the world in general Traces of this view appear in the *Marduk* epic celebrating the achievements of this god, and the **Ea** cult at Eridu is connected with that of *Marduk*, since *Marduk* is generally termed the son of **Ea** who derives his powers from the voluntary abdication of the father in favour of his son

Ea acquires his permanent place in the pantheon as the third figure in the triad, the two other members of which were **Anu** (*q v*) and **Enlil** (**Bêl**) To him was assigned the control of the watery element, and in this capacity he becomes the *shar apu*, i.e., king of the *Apsu* or "the deep," an ocean beneath the earth Since the gathering place of the dead, known as *Aralu*, was situated near the confines of the *Apsu*, he was also designated as En Ki, i.e., "lord of that which is below," in contrast to **Anu**, who was the lord of the "above" or the heavens The cult of **Ea** extended throughout Babylonia and Assyria Temples and shrines were erected in his honour, e.g., at Nippur, Girsu, Ur, Babylon, Sippar and Nineveh, and the numerous epithets given to him, as well as the various forms under which the god appears, alike bear witness to the popularity which he enjoyed from the earliest to the latest period of Babylonian Assyrian history The consort of **Ea**, known as *Damkina*, "lady of that which is below" or *Nin Ki*, having the same meaning, or *Damgal-nunna*, "great lady

| NAME OF FORM | APPROXIMATE DATE | FORM OF LETTER |
|-----------------------------|-----------------------------------|----------------|
| PHOENICIAN | B.C. 1200 | 𐤅 |
| CRETAN | 1100-900 | 𐀅 𐀆 |
| THERAËAN | 700-600 | 𐤅 |
| ARCHAIC LATIN | 700-500 | (E) |
| ATTIC | 600 | Ϝ |
| CORINTHIAN | 600 | Ϝ Ϝ Ϝ |
| CHALCIDIAN | 600 | Ε |
| IONIC | 403 | Ϝ |
| ROMAN COLONIAL | PRE-CLASSICAL AND CLASSICAL TIMES | Ε WITH |
| URBAN ROMAN | | E |
| FALISCAN | | 𐀅 𐀆 |
| OSCAN | | 𐀅 𐀆 |
| UMBRIAN | | 𐀅 𐀆 |
| CLASSICAL LATIN AND ONWARDS | | E |

THE DEVELOPMENT OF THE LETTER **E** FROM THE PHOENICIAN THROUGH CLASSICAL LATIN TO THE PRESENT FORM

e stood for a short, close vowel as opposed to **η** whose sound was long and open, although in all local alphabets, especially in early times, this distinction was not exactly observed In Attic Greek the long, close sound was expressed by **ε** In the Latin alphabet the letter **E** did duty for all shades of the sound, long or short, close or open

In English an extensive change took place in the sound of the long vowel during and after the later Middle English period (probably between the 15th and 17th centuries) Just as the sound represented by **a** moved forward till it now covers the

of the prince," plays a part merely in association with her lord

BIBLIOGRAPHY—Tentative excavations were made at Eadu in 1919 by H. R. Hall, see "Ur and Eadu," *Journal of Egyptian Archaeology*, IX (1923), and in 1918 by R. Campbell Thompson, "The British Museum Excavations at Abu Shahrein," *Archaeologia* LXX (1920)

EADBALD (Eðbald) (d. 640), king of Kent, succeeded on the death of his father Aethelbert in 616. He had not been influenced by the teaching of the Christian missionaries, and on his accession he followed the heathen custom and married his father's widow. After his subsequent conversion by Laurentius, archbishop of Canterbury, he recalled the bishops Mellitus and Justus, who had fled from his persecution, and built a church dedicated to the Virgin at Canterbury. He arranged a marriage between his sister Aethelburh and Edwin of Northumbria, on whose defeat and death in 633 he received his sister and Paulinus, whom he had sent with her, and offered the latter the bishopric of Rochester. After his conversion Eadbald ceased to live with his first wife, and married Emma, a Frankish princess. He died on Jan. 20, 640.

EADMER or EDMER (c. 1060–1124), English historian and ecclesiastic, was probably of English parentage. At the monastery of Christ Church, Canterbury, he met Anselm, to whom he served as assistant when Anselm became archbishop of Canterbury in 1093. In 1120 he was nominated archbishop of St. Andrews, but the Scots refused to recognize the authority of Canterbury. He died probably in 1124. His most important work is the *Historiae Novorum*, dealing with the history of England, mainly ecclesiastical, between 1066 and 1122.

EADS, JAMES BUCHANAN (1820–1887), U.S. engineer, was born at Lawrenceburg, Ind., on May 23, 1820. His first engineering work of any importance was in raising sunken steamers. In 1845 he established glassworks in St. Louis. During the Civil War he constructed ironclad steamers and mortar boats for the federal government. His next important engineering achievement was the construction of the great steel arch bridge across the Mississippi at St. Louis upon which he was engaged from 1867 till 1874. The work, however, upon which his reputation principally rests was his deepening and fixing the channel at the mouth of the Mississippi by means of jetties, whereby the narrowed stream was made to scour out its own channel and carry the sediment out to sea. Shortly before his death he projected a scheme for a ship railway across the isthmus of Tehuantepec, in lieu of an isthmian canal. He died at Nassau, in the Bahamas, on March 8, 1887.

EAGLE, the name given to the larger diurnal birds of prey, in the family Accipitridae, with feathered head, strongly hooked beak, great talons and keen vision. They range throughout the world, and are famous for their powerful, stately, soaring flight. Most of them belong to the subfamily Buteoninae, typified by the European buzzards and large American hawks (*Buteo*).

The typical eagles (*Aquila*) include eight species with "booted" legs, feathered to the toes. The best known is the golden eagle (*A. chrysaetos*), inhabiting mountainous or rocky regions of Europe, Asia and North America. They build a huge eyrie of sticks on cliffs or tall trees, returning year after year to lay one to four large white eggs mottled with brown. The young are clad in white down, assume the dark brown juvenile plumage after ten weeks, and molt annually until the adult golden brown is acquired at four years. Kirghiz Tatars used the golden eagle to capture antelopes, but in Europe, during the height of falconry, it was flown only by kings. Of eight geographic races, the typical form is found in Europe, another (*A. c. fulva*) breeds in Scotland and the Hebrides, while a third (*A. c. canadensis*) is familiar in North America from Alaska and northeastern Canada south in the mountains to North Carolina, Tennessee and central Mexico, especially in the western mountains. Other races are found in Spain and northwest Africa, Japan and Korea and Asia. Related species include the spotted or imperial eagle (*A. heliaca*), southern Europe to China, the tawny eagle (*A. rapax*), Africa and India, and several smaller species in Asia, Africa and eastern Europe.

The sea eagles (*Haliaeetus*) range all continents except South

America, and may be known from typical eagles by the naked tarsus or lower leg. They generally eat fish, and are largely robbers and scavengers. Of the eight species, the noble-looking bald eagle (*H. leucocephalus*), national emblem of the United States, is confined to North America. The typical race breeds in the southern United States and northern Mexico, while a larger form (*H. l. washingtonensis*) occurs from Connecticut, the Great Lakes and Washington to northern Canada and Alaska. The eyrie is a huge mass of sticks atop a large tree or pinnacle of rock,



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

AMERICAN EAGLE THE NATIONAL EMBLEM OF THE UNITED STATES. In the adult of this bald sea eagle, the head, neck and tail are white.

within easy flight of sea, lake or stream, one to three eggs hatch in 35 days, both parents sharing incubation and care of young. The smoky gray down is replaced by dark brown juvenile plumage in about eight weeks, and the pure white head and tail are assumed in the fourth year. The magnificent white-tailed or gray sea eagle (*H. albicilla*), from Iceland to Japan, formerly bred in the northern British Isles and Egypt, and is casual in the Aleutians, accidental off Massachusetts. The African sea eagle or river eagle (*H. vocifer*) is like the bald eagle, but the white of the head extends over breast and upper back. The white-bellied sea eagle (*H. leucogaster*) occurs in southeastern Asia, Australia and western Polynesia. Other striking species are found in Kamchatka, Korea, Madagascar and from southern Russia to northern Burma. Two allied species of fishing eagles (*Icthyophaga*) range from India through the Malay to the Philippines, while the large dark wedge-tailed eagle (*Uroaetus* *australis*) lives in Australia.

Among the largest, most powerful birds of prey are the harpy eagles (*Q. v.*), six genera and seven species occurring in South America, one in the Philippines and one in New Guinea.

Five species of smaller hawk eagles (*Hieraaetus*) inhabit the old world. Six species of crested hawk-eagles (*Spiraeetus*) are recognized, three in Central and South America, three in southeastern Asia, the Malays, Philippines and Japan, and four genera, each with a single species, including the large martial eagle (*Polemaetus*), occur in Africa.

The Brazilian eagle (*Hypomorphnus urubitinga*) is a large black buzzard or hawk, ranging from Mexico to southern South America. The Chilean eagle (*Geranoastur melanoleucus*) occurs in the Andes from Venezuela to the Straits of Magellan, east to southern Brazil and eastern Argentina.

Quite different from the aforementioned eagles are 5 genera and 13 species of smaller birds of prey belonging to the subfamily Circaetinae, confined to the old world. These include the amazing, bald, bob-tailed bateleur eagle (*Terathopius ecaudatus*) of Africa, the harrier eagles (*Circus*) of Africa, Asia and southern Europe, and the serpent eagles of southeastern Asia and the Malays and Philippines (*Sylorinus*), central Africa (*Dryotrochus*) and Madagascar (*Entrochus*).

Two old world vultures, subfamily Aegypinae, have been known as eagles, their feathered heads being quite different from naked heads of other vultures. One is the famous bearded vulture or lammergeier (*Gypaetus barbatus*), living in mountains of southern Europe, central Asia and Africa. The other is the vulture fish eagle (*Gypohierax angolensis*), a striking white and black bird of central west Africa. (See LAMMERGEIER.)

See C. W. R. Knight, *The Golden Eagle* (1927), F. H. Herring, *American Eagle* (1934).

EAGLE GROVE, a city of Wright county, Iowa, U.S.A., 94 mi. N. of Des Moines. It is served by the Chicago and North Western and the Chicago Great Western railways. Pop. (1950) 4,167. It is a farm crops processing center with soybean and



BY COURTESY OF CAPTAIN C. W. E. KNIGHT

THE GOLDEN EAGLE

The golden eagle (*Aquila chrysaetos*) found over a large portion of the northern hemisphere. It is the largest of the birds of prey trained for falconry and has been used in Asia, especially in India, for taking bustards, antelopes, hares, foxes, and it is said even larger animals such as wild goats and wolves.



BY COURTESY OF CAPTAIN L. W. B. ARIE HT

GOLDEN EAGLE WITH PREY

1 and 2 A female golden eagle, trained for falconry, shown here killing a rabbit. Training an eagle is a formidable task. Owing to its extreme ferocity when deprived of its prey and to its slowness in turning in the air, the attempt is seldom made to train the eagle for falconry.

animal protein processing plants, fertilizer and livestock products companies and a field seed treatment plant.

EAGLE OWL (*Bubo bubo*), an owl inhabiting Europe and Asia, though only a straggler in most of Great Britain, and characterized by its large size and the two tufts of feathers on the head. It is allied to the great horned owl (*B. virginianus*) of North America, but is larger. On the northwest coast of the United States the latter is represented by the dusky horned owl (*B. v. sativatus*), a very dark-colored race. The Arctic horned owl (*B. v. swainsoni*) is lighter colored. In Lower California there is a small, light coloured race, the dwarf horned owl (*B. v. elachistus*). Other races occur in eastern Canada (*B. v. heterocnemus*) mountainous western Canada (*B. v. lagophonus*), coast of Alaska (*B. v. alpinus*), northern Great Plains to northeastern California (*B. v. occidentalis*), U.S. coastal mountains (*B. v. pacificus*), desert southwest (*B. v. pallidus*) and southward.

EAGLE PASS, a city of southwestern Texas, U.S., on the Rio Grande opposite Pedras Negras, Mex., a port of entry and the county seat of Maverick county. It is served by the Southern Pacific railway. Pop (1950) 7,247. Stock, feed, cotton and vegetables (notably spinach, tomatoes and onions) are raised in the surrounding country, and coal and gas are mined near by. The city was settled about 1846 and incorporated in 1906.

EAGRE see BOAR.

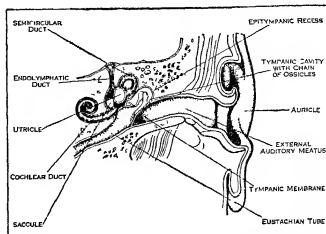
EAKINS, THOMAS (1844–1916), U.S. portrait and figure painter, was born at Philadelphia, Pa., on July 25, 1844. A pupil of J. L. Gerome, in the Ecole des Beaux Arts, Paris, and also of Leon Bonnat, besides working in the studio of the sculptor Augustus Dumont, he became a prolific portrait painter. He returned to Philadelphia in 1870, opened his own studio and began the study of anatomy. In 1873 he became professor of anatomy at the schools of the Pennsylvania Academy of the Fine Arts in Philadelphia, where he remained for a number of years. Eakins also painted genre pictures, sending to the Centennial exhibition at Philadelphia, in 1876, the "Chess Players," now in the Metropolitan Museum of Art, New York. A large canvas, "The Surgical Clinic of Professor Gross," owned by Jefferson Medical college, Philadelphia, contains life sized figures and portrays the demonstration of a surgical operation to a group of medical students. Eakins, with his pupil, Samuel Murray (1870–1941), modelled the heroic "Prophets" for the Witherspoon building, Philadelphia, and his work in painting has a sculptural quality. Eakins experimented in many directions, depicting on canvas modern athletic sports, the Negro and early American life, but he is best known by his portraits. He died in Philadelphia, June 25, 1916.

EALING, a municipal and parliamentary borough of Middlesex, Eng., suburban to London, 9 mi. W. of St. Paul's cathedral, on the highroad to Uxbridge, served by the Western Region railway and the London Passenger Transport board. Pop (est. 1938) 161,000. Area 13.98 sq. mi.

The borough was considerably enlarged in 1926 by the addition of the urban districts of Hanwell and Greenford, and further additions in 1928 made it one of the largest noncounty boroughs. The parish church of St. Mary (rebuilt c. 1870) contains many interesting tombs. The church of All Saints (1905) commemorates Spencer Perceval, prime minister, who was assassinated in the house of commons in 1812 and who lived in Ealing. It was erected under the will of his daughter Frederica, a resident of Ealing. The tower of Holy Cross, Greenford, has a timber structure of the 12th century. Ealing has 979 ac. of parks, recreation grounds and open spaces under its control, including the ancient common (47 ac.), Walpole park (30 ac.), Pitsanger park (26 ac.) and others. Gunnersbury park (186 ac.), with two large mansions, was purchased in 1925 from the Rothschild family by the Ealing and Acton borough councils, with whom it is also shared by the borough of Brentford and Chiswick. Among former owners of the property was Princess Amelia, daughter of George II, who lived there from 1761 till her death in 1786. The name of Gunnersbury is said to be traceable to the residence there of Gunilda, niece of King Canute. The manor of Ealing early belonged to the see of London. Ealing, which was incorporated in 1901, has a technical institute and art school.

It turns one member to parliament.

EAR, ANATOMY OF The human ear is divided into three parts—external, middle and internal. The external ear consists of the auricle and the external auditory meatus (fig. 1). The auricle is formed by a yellow fibrocartilage covered by skin. Round the margin in its upper three quarters is a rim called helix in which is often seen a little prominence known as Darwin's



FROM CURRIE'S HANDBOOK OF ANATOMY. PERMITS FOR THE OXFORD MEDICAL PUBLICATIONS.

FIG. 1.—DIAGRAMMATIC VIEW OF THE ORGAN OF HEARING SHOWING THE RELATIONS OF THE EXTERNAL, THE MIDDLE AND THE INTERNAL EAR.

tubercle, representing the folded over apex of a prick-eared ancestor. Concentric with the helix (and nearer) the meatus is the anthelix which, above, divides into two limbs. Surrounded by the anthelix is a deep fossa known as the concha, from whose anterior part the external meatus passes inward into the skull. Overlapping the meatus from in front is a flap called the tragus, and below and behind it another smaller flap, the antitragus. The lower part of the auricle is the lobule, which contains no cartilage. The auricle can be slightly moved by the anterior, superior and posterior auricular muscles. The external auditory meatus is a tube about an inch long, its outer third being cartilaginous and its inner two thirds bony. It is lined in its whole length by skin, the sweat glands of which are modified to secrete the wax or cerumen. Internally it is closed by the tympanic membrane or drumskin.

The middle ear, or tympanum (fig. 1), is a small cavity in the temporal bone. The Eustachian tube runs thence forward, inward and downward, to open into the nasopharynx, and so admits air into the tympanum. From the upper part of the posterior wall of the tympanum, an opening leads backward into the mastoid antrum and so into the air cells of the mastoid process. Lower down is a little pyramid which contains the stapedial muscle, and at the base of this is a small opening for the chorda tympani to come through from the facial nerve. The roof is formed by a very thin plate of bone, which separates the cavity from the middle fossa of the skull. Below the roof the upper part of the tympanum is somewhat constricted off from the rest, and to this part the term "attic" is often applied. The floor is a mere groove formed by the meeting of the external and internal walls. The outer wall is largely occupied by the tympanic membrane (fig. 2), which entirely separates the middle ear from the external auditory meatus. It is circular, and so placed that it slopes from above, downward and inward, and from behind, forward and inward. Externally it is lined by skin, internally by mucous membrane, while between the two is a firm fibrous tissue, convex inward about its centre to form the umbo, or navel.

The inner wall of the tympanic cavity shows a promontory caused by the cochlea and grooved by the tympanic plexus of nerves, above and behind it is the oval window, while below and behind, the round window is seen, closed by a membrane. Curving round, above and behind the promontory and windows is a ridge caused by the Fallopian aqueduct, or canal, for the facial nerve. The whole tympanum is about half an inch from before backward

and half an inch high, and is spanned from side to side by three small bones, of which the hammer is external. The hammer is attached by its handle to the navel of the tympanic membrane, while its head lies in the attic and articulates posteriorly with the upper part of the next bone or anvil. The long process of the anvil runs downward and ends in the lentiform nodule of Sylvius, joined on to the stapes, or stirrup bone. The two branches of the stirrup are anterior and posterior, while its footplate fits into the oval window bound to it by the annular ligament. It will thus be seen that the stirrup lies nearly at right angles to the long process of the anvil. Bony process of the hammer and anvil articulating respectively with the anterior and posterior walls of the tympanum form a fulcrum by which the lever action of the hammer and anvil is brought about, so that when the handle of the hammer is pushed in by the membrane the head moves out, the top of the anvil, attached to it, also moves out, and the knotted nodule moves in, and so the stirrup is pressed into the oval window. Two minute muscles—stapedius and tensor tympani—modify the movements of the ossicles.

The mucous membrane lining the tympanum is continuous through the Eustachian tube with that of the nasopharynx, and is reflected on to the ossicles, muscles and chords tympani nervi. It is callosified except where it covers the tympanic membrane, ossicles and promontory, here it is stratified.

The internal ear, or labyrinth, consists of a bony and a membranous part, the latter of which is contained in the former. The bony labyrinth is composed of the vestibule, the semicircular canals and the cochlea. The vestibule lies just internal to the posterior part of the tympanum, and there would be a communication between the two, through the oval window, were it not that the footplate of the stirrup blocks the way. The inner wall of the vestibule is separated from the bottom of the internal auditory meatus by a plate of bone pierced by many minute passages for branches of the auditory nerve, while at the lower part is the opening of the vestibular aqueduct, by means of which a communication is established with the posterior cranial fossa. Posteriorly the three semicircular canals open into the vestibule, of these the external has two independent openings, but the superior and posterior join together at one end, while at their other ends they open separately. One end of each canal is dilated to form its ampulla. The superior semicircular canal is vertical, and the two pillars of its arch are nearly external and internal, the external canal is horizontal, its two pillars hang anterior and posterior, while the convexity of the arch of the posterior canal is backward and its two pillars are superior and inferior. Anteriorly the vestibule leads into the cochlea (figs 1, 2) which is twisted two and one half times round a central pillar called the modiolus, the whole cochlea forming a rounded cone something like the shell of a snail though it is only about five millimeters from base to apex. Projecting from the modiolus is a horizontal plate, the shell-like osseous, or bony, spiral lamina, which runs round it from base to apex, it stretches nearly halfway across the canal of the cochlea and carries branches of the auditory nerve.

The membranous labyrinth lies in the bony labyrinth, but does not fill it, between the two the fluid called perilymph, while inside the membranous labyrinth is the endolymph. In the bony vestibule

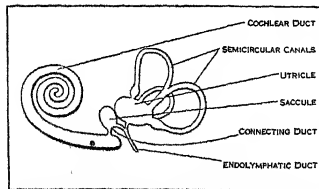


FIG 2—DIAGRAM OF THE DIFFERENT PARTS OF THE MEMBRANOUS LABYRINTH

lie two membranous vesicles, one of which, the saccule (fig 2), is in front, and the other, the utricle, behind each has a special patch of sensory epithelium called maculae to which twigs of the auditory nerve are supplied, terminating among specialized sensory hair cells.

Attached to the maculae are crystals of carbonate of lime called otoconia. The membranous semicircular canals are very much smaller in section than the bony, in the ampulla of each is a ridge, called acoustic crista made up of modified epithelium containing sensory hair cells resembling those in the maculae. All the canals open into the utricle from the lower part of the saccule runs a small canal called the endolymphatic duct. Anteriorly the saccule communicates with the membranous cochlea, or scala media, by a short connecting

duct. A section obtained through each turn of the cochlea shows the bony spiral lamina, already mentioned, which is continued right across the canal by the basilar membrane (fig 3), thereby cutting the canal into an upper and lower half, and connected with the outer wall by the strong spiral ligament. Near the free end of the spiral lamina the membrane of Reissner is attached, and runs outward and upward to the outer wall, taking a triangular slice out of the upper half. There are now three canals seen in section, the upper is the scala vestibuli, the middle, or scala media, is the cochlear duct or true membranous cochlea, and the lower, the scala tympani. The scala vestibuli and scala tympani communicate at the apex of the cochlea, so that the perilymph can here pass from one canal to the other. At the base of the cochlea the perilymph in the scala vestibuli is continuous with that in the vestibule, but that in the scala tympani bathes the inner surface of the membrane stretched across the round window, and

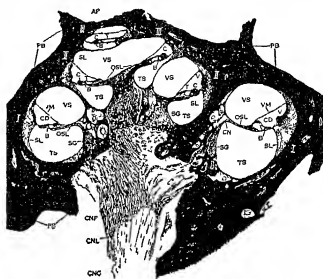


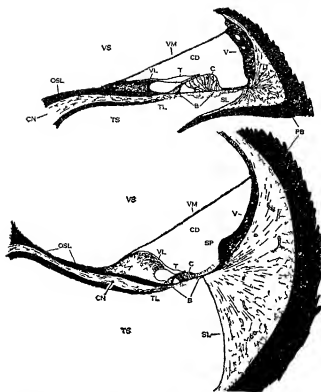
FIG 3—SECTIONAL VIEW OF THE COCHLEA OR SNAIL OF AN ADULT RHEUS MACAQUE IN A PLANE PARALLEL TO AND NOT FAR FROM THE AXIS OF THE MODIOLUS. ABBREVIATIONS: AP APEX OR TIP OF COCHLEA, B BASILAR MEMBRANE, C CORTI'S ORGAN OR BASILAR PAPILLA, CP COCHLEAR DUCT OR COCHLEAR NERVE, CNL CENTRAL PORTION OF COCHLEAR NERVE, CNL LINE DIVIDING CENTRAL FROM PERIPHERAL PORTION OF COCHLEAR NERVE, CNP PERIPHERAL PORTION OF COCHLEAR NERVE, OSL OSSEOUS SPIRAL LAMINA, PB PETROUS BONE, SG SPIRAL GANGLION, SL SPIRAL LIGAMENT, T TECTORIAL MEMBRANE, TS TYMPANIC SCALE, V VASCULAR STRIA, VS VESTIBULAR MEMBRANE, VS TRIBULAR SCALE, I I, II II, III III, BASAL, MIDDLE AND APICAL COIL, LOW MAGNIFICATION.

also communicates with the subarachnoid space through the cochlear aqueduct, which opens into the posterior cranial fossa. The scala media containing endolymph communicates with the saccule through the connecting canal of Hensen, while, at the apex of the cochlea, it ends blindly.

The scala media contains the essential organ of hearing or organ of Corti (figs 4, 5), which lies upon the vestibular side of the basilar membrane, it consists of a tunnel bounded on each side of the inner and outer rods of Corti on each side of these are the inner and outer hair cells, between the latter of which are found the supporting cells of Deiters. Most externally are the large cells of Hensen. A delicate membrane called the reticular lamina covers the top of all these, and is pierced by the hairs of the hair cells, while above this is the loose tectorial membrane attached to the petrous part of the spiral lamina, near its tip, internally, and possibly to some of Deiters' cells externally. The fibres of the cochlear or auditory nerve enter the spiral lamina from the spiral ganglion (fig 3) and are distributed to the inner and outer hair cells (figs 4, 5).

Function of the Ear—Originally the function of the ear was to preserve the proper position of the body in space, or balance. This is still the principal, and in most species of the low vertebrates such as fishes the only, function. The maintenance of the body balance through the appropriate reflex reactions of the bodily muscles and those of the eyes is, then, the function of the vestibular apparatus, in particular of the utricle and the semicircular ducts. Part of the labyrinth, the saccule, apparently responds to the sound vibrations, as in certain fishes. In the terrestrial vertebrates the auditory function becomes firmly established and increases in importance, culminating in the birds and mammals. The vestibule, in its own right, undergoes a further parallel development and perfection necessitated by the varied and more specialized use of the limbs in land animals.

The function of the auditory system in the proper sense is to react to the sound vibrations. Ordinarily the bulk of the sound



FROM DR. STEPHEN L. POLYAK, THE NERVEN EAR IN ANATOMICAL TRANSPARENCIES (SOUND TONE CORPORATION, T. H. MCKENNA, INC., AUGUST 21, 1944)

FIG. 4.—SECTIONAL VIEW OF THE COCHLEAR DUCT OF AN ADULT RHESUS MACAQUE SHOWING REGIONAL VARIATION OF STRUCTURES IN THE APICAL COIL (UPPER FIGURE) AND IN THE BASAL COIL (LOWER FIGURE). AB, BASILAR MEMBRANE; B, BASILAR MEMBRANE; C, CORTI'S ORGAN; CD, COCHLEAR DUCT; CN, COCHLEAR NERVE; OSL, OSSEOUS SPIRAL LAMINA; PB, PETROUS BONE; SL, SPIRAL LIGAMENT; SP, SPIRAL PROMINENCE; T, TECTORIAL MEMBRANE; TL, TYMPANIC LIP OF OSSEOUS SPIRAL LAMINA; TS, TYMPANIC SCALA; V, VASCULAR STRIA; VL, VESTIBULAR LIP OF OSSEOUS SPIRAL LAMINA; VH, VESTIBULAR MEMBRANE; VS, VESTIBULAR SCALA. MEDIUM MAGNIFICATION.

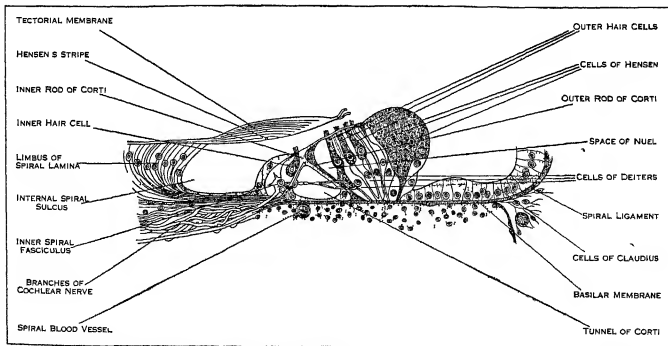
vibrations is caught by the external mobile flaps called "auricles," or "pinnae," and less so by applying directly to the skull and the body. From the auricle the vibrations enter the external auditory meatus,

passing over to the tympanic, or eardrum, membrane and finally to the chain of auditory ossicles. These latter act as an elastic bridge along which the sound is transmitted to the stirrup's footplate, classically fitted into the oval window. The other opening, the round window, is in turn closed off by an elastic "secondary tympanic membrane." The perilymphatic fluid filling the rigid bony labyrinth because of its incompressibility, has only one exit, the round window, by which it may give way whenever the footplate of the stirrup is pushed in, or is sucked in when the footplate is pulled out. The oscillatory movements thus caused pass through the two scale of the bony cochlea, taking a shortcut through one or the other segment of the basilar membrane, closer to the base in the sounds of high pitch and nearer the apex of the cochlea in low-pitched sounds. The remaining sound vibrations pass through the intermediate segments. (See BASILAR MEMBRANE.)

Embryology.—The auricle is formed from six tubercles which appear around the first pharyngeal groove, or gill cleft. Those for the tragus and anterior part of the helix belong to the first, or mandibular, arch, while those for the antitragus, antihelix and lobule come from the second, or hyoid, arch. The tubercle for the helix is dorsal to the end of the cleft where the two arches join. The external auditory meatus, tympanum and Eustachian tube are remnants of the hyomandibular cleft, the tympanic membrane being a remnant of the cleft membrane and therefore lined by ectoderm outside and endoderm inside. The auditory ossicles are modified bones of the visceral skeleton of lower vertebrates (e.g., fishes, etc.). The internal ear first appears as a pit from the cephalic ectoderm, the mouth of which in mammals closes up, to leave a pear-shaped cavity. The lower part of the vesicle grows forward and becomes the cochlea, while from the upper part three hollow circular plates grow out, the central parts of which disappear, leaving the margin as the semicircular canals. Subsequently, constrictions appear in the vesicle marking off the sacculus and utricle. From the surrounding mesoderm the petrous bone is formed by a process of chondrification and ossification.

Comparative Anatomy.—The ectodermal invagination of the internal ear has probably a common origin with the organs of the lateral line of fishes. In the lower forms the endolymphatic duct retains its communication with the exterior on the dorsum of the head, and in some elasmobranchs the opening is wide enough to allow the passage of particles of sand into the sacculus. In certain teleostean fishes the swim bladder forms a secondary communication with the internal ear by means of special ossicles. Among the Cyclostomata the external semicircular canals are wanting, *Petromyzon* has the superior and posterior only, while in *Myxine* these two appear to be fused. In higher types the three canals are constant. Concretions of carbonate of lime are present in the internal ears of almost all vertebrates, when these are very small they are called otoliths, but when, as in most of the teleostean fishes, they form huge concretions, they are spoken of as otoliths. One shark, *Squalus*, has sand instead of otoliths. The utricle, sacculus, semicircular canals, endolymphatic duct and a short lagena are the only parts of the ear present in fishes.

The Amphibia (q.v.) have an important sensory area at the base of the lagena, it is probably the first rudiment of a true cochlea. The



FROM CURNINGHAM, TEXT BOOK OF ANATOMY, PERMISSION THE OXFORD MEDICAL PUBLICATIONS

FIG. 5.—TRANSVERSE SECTION THROUGH BASILAR PAPILLA OR CORTI'S ORGAN FROM THE CENTRAL COIL OF COCHLEA

endolymphatic duct has lost its communication with the skin, but it is frequently prolonged into the skull and along the spinal canal, from which it protrudes, through the intervertebral foramina, bulging into the column. This is the case in the common frog. In this class the tympanum and Eustachian tube are not developed, the tympanic membrane has flush with the skin of the side of the head, and the sound waves are transmitted from it to the internal ear by a single bony rod—the columella.

In the Reptilia the internal ear passes through a great range of development. In the Chelonians and Ophidians the cochlea is rudimentary as in the Amphibia, but in the higher forms (Crocodilia) there is a lengthened and slightly twisted cochlea, at the end of which the lagena forms a minute terminal appendage. At the same time indications of the scialae tympani and vestibuli appear. As in the Amphibia the endolymphatic duct sometimes extends into the cranial cavity and on to other parts of the body. Snakes have no tympanic membrane. In the birds the cochlea resembles that of the crocodiles, but the posterior semicircular canal is above the superior where they join. In certain birds and birds (owls) a small fold of skin represents an external ear. In monotremes the internal ear is reptilian, but above them the mammal is always have a spirally twisted cochlea, the number of turns vary from one and a half in the Cetacea to nearly five in the rodent *Colelogenes*. The lagena is reduced to a mere vestige. The organ of Corti is peculiar to mammals and the single columella of the middle ear is replaced by the three ossicles already described. In some mammals, especially Carnivora, the middle ear is enlarged to form the tympanic bulla, but the mastoid cells are peculiar to man.

(S. L. PR.)

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EAR, NOSE AND THROAT, DISEASES OF THE

Though diseases of these parts are considered separately, the parts themselves are closely connected by the Eustachian tube.

Diseases of the Ear.—The ear consists of three parts, each with its own particular diseases: the outer ear, the middle ear and the internal ear.

The outer ear projects from the side of the head and includes the ear canal. Because of its exposed position, frostbite of the outer ear is common in freezing weather: the edge of the ear turns white and becomes insensitive to touch. The frozen part should be thawed out gradually in a cool room, and with cold water compresses applied to the ear until the colour returns, to prevent permanent damage to the tissues.

Accumulation of wax in the ear canal producing a painless impairment in hearing. This is a rather common cause for

moderate degrees of deafness, and is relieved by removing the wax. This can be done by syringing with warm water, or the experienced ear physician (otologist) may use instruments in the ear canal.

Skin infections of the outer ear canal may be caused by various micro organisms or moulds which are carried in by water or from the air. These canal infections are especially common in the tropics. The ear feels full, with a malodorous discharge, and sometimes pain or itching. The treatment is to remove with great care all most accumulations from the depth of the ear canal, followed by the use of appropriate medication against the particular causative micro organism.

Balls of the ear canal, like boils elsewhere, are due to infection in a hair follicle by *Staphylococcus aureus*. In the ear canal a boil is exceedingly painful and tender with swelling that may block the canal and temporarily impair the hearing. Heat and the use of an antiseptic solution are the treatment.

Eczema of the ear canal produces a reddened scaly appearance around the opening, with severe itching and a slight watery discharge. In some cases eczema is due to an allergy to feathers or to a food, and disappears when the particular substance is avoided.

Tumours of the outer ear include osteomas, which are small bony growths that sometimes occur in the depth of the ear canal after years of swimming in cold water and carcinoma (cancer) of the skin of the ear. Skin cancer begins as a small ulcer covered by a scab, it fails to heal completely, and instead slowly increases in size. If removed early and completely, skin cancers are curable.

The middle ear is a small cavity encased in bone and filled with air. It connects with the upper part of the throat through the Eustachian tube. To keep the air pressure in the middle ear equalized with the air pressure outside, the Eustachian tube opens momentarily on swallowing or yawning. This becomes very important in rapid changes of altitude, for if the air pressure is not equalized severe pain in the ear with impaired hearing results.

The middle ear cavity is separated from the outer ear canal by the very thin transparent drum membrane, the purpose of which is to vibrate in response to sound that enters the outer ear. A chain of tiny middle ear bones attached to the drum membrane carries the sound vibrations across the middle ear cavity to the internal ear, which is filled with fluid. When the fluid in the internal ear vibrates, it stimulates the endings of the hearing nerve, which carries the message to the brain.

Perforation of the drum membrane can result from a sudden change in air pressure. It can also result from infection in the middle ear cavity (abscessed ear). A perforated drum membrane cannot vibrate normally and in impairment of hearing results. Some perforations heal by themselves, others can be caused to heal by treatment, while still others become permanent.

Infection of the middle ear, sometimes called abscessed ear, is the result of micro organisms, especially the *Streptococcus* reaching the middle ear cavity from the throat through the Eustachian tube. There is a severe earache with fever and impaired hearing. If the pus bursts through the drum membrane, the ear begins to drain and the pain becomes less. Infections of the middle ear are important because they may spread to near by important structures, including the brain cavity and brain, the internal ear, the mastoid bone, and the facial nerve that supplies the muscles of the face. Fortunately these middle ear infections, when acute, clear up quickly with the use of sulfa drugs, penicillin or other antibiotic drugs. Chronic infections of the middle ear cavity are a different problem, and many require surgery to remove the disease and prevent extension to the brain cavity or other near by structures. Chronic middle ear infections also cause a permanent impairment in hearing by preventing the transmission of sound across the middle ear cavity to the internal ear.

The internal ear, encased in bone and filled with fluid, is also known as the labyrinth since it consists of a complicated arrangement of cavities. Part of the labyrinth is to maintain equilibrium, and part is for hearing. Various disturbances in the labyrinth can therefore affect the balance as well as the hearing. When the fluid in the labyrinth is under increased pressure, there are attacks of dizziness, with impaired hearing, and head noises. If the dizzy attack is severe the victim falls down and is nauseated. This condition is called Ménière's disease, after Emile Antoine Ménière, who first described it.

Degeneration of the hearing nerve is a common cause of deafness. It may be the result of a severe infection with a high fever. It can result from large doses of certain drugs like quinine. It very often comes after exposure to loud noise, in certain industries ("boiler-makers' deafness") or in military personnel. Degeneration of the hearing nerve also occurs with advancing age. As a rule a degenerated hearing nerve cannot be helped by medical treatment.

Otosclerosis is a common cause of progressive deafness beginning in early adult life. The loss of hearing is due to a small growth of bone that blocks the passage of sound vibrations to the internal ear. In some cases of otosclerosis the hearing can be improved by an operation to construct a new opening for the passage of sound, called the fenestration operation.

Diseases of the Nose—The nasal cavity is lined by a mucous membrane which covers the air-filled cavities called the anuses. The common cold is an infection of the nasal mucous membrane caused by a virus, or in some cases certain micro-organisms. The inflamed mucous membrane is swollen, with obstruction to breathing, and there is an increased production of mucus from the membrane. When severe, the infection may result in an accumulation of mucus and pus in one of the anuses with pain, headache and increased discharge.

Allergy of the nasal mucous membrane is due to sensitization to a particular substance of a protein nature that is inhaled or is eaten. House dust, animal hair, feathers and the pollens of certain weeds and grasses ("hay fever") are common causes for nasal allergy.

Nasal polyps are soft, gelatinous, fleshy growths that develop from the mucous membrane in some cases of nasal allergy, and block the nasal cavity.

Nosebleed is a common condition following an injury or sometimes occurring spontaneously. Sitting upright with the head bent forward and both nostrils plugged with a ball of cotton and held firmly shut between the thumb and finger will stop most nose-bleeds.

Chronic infection of a sinus produces a drainage of thick mucus and pus, from the nose into the throat, sometimes with pain and headache. Some of the chronic sinus infections are the result of an allergic condition in the nose. Others are the result of an abscessed tooth that breaks into the sinus, or of severe head cold. Improved drainage, either by improving an allergic condition, or by irrigating the sinus, or by an operation, is the accepted treatment for chronic sinusitis.

Malignant tumours (cancer) of the nose or sinuses are not common. The first symptoms are a bloody discharge, with obstruction to breathing. The diagnosis is made by removing a small piece of the suspicious tissue and examining it under a microscope.

The treatment of cancer of the nose is to remove the tumour early and completely.

Diseases of the Throat—The throat is the passage that connects the nose and mouth with windpipe and lungs. To help protect the body against micro organisms that enter through the nose and mouth, the throat is supplied with masses of lymphoid tissue around the base of the tongue, and the roof and sides of the throat. The tonsils are large masses of lymphoid tissue, lying on either side of the entrance to the throat. Acute tonsillitis is due to infection, usually with streptococci, with severe soreness, swelling and fever. Quinsy sore throat is due to infection behind the tonsil, forming an abscess, with even greater soreness and pain and great difficulty in swallowing. Diphtheria of the tonsils and throat must always be suspected in a sore throat that lasts more than a few days, for if treated early with antitoxin, recovery is rapid, whereas untreated diphtheria is often fatal. Scarlet fever is a particularly severe form of tonsillitis with a skin rash.

Chronic tonsillitis with enlargement and redness, but usually without pain, may cause malnutrition especially in children, and arthritis, rheumatic fever and other conditions in other parts of the body. Tonsillectomy is the accepted treatment for chronic tonsillitis. Unless the tonsils are greatly enlarged or are diseased they serve a purpose and should not be removed.

The adenoids are an accumulation of lymphoid tissue in the roof of the throat above and behind the palate. Enlarged adenoids occur usually in childhood, with nasal obstruction and mouth breathing, and obstruction of the Eustachian tubes with impaired hearing. Enlarged adenoids are one of the commonest causes of deafness in school children. The treatment is removal of the adenoids, usually done at the same time as removal of the tonsils.

Malignant disease (cancer) of the throat is not very common. It begins as a chronic swelling, at first painless, and later painful, and is diagnosed by removing a small piece of the suspicious tissue and examining it under the microscope. X-ray or radium treatment is often effective in controlling cancer of the throat.

Hoarseness is the symptom of disease of the larynx (voice box), and if the hoarseness lasts for more than two weeks the larynx should always be examined for a possible beginning cancer. Cancer of the larynx is one of the more common forms of cancer, and if discovered early it can be cured permanently in a high percentage of cases by removal of the tumour. Other causes for hoarseness are tuberculosis of the larynx, a benign tumour on the vocal cord called a "singer's node" because it comes from overuse of the voice and acute laryngitis from a sore throat, or from smoking. In children especially hoarseness may be the first symptom of diphtheria of the larynx, known also as croup.

Early diagnosis and the use of antitoxin may save the life of a child with diphtheria of the larynx.

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EARL, a title and rank of nobility (corresponding to Lat. *comes*, Fr. *comte*), now the third in order of the British peerage, between marquis and viscount. Earl is the oldest title and rank of English nobles, and was the highest until 1337, when the Black Prince was created duke of Cornwall by Edward III.

The nature of a modern earldom is readily understood, since it is a rank and dignity of nobility which, while it confers no

official power or authority, is inalienable, indivisible, and descends in regular succession to all the heirs under the limitation in the grant until, on their failure, it becomes extinct.

The title is of Scandinavian origin, and first appears in England under Canute as *jarl*, which was Englished as *earl*. Like the *caldorman*, whose place he took, the *earl* was a great royal officer, who might be set over several counties, but who presided separately in the county court of each with the bishop of the diocese. Although there were counts in Normandy before the Norman Conquest, they differed in character from the English earls, and the earl's position appears to have been but slightly modified by the Conquest. He was still generally entitled to the "third penny" of the county, but his office tended, under Norman influence, to become an hereditary dignity and his sphere was restricted by the Conqueror to a single county. The right to the "third penny" is a question of some obscurity, but its possession seems to have been deemed the distinctive mark of an earl, while the girding with "the sword of the county" formed the essential feature in his creation or investiture, as it continued to do for centuries later. The fact that every earl was the earl of a particular county has been much obscured by the loose usage of early times, when the style adopted was sometimes that of the noble's surname (e.g., the Earls Ferrers), sometimes that of his chief seat (e.g., the Earls of Arundel), and sometimes that of the county. Palatine earldoms, or palatinates, were those which possessed *regalia*, i.e., special privileges delegated by the Crown. The two great examples, which dated from Norman times, were Chester and Durham, where the earl and the bishop respectively had their own courts and jurisdiction, and were almost petty sovereigns.

The earliest known charter creating an earl is that by which Stephen bestowed on Geoffrey de Mandeville, in or about 1140, the earldom of Essex as an hereditary dignity. Several other creations by Stephen and the empress Maud followed in quick succession. From at least the time of the Norman Conquest the earl had a double character, he was one of the "barons," or tenants in chief, in virtue of the fief he held of the Crown, as well as an earl in virtue of his "belting" (with the sword) and his "third penny" of the county. His fief would descend to the heirs of his body, and the earliest charters creating earldoms were granted with the same "limitation." The dignity might thus descend to a woman, and, in that case, like the territorial fief, it would be held by her husband, who might be summoned to parliament in right of it. The earldom of Warwick thus passed through several families till it was finally obtained, in 1449, by the Kingmaker, who had married the heiress of the former earls. But in the case of "co heiresses" (more daughters than one), the king determined which, if any, should inherit the dignity.

The 14th century saw some changes introduced. The earldom of March, created in 1328, was the first that was not named from a county or its capital town. Under Edward III also an idea appears to have arisen that earldoms were connected with the tenure of lands, and in 1337 several fresh ones were created and large grants of lands made for their support. The first earldom granted with limitation to the male heirs of the grantee's body was that of Nottingham in 1383. Another innovation was the grant of the first earldom for life only in 1377. The girding with the sword was the only observance at a creation till the first year of Edward VI, when the imposition of the cap of dignity and a circlet of gold was added. Under James I the patent of creation was declared to be sufficient without any ceremony. An earl's robe of estate has three bars of ermine, but possibly it had originally four.

Something should be said of anomalous earldoms with Norman or Scottish styles. The Norman styles originated either under the Norman kings or at the time of the conquest of Normandy by the house of Lancaster. To the former period belonged that of Aumale, which successive fresh creations, under the Latinized form of "Albemarle" have perpetuated to the present day (see *ALBEMARLE*, WILLIAM DE FOSS). The so-called earls of Eu and of Mortain, in that period, were really holders of Norman *comtés*. Henry V and his son created five or six, it is said, but really seven at least, Norman countships or earls.

doms, of which Harcourt (1418), Perche (1419), Dreux (1427) and Mortain (1430) were bestowed on English nobles, Eu (1419) and Tankerville (1419) on English commoners and Longueville (1419) on a foreigner, Gaston de Foix. Of these the earldom of Eu was assumed by the earls of Essex till the death of Robert, the parliament's general (1646), while the title of Tankerville still survives under a modern creation (1714). An anomalous royal licence of 1661 permitted the earl of Bath to use the title of earl of Corbeil by alleged hereditary right. Of Scottish earldoms recognized in the English parliament the most remarkable case is that of the Lords Umfraville, who were summoned for three generations (1297-1380) as earls of Angus, Henry, Lord Beaumont, also was summoned as earl of Buchan from 1334 to 1339.

The earldom of Chester is granted to the princes of Wales on their creation, and the Scottish earldom of Carrick is held by the eldest son of the sovereign under act of parliament.

The premier earldom is that of Arundel (*qv*), but as this is at present united with the dukedom of Norfolk, the oldest earldom not merged in a higher title is that of Shrewsbury (1412), the next in seniority being Derby (1485) and Huntingdon (1529). These three have been known as "the catkin earls," a term of uncertain origin. The ancient earldom of Wiltshire (1397) was unsuccessfully claimed in 1869 by Scrope of Danby, and that of Norfolk (1312) in 1906 by Lord Mowbray and Stourton.

The premier earldom of Scotland as recognized by the Union Roll (1707) is that of Crawford, held by the Lindsays since its creation in 1398, but it is not one of the ancient seven earldoms. The Decret of Ranking (1606) appears to have recognized the earldom of Sutherland as the most ancient in virtue of a charter of 1347, but the house of lords decision of 1771 recognized it as having descended from at least the year 1275, and it may be as old as 12-8. It is at present united with the dukedom of Sutherland. The original seven earldoms (of which it was one) represented seven provinces each of which was under a *norman*. This Celtic title was rendered *jarl* by the Norsemen and under Alexander I (c. 1115) began to be replaced by earl (*comes*), as a result of Anglo-Norman influence, which also tended to make these earldoms less official and more feudal.

In Ireland the duke of Leinster is, as earl of Kildare, premier earl as well as premier duke.

An earl is "Right Honourable," and is styled "My Lord." His eldest son bears his father's second title and, therefore, that second title being in most cases a viscountcy, he generally is styled "Viscount," where, as with Devon and Huntingdon, there is no second title, one may be assumed for convenience, under all circumstances, however, the eldest son of an earl takes precedence immediately after the viscounts. The younger sons of earls are "Honourable," but all the daughters are "Ladies." In formal documents and instruments, the sovereign, when addressing or making mention of any peer of the degree of an earl, usually designates him "trusty and well-beloved cousin"—a form of appellation first adopted by Henry IV, who either by descent or alliance was actually related to every earl and duke in the realm. The wife of an earl is a countess, she is "Right Honourable," and is styled "My Lady." For the earl's coronet see CROWN AND CROWNLET.

See Lord, *Reports on the Dignity of a Peer*, Pike, *Constitutional History of the House of Lords*, Selden, *Titles of Honour*, G. E. (Cokayne), *Complete Peerage*, J. H. Round, *Geoffrey de Mandeville* (1892).

EARLE, JOHN (c. 1601-1665), English divine, was born at York about 1601. He matriculated at Christ Church, Oxford, but migrated to Merton, where he obtained a fellowship. In 1631 he was proctor and also chaplain to Philip, earl of Pembroke, then chancellor of the university, who presented him to the rectory of Bishopston in Wiltshire, and in 1641 he was appointed chaplain and tutor to Prince Charles. Early in 1643 he was chosen chancellor of the cathedral of Salisbury, but was soon deprived as a "malignant," and in the same year was elected one of the assembly of divines at Westminster but declined to sit. After Cromwell's victory at Worcester, Earle went abroad, and

was named clerk of the closet and chaplain to Charles II, being appointed dean of Westminster at the Restoration and in 1661 one of the commissioners for revising the liturgy. In Nov. 1662 he was consecrated bishop of Worcester, and was translated ten months later, to the see of Salisbury, where he conciliated the Non-conformists.

Earle was on friendly terms with Richard Baxter and was strongly opposed to the Conventicle and Five Mile acts. During the Great Plague Earle attended the king and queen at Oxford, and there he died on Nov. 17, 1665.

Earle wrote the witty work entitled *Microcosmographie, or a Pease of the World Discovered, in Essayes and Characters* (1628-33), which ran through ten editions in the author's lifetime. He was employed by Charles II to make the Latin translation of the *Eikon Basilike*, published in 1649, a similar translation of Hooker's *Ecclesiastical Polity* was accidentally destroyed.

See Philip Buss's edition of the *Microcosmographie* (1811 and 1868).

EARL MARSHAL, in England, ranks as the eighth of the great officers of state, is the head of the college of arms and up points the kings of arms, heralds and pursuivants. He attends the sovereign in opening and closing the session of parliament, walking at his or her right hand. He arranges state processions and ceremonials, especially coronations, royal marriages and funerals, and with the lord great chamberlain he assists in introducing newly created peers in the house of lords.

He exercised joint and co-ordinate jurisdiction with the constable in the court of chivalry, and afterward became the sole judge of that tribunal till its obsolescence in 1737. The marshalship of England was formerly believed to have been inherited from the Clares by the Marshal family, who had only been marshals of the household. It was held, however, by the latter family as early as the days of Henry I, and passed to the Bigods. In 1306 it fell by inheritance to Edward I, and in 1316 was granted by Edward II to his own younger brother, Thomas "of Brotherton," earl of Norfolk. As yet the style of the office was only "marshal." The office, having reverted to the crown, was granted out anew by Richard II in 1385 to Thomas Mowbray, earl of Nottingham, the representative of Thomas "of Brotherton." In 1386 the style of "earl marshal" was formally granted to him in addition. After several alterations and partial restorations in the reigns of the Tudors and the Stuarts, the earl marshalship was granted anew to the Howards by Charles II in 1672 and entailed on their male line, under which settlement it has regularly descended to the present duke of Norfolk. Its holders, however, could not execute the office until the Roman Catholic emancipation, and were forced to appoint deputies. His grace appends the letters "E.M." to his signature, and bears behind his shield two batons crossed in saltire, the marshal's rod (*varga*) having been the badge of the office from Norman times. There appear to have been hereditary marshals of Ireland, but their history is not well ascertained. The Keiths were great marshals of Scotland from at least the days of Robert Bruce, and were created earls marshal in or about 1458, but lost both eridom and office by the attainer of George, the 10th earl, in 1716. (See also MARSHAL.)

See "The Marshalship of England," in J. H. Round, *Commune of London and Other Studies* (1899), G. E. (Cokayne), *Complete Peerage* (J. H. R.).

EARLON, RICHARD (1742-1822), English mezzotint engraver, was born and died in London. In 1765 he was employed by Alderman Boydell, then one of the most liberal promoters of the fine arts, to make a series of drawings from the pictures at Houghton Hall, and these he afterward engraved in mezzotint. His most perfect works as engraver are perhaps the fruit and flower pieces after the Dutch artists Van Os and Van Huysum. Earlon executed a series of 200 facsimiles of the drawings and sketches of Claude Lorraine, which was published in three volumes under the title of *Liber variatus* (1777-1819).

EARLSTON (formerly ERLINGTON, of which it is a corruption), civil parish, Berwickshire, Scot. Pop. (1951) 1,761. The village is on Leader Water in Lauderdale, 7½ mi. SE of Edinburgh by rail, and about 4 mi. NE of Melrose. Originally it was

called Arctoldun or "Prospect Fort," an ancient earthwork on Black Hill. In the 12th and 13th centuries the Lindsays and the earls of March and Dunbar were the chief baronial families. The ivy clad ruin of the ancient tower, "The Rhymer's Castle," is the traditional residence of Thomas Learmont, commonly called Thomas of Erildoune, or Thomas the Rhymer, poet and prophet, and friend of the Fairies, who was born here about 1225. The Edinburgh Border Counties Association acquired this relic and surrounding lands in 1895. The leading manufactures are ginghams and tweeds, and the town is also an agricultural centre, stock and corn sales taking place at regular intervals and cattle and horse fairs being held every year. Some 3 mi away is Bemersyde, which has been in the possession of the Haigs since probably the 12th century, and which was presented to Field Marshal Earl Haig by the nation in 1921. The prospect from Bemersyde Hill was Sir Walter Scott's favourite view. The castle at Bemersyde was erected in 1535 to secure the peace of the Border.

EARLY, JUBAL ANDERSON (1816-1894), American soldier and lawyer, was born in Franklin county (Va.), on Nov. 3, 1816, and graduated at West Point in 1837. He served in the Seminole War of 1837-38, after which he resigned in order to practise law in Franklin county, Virginia. He also engaged in State politics, and served in the Mexican War as a major of Virginia volunteers. He was strongly opposed to secession, but thought it his duty to conform to the action of his State. As a colonel in the Confederate army, he rendered conspicuous service at the first battle of Bull Run (*qv*). Promoted brigadier general and later major-general, Early served throughout the Virginia campaigns of 1862-63, and defended the lines of Fredericksburg during the battle of Chancellorsville. At Gettysburg he commanded a division of Ewell's corps. In the campaign of 1864 Early, who had now reached the rank of lieutenant general, commanded the Confederate forces in the Shenandoah valley. After several successful actions in the Shenandoah and Potomac valleys (on July 11 he threatened the city of Washington), Gen. Sheridan arrived with Union reinforcements, forced Early to retreat, and defeated him at Winchester and Fisher's Hill. Finally, on Oct. 19, after inflicting at first a severe blow upon the Federal army in its camp at Cedar creek, he was decisively beaten by Sheridan. (See SHENANDOAH VALLEY CAMPAIGNS.) Waynesboro (March 1865) was his last fight, after which he was relieved of his command.

Gen. Early was regarded by many as one of the ablest soldiers in the Confederate army.

After the declaration of peace he went to Canada, but in 1867 returned to resume the practice of law. For a time he managed the Louisiana lottery in conjunction with Gen. Beauregard. He died at Lynchburg (Va.), on March 2, 1894. Gen. Early was for a time president of the Southern Historical Society, and wrote, besides various essays and historical papers, *A Memoir of the Last Year of the War, etc.* (1867).

See *Lieutenant General Jubal Anderson Early, an Autobiographical Sketch and Narrative of the War Between the States* (1912).

EARLY CLOSING MOVEMENT. The Early Closing Association came into existence in Great Britain following a meeting of drapers' assistants held at the Commercial Tavern, Holborn, on Oct. 1842. A resolution was then passed "that the present hours of business are longer than either the convenience or the necessities of the public require and that a judicious curtailment thereof may be effected, without injury to any of the principals concerned, which would be productive of the most beneficial results." In the period after 1842 great progress was made, including (1) the establishment of the Saturday half-holiday culminating in the Shops act, 1912, legalizing a weekly half-holiday for every shop assistant, (2) the Shops (Seal) act (1899), which stipulated for one seat to every three female assistants in shops, (3) the Shops act (1920), which provided compulsory closing of shops at eight o'clock weekday nights and nine o'clock Saturdays, in addition to the weekly half-holiday, and (4) improved shop conditions.

The Saturday half-holiday became a British national institution, and was adopted by almost every other country in the world.

(A. LK.)

United States.—Laws limiting working hours of mercantile employees had been passed in most states prior to World War II, but actual openings and closings were determined by employers. Traditionally, Saturday became the chief shopping day of the week, with most stores remaining open later on that day, particularly in firm communities. After 1942, however, the changed buying habits of the public, resulting from increased income and population shifts into war industry areas, caused merchants to experiment radically with store hours.

The department stores in some of the large cities eliminated the late Saturday closing and substituted instead certain weekdays.

Chain grocery stores and butcher shops in many of the bigger cities also eliminated the late Saturday closing. In the food trade the early closing policy was initiated by the meat cutters' trade union in San Francisco before 1920, and thereafter was generally adopted in other western cities. Labour's desire for improved working conditions became an increasingly important factor during the seven years previous to 1940 which saw the passage of the National Industrial Recovery act, the Wagner act and the Fair Labor Standards act.

Early closing hours for department stores were first demanded by the Working Women's society in 1891. This group enlisted the support of women consumers to secure better conditions for store employees by constructive legislation.

After its inception in 1891, the Consumers' League of New York helped bring about a shortened week for women employees, improved working conditions in retail stores, the closing of stores in the evening, half holidays on Saturday, and advocated early Christmas shopping.

(R. GR.)

EARLY ENGLISH PERIOD, in architecture, the first of the three divisions into which the English Gothic style is usually divided. Although originally the term was applied to English Gothic up to the beginning of the 14th century (as by Rickman and R. P. Spers), it is now more customarily limited to the first half of the 13th century. In the last quarter of the 12th century, partly through the influence of the Cistercian order and partly through that of the French design of the early Gothic parts of Canterbury cathedral (choir, c. 1175-78), pointed arches and other Gothic ideas became more and more common, so that by the end of the century the transitional period was over and the architecture of England completely Gothic. It is this earliest developed Gothic which is known as Early English. The chief characteristics of the style are: frequent use of high, slim openings, capped with steeply pointed arches, known as lancets, often grouped in threes, hves (the "five sisters" in the transept of York cathedral) or even in sevens, simple four part church vaulting (see VAULT), often with a ridge rib in addition to groin, cross and wall ribs, arch mouldings, consisting of complex combinations of convex projections with deep, rounded hollows, nave and chapter house piers of a central core of stone surrounded by a number of black Purbeck marble shafts, tied together by occasional moulded bands, capitals, almost always consisting of a circular abacus with rich mouldings below, or sometimes with conventionalized foliage with many rounded lobes, frequent use of ball flower (*qv*) and dog-tooth (*qv*) ornament. Toward the end of the period the use of tracery became general, lavishness of ornament increased, as in the diaper patterns in the arch spandrels of Westminster Abbey, and naturalism in the carving grew. Outstanding examples of the style are Salisbury cathedral, begun 1220, the nave and transept of Wells cathedral, end of the 12th century to 1242, parts of York cathedral transepts, 1230-60. (See GOTHIC ARCHITECTURE.)

(T. F. H.)

EARN, a loch and river, Perthshire, Scotland. The loch is $\frac{1}{2}$ m long east to west and $\frac{1}{4}$ m in maximum breadth. It discharges by the river Earn. On its shores are Lochearnhead (at the southern extremity of Glen Ogle), which has a station on the railway from Perth to Balquhadder, and the ruins of St. Blane's chapel, Ednam Castle, an old turreted mansion belonging to the marquess of Breadalbane, situated in well-wooded grounds near the pretty falls of the Ample, Ardvorlich House, the original of Dar

lin-arach in Scott's *Legend of Montrose*, and the village of St Fillans at the foot of the loch. The river, a notable fishing stream, flows out of Loch Earn eastwards with a gentle inclination to wards the south, and reaches the Firth of Tay, 64 m below Perth. The principal places of interest on the banks of the Earn are Duntra House, the village of Comrie, the town of Crieff, the ruined castle of Innerpefray, founded in 1610 by the 1st Lord Maderty, close to which is the library founded in 1691 by the 3rd Lord Maderty, containing some rare black letter books and the Bible that belonged to the marquess of Montrose, Gascon Hall, now in ruins, but with traditions reaching back to the days of Wallace, Dupplin Castle, a fine mansion in Tudor style, Forgan denny, and Bridge of Earn, a health resort situated amidst picturesque surroundings. Stratharn, as the valley of the Earn is called, extending from the loch to the Firth of Tay, is a beautiful and, on the whole, fertile tract, though liable at times to heavy floods. The earl of Perth is hereditary steward of Stratharn.

EARNEST, the payment of a sum of money by the buyer of goods to the seller on the conclusion of a bargain as a pledge for its due performance. It is almost similar to the *arraha* of the Roman law. Apart from its survival as a custom, its chief importance in English law is its recognition by the Statute of Frauds as giving validity to contracts for the sale of goods of a value exceeding £10 (*See SALE OF GOODS*). It is in that statute clearly distinguished from part payment, consequently any sum, however small, would be sufficient as earnest, being given as a token that the contract is binding and should be expressly stated so by the giver (*See DEPOSIT*).

EAR-RING, an ornament worn pendent from the ear, and generally suspended (especially among the more civilized races) by means of a ring or hook passing through the pendulous lobe of the ear. Among savage races the impulse to decorate, or at any rate to modify the appearance of the ear, is almost universal. The Berawan people of Borneo use plugs through the lobe of the ear $\frac{3}{4}$ in in diameter. More extraordinary still is an example of a stone ear plug worn by a Masai, $\frac{1}{2}$ in in diameter and weighing 2 lb 14 ounces. Among the superior races, though ear ornaments of extravagant size and elaboration are not unknown, moderation in size is commonly observed, and greater attention is paid to workmanship and fineness of material.

The general usage appears to have been to have ear rings worn in pairs, the two ornaments in all respects resembling each other, in ancient times, or more recently among Oriental races, a single ear-ring has sometimes been worn. The use of this kind of ornament, which constantly was of great value, dates from the remotest historical antiquity, the earliest mention of ear-rings occurring in the book of Genesis. It appears probable that the earrings of Jacob's family, which he buried with his strange idols at Bethel, were regarded as amulets or talismans, such unquestionably being the estimation in which some ornaments of this class have been held from a very early period as they still are held in the East. Thus in New Zealand ear-rings are decorated with the teeth of enemies, and with talismanic sharks' teeth. Among all the Oriental races of whom we have any accurate knowledge, the Hebrews and Egyptians excepted ear-rings always have been in general use by both sexes, as in the West, as well as by the Hebrews and Egyptians, as a general rule they have been considered exclusively female ornaments. By the Greeks and Romans also ear-rings were worn only by women, and the wearing of them by a man is often spoken of as distinctly oriental.

In archaic art ear-rings are frequently represented or their traces are left in the perforated ear lobes of early statues. After

the 4th century such perforations occur seldom. In one instance, a Greek inscription records the weight of the detachable gold ornaments on a statue, among which a pair of ear-rings is included. Ear-rings of characteristic form are frequently discovered by excavation. In Egypt, a system of pendent chains is found hanging from a disc. In Assyria the decoration consists of pendants or knobs attached to a rigid ring. In the Mycenaean period, ear-rings are infrequent in Greece, but have been found in abundance in the Mycenaean finds of Enkomi (Cyprus) in the form of pendent bulls' heads, or of decorative forms based on the bull's head. In the tombs of the Greek settlers in the Crimea (4th century a.c.), ear-rings are found of marvellous complexity and beauty. The lexicographer Pollux, speaking of the names given to ear-rings, derived from their forms, mentions caryatids, hippo camps and centauresses. Jewels of the same class, of exquisite beauty and of workmanship that is truly wonderful, have been rescued from the sepulchres of ancient Etruria. Ear-rings of comparatively simple forms, but set with pearls and other stones, were the mode in Rome. Researches among the burial places of Anglo-Saxon Britain have led to the discovery of jewels in considerable numbers, which among their varieties include ear-rings.

These ornaments, which have never fallen into disuse, showed a considerable decline in Europe and America during the 19th century, but have been revived again in the 20th century to the extent that they are not uncommonly worn on the street or with evening dress. The more recent ones do not pierce the ear and are considerably smaller (*See also JEWELLERY*).

EAR-SHELL *see* ABALONE

EARTH In the present article we shall treat the subject matter of the earth as a planet under the following headings—(1) size, mass, density and form, (2) movements, (3) constitution, (4) age of the earth, and (5) earth's thermal history.

SIZE, MASS, DENSITY AND FORM

To primitive man the earth was a flat disk with its surface diversified by mountains, rivers and seas. The spherical form was asserted by Pythagoras, and Aristotle used arguments in its favour similar to those used to day, viz., the ship gradually dis-



A BANTU NEGRO

Among certain African tribes ear-rings are worn not so much for ornament as for putting the ear into a fashionable size and shape.

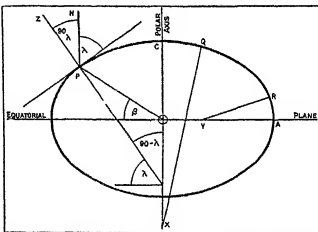


FIG 1.—DIAGRAMMATIC SECTION OF EARTH THROUGH POLAR AXIS TO ILLUSTRATE LATITUDE

The latitude of a point P is the angle λ between PN parallel to the polar axis and a horizontal plane through P. The zenith distance of the pole is the angle $\text{NPZ} = 90^\circ - \lambda$. QX and RY are normals to the polar axis and the difference between CQ and RA represents the difference in length of a degree of latitude near the pole and near the equator.

appearing, hull first, masts later, as it recedes beyond the horizon, the circular shadow cast on the moon during an eclipse, and the alteration in the appearance of the heavens as one passes from place to place on the surface. With regard to the last point, we may notice that if the earth were flat any star above it would be visible from every point of it. This is not true: many of the stars visible in England are never visible in South Africa or Australia, and conversely. On the other hand, an observer on the surface of a spherical earth would see every star that is above the tangent plane to the sphere at the point where he is. The direct-

tion of this plane varies with his position, and therefore the stars visible also depend on his position. The mean altitude (angular elevation above the horizon) of the Pole star is equal to the latitude of the place, for observers in the northern hemisphere.

The spherical form did not, however, become generally believed until after explorers had actually sailed around the earth, though this argument is not intrinsically so conclusive as any of the three first given. The distance a traveller has to proceed northwards to make the mean altitude of the Pole star increase by 1° is a "degree of latitude." Eratosthenes, in 250 B.C., was the first to measure this, by determining the difference of latitude between Alexandria and Syene, but there is some doubt about his measurement of the distance between these places. Jean Picard, in 1671, obtained the first useful estimate. From the length of the degree of latitude the size of the earth can be calculated.

Actually, the length of the degree of latitude is found to vary slightly with latitude. This is because the earth is not exactly a sphere, a better approximation to its shape being an oblate spheroid (the surface swept out by an ellipse rotated about its shortest diameter). Such a surface is flatter near the pole than near the equator, and the degree of latitude is therefore longer in high latitudes than in low ones. Thus observation of the length of the degree in both high and low latitudes determines both the size of the earth and its polar flattening. The best determination yet made is that of J. F. Hayford, from observations in the United States, published in 1910. He gives

$$\begin{aligned} a &= \text{equatorial semi axis} = 6,378.388 \text{ km} \\ b &= \text{polar semi axis} = 6,356.909 \text{ km} \\ \frac{a-b}{a} &= \text{ellipticity} = \frac{1}{297.0 \pm 0.5} \end{aligned}$$

The distance from pole to equator, measured along the surface, is very nearly 10,000 kilometres.

The mass of the earth is found by comparing its gravitational attraction on a small sphere at its surface with that of a large sphere of known mass on the same small sphere. The attractive force satisfies the law of gravitation, namely, that the force pro-

duced on a given small body is proportional to $\frac{m}{r^2}$, where m is the

mass of the attracting body and r the distance of its centre. If then the forces produced and the distances are known, we can find the ratio of the masses. Observations by C. V. Boys and P. R. Heyl give the mass to be $(5.976 \pm 0.005) \times 10^{21}$ metric tons (1 metric ton = 10^3 grams = 0.9842 British ton). This is the mass of a body with a volume equal to that of the earth, and with a density equal to 5.517 ± 0.004 times that of water. The mean density of the earth is therefore 5.517 gm per cc.

MOVEMENTS

The motion of the earth is known if we know three things which are independent or nearly so: first, the motion of its centre, second, its rotation about its centre, third, any variations of shape that may be taking place. These three types of motion may be described separately.

Movement of the Earth as a Whole.—The most important part of the movement of the centre is the revolution about the sun. The centre of mass of the earth and moon together describes in the course of a year an elliptic path, with the centre of the sun at one focus. The mean distance from the sun is 149,700,000 km, or 92,900,000 miles. The eccentricity of the orbit is 0.016751 (eccentricity = difference of greatest and least distances \div sum of greatest and least distances).

The centre of the sun, however, is not fixed, but shares in the general motion of the solar system relative to the stars. The latter is a steady motion of the centre of mass of the whole system with a velocity of about 20 km per sec relative to the stars in its neighbourhood toward a point in the constellation Hercules. It is found by statistical discussion of the apparent motions of stars. The sun's centre is close to the centre of mass of the solar system, but moves with regard to it on account of the attractive forces of the planets on the sun. The planets also

attract the earth and moon. These forces introduce very complicated minor disturbances called perturbations.

The centre of mass of the earth and moon is about 4,800 km from the centre of the earth, the latter mass is about the former in the course of a month on account of the attraction of the moon on the earth, and on this account the earth gets alternately in front of and behind its mean position. This monthly inequality provides a means of determining the moon's mass.

Rotation.—The rotation of the earth about its polar axis is nearly uniform, the period being the sidereal day, which is 23 hr 56 min 4.095 sec of solar time. The revolution about the sun and the rotation were both established by Copernicus in 1543. In his great work *De orbium coelestium revolutionibus* it was shown that the common astronomical phenomena, such as the rising and setting of stars and the sun, the difference between the lengths of the sidereal and solar days, and the seasons, could be explained most simply by regarding the earth as revolving annually about a fixed sun, while rotating about an axis in itself. Later, the explanation of the revolutions of the planets was the greatest triumph of Newton's law of gravitation.

The position of the axis, however, varies. The disturbances are known as precession, nutation and the variation of latitude. Precession (often called precession of the equinoxes) is a motion of the earth's axis in a cone whose axis is perpendicular to the plane of the earth's orbit, so that the celestial pole appears to move in a circle about the pole of the ecliptic. The time taken for the complete revolution is about 25,800 years. The phenomenon was discovered by Hipparchus (120 B.C.), and was first explained by Newton. The attraction of the sun and moon on the earth's equatorial protuberance tends to make it move so as to bring the equator into the plane of the orbit of the earth or the moon respectively. But the earth's rotation introduces a gyroscopic control, and the ultimate result is that each point of the earth's axis moves parallel to the plane of its orbit. The explanation is similar to that of the motion of the axis of a spinning top. Gravity tends to make the axis move downward, but the spin of the top converts the disturbance into a revolution of the axis about the vertical. One effect of precession is that the equinoxes move around the ecliptic so as to be always moving to meet the sun. The rate is $50''$ 26 per year, enough to displace the equinoxes by 30° in 2,150 years. The vernal equinox, the point where the sun crosses the equator on its way north, is known in astronomy as the "first point of Aries", but on account of precession it is now in Pisces. Also 4,000 years ago the star nearest the pole was α Draconis, but since the pole has moved it is now α Ursae Minoris, in 24,000 years it will be Vega.

The force tending to alter the tilt of the axis is not constant, when the sun or moon is crossing the equator, for instance, it has no effect. The path of the pole is therefore not described with uniform velocity, and is not quite a circle. The departures from the uniform circular motion are called "nutations." The largest of them, discovered by Bradley, is the lunar nutation, with a period of 18.6 years and an amplitude of $9''$ 2 in latitude. This arises because the plane of the moon's orbit revolves on the plane of the ecliptic in 18.6 years, so that the motion of the pole caused by the moon is not always about quite the same point of the sky. The variation of latitude consists of two small movements, one with a period of about 14 months, the other of a year. Both have amplitudes of about $0''$ 1. The existence of the former was predicted on dynamical grounds by Euler, it is a circular oscillation of the axis akin to the wobbling of a badly thrown quill. If the earth were quite rigid its period would be 306 days, actually it is 439 ± 6 days, the difference being due to the earth's elastic yielding. The annual movement is due to seasonal displacements of matter over the earth's surface. Both were discovered by Chandler in 1841, the qualitative explanation is due to Newcomb.

Deformations.—In addition to the above general movements, the earth is continually altering its shape. The movements involved in mountain formation and isostatic compensation are large but slow, taking millions of years for completion. The movement in a large earthquake may reach several metres close to the origin, it starts suddenly and is soon over, but elastic waves

are sent throughout the earth and produce small movements of the ground at great distances. The tidal forces of the sun and moon not only displace the water on the surface, but pull the solid earth itself somewhat out of shape: this deformation is associated with an indirect one due to the weight of the displaced oceanic waters. All of these movements require either long intervals or sensitive instruments to make them perceptible.

CONSTITUTION

There are several different sources of information available concerning the constitution of the earth. Starting with the geological evidence, we know that most of the land surface is covered with a layer of sedimentary rocks. The chief of these are sandstones and shales, produced mainly by the weathering of granite and related rocks and redeposition of the resulting sediments in shallow water. In addition, large areas within the continents are covered with ancient rocks akin to granite, and granite is also a common intrusive rock. For all these reasons geologists (following Suess) have come to believe in a widespread granitic layer under all the continents. Another very common intrusive rock is basalt, which exists in several different forms, such as dolerite, gabbro, eclogite and tachylyte. It is denser, in its commonest forms, than granite (1.3 against 2.7), and therefore has probably come from a greater depth. But the mean density of the earth is 5.5, nearly twice the density of basalt, and it has been shown that the high pressures in the interior of the earth are insufficient to compress basalt to such an extent. There must be much denser matter within the earth, and its density must be much greater than 5.5 to make up for the lighter stuff on the outside. This indicates an interior composed of heavy metals, especially iron, since this is the commonest heavy metal in the crust.

Upper Layers.—More detailed information is provided by seismology. As has just been mentioned, earthquakes send out elastic waves through the body of the earth, and the arrival of these at distant stations is recorded by instruments. Two types of bodily waves exist in a solid: first, a compressional wave like a sound wave, such that, as the wave passes, a particle vibrates in the direction of travel of the wave, and, second, a distortional wave, where the vibrating particle moves at right angles to the direction of travel of the wave. The two types are referred to for brevity, as *P* and *S*. The letters stand for "primary" and "secondary" because the compressional wave travels faster. The velocities depend on the elastic properties of the material (compressibility and rigidity, or resistance to change of shape) and on its density. When the substance is not uniform the energy of each wave behaves very much like that of light: that is, it travels in rays which are curved in such a way that the wave travels from one end of the ray to the other in a shorter time than it would take if it travelled by any slightly different path. As in the case of light, again, if there is a sharp boundary between two different materials, a wave reaching the boundary is partly transmitted and partly reflected. A complication arises, however, in elastic waves, in a solid, four waves arise at a boundary, a compressional one and a distortional one in each medium. The distortional wave is entirely characteristic of solids: it does not exist in a liquid.

It is actually found, when the times of arrival of the waves from a near earthquake at different distances are compared, that a pair of waves can be traced, travelling with velocities of 5.6 km per sec. and 3.3 km per sec., respectively. The former velocity agrees with that found by L. H. Adams and L. D. Williamson, of the Geophysical Laboratory at Washington, for the velocity of compressional waves in granite, possibly with some admixture of the glassy form obsidian. This wave is consequently denoted by *P*_g and the other, which appears to be the corresponding distortional wave, by *S*_g. They travel wholly in the granitic layer from the origin to the observing station, apart from their short passage upward through the sedimentary layer. These waves were first observed by A. Mohorovičić of Zagreb, Yugoslavia in 1909.

If, however, a basalt layer underlies the granitic one it would be expected that some part of the waves sent out would be transmitted into this layer, travel through it, and be refracted up again

when they return to the boundary. Now actually not one, but two other pairs of waves can be traced, they have been given specific symbols, and their average velocities are *P*_{ss}, 6.3 km per sec., *S*_{ss}, 3.7 km per sec., *P*_s (or simply *P*) 7.8 km per sec., *S*_s (or simply *S*), 4.3 km per sec. They have slightly different values in different regions. The curious fact is that none of these velocities fits that for compressional waves in crystalline basalt, as found in the laboratory, which is 6.9 km per second. The in-

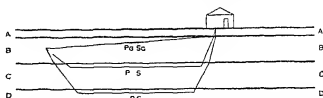


FIG. 2.—PATHS OF THE SIX PULSES OBSERVED IN NEAR EARTHQUAKES as sedimentary layer bb granitic layer cc intermediate layer dd dunite layer

ference is that there is no widespread layer of crystalline basalt. The velocity of *P* fits either tachylyte, which is basalt in a vitreous, or glassy, condition, or diorite, a crystalline rock intermediate in composition between granite and basalt. *P*_g has a very high velocity. One rock that transmits waves with so high a velocity is dunite, a vitreous rock at the surface, but consisting almost entirely of the mineral olivine (MgSiO₃ and FeSiO₃), which is common as a constituent of mixed rocks. Eclogite, which has a similar composition to basalt, but a density of 3.3, gives a similar velocity. There are thus two possible successions with increasing depth, both consistent with the seismological data, namely, granite tachylyte dunite and granite diorite eclogite dunite. The former was suggested by H. Jeffreys, the latter by Professor A. Holmes, and both views have arguments in their favour. The six waves all appear to travel with uniform velocity, so long as the distance does not exceed about 900 kilometres. But their times of arrival are related as if they had started at times differing by 19 seconds. If Δ is the distance of an observing station from the "epicentre" (the point of the surface vertically above the origin), *T* the time of arrival at the station, and *v* the velocity of travel of the wave, we have

$$T = T_0 + \frac{\Delta}{v}$$

where *T*₀ is the same for all stations for the same wave, so that the wave appears to have started at time *T*₀ and travelled out with velocity *v*. But every wave has its own *T*₀, on account of the delay of the indirect waves in travelling down to the intermediate and lower layers, whereas the waves *S*_g and *P*_g come practically directly, just as walking to the next village may be quicker than travelling by train if one does not live near the station. These apparent delays in starting provide means of estimating the thicknesses of the granitic and intermediate layers, which are together about 30 km, under average continental conditions.

Below the ocean the structure must be somewhat different. Granitic rocks appear not to exist there, and basalt may come right up to the ocean bottom. On the other hand Holmes has suggested that there may be a thin upper layer of syenite, a rock resembling granite except that it contains no quartz. Direct seismological evidence is lacking, except that *P*_{ss} and *S*_{ss} seem to have the same velocities as under the continents. The chief difference between continents and oceans is, then, that under the oceans the granitic layer is absent or very thin.

Deeper Portions.—At distances over 900 km the four waves *P*_g, *P*_{ss}, *S*_g, *S*_{ss} have all disappeared or at least become unrecognizable. But *P*_s and *S*_s still exist. Their observed times of transmission give a means of finding their velocities of propagation at great depths, which has been employed by E. Wiechert, B. Gutenberg, S. Mohorovičić and others. The velocities increase with depth, somewhat irregularly, to a depth of 0.45 of the radius, or 2,900 km, that of *P* varies within this range from 7.8 to 13.6 km per sec., the corresponding values for *S* are 4.35 km per sec. and

7.3 km per second. The increase is to be attributed mainly to an effect of the high pressure in increasing the stiffness of the material. The velocities increase rather sharply by about 10% at a depth of about 450 km.

P waves just reaching a depth of 2,900 km emerge at an angular distance of 103° from the epicentre, that is, the line joining the epicentre to the point of emergence subtends an angle of 103° at the centre of the earth. At greater distances *P* and *S* cannot be detected. *P* reappears at a distance of 143° , and can be traced from there to the antipodes, but *S* never reappears at all. This is what would be expected if the earth had a liquid central core, for the fundamental property of a liquid is its inability to transmit distortional waves. But other alternatives are just possible, and we cannot decide that the central core is liquid without discussing other evidence.

P waves travel more slowly in the central core than just outside it, their mean velocity being about 9 km per second. These waves were first identified by R. D. Oldham in 1906, and further work on them has been done by Gutenberg and H. H. Turner. They emerge at minimum deviation at an angular distance of about 143° , and consequently have large amplitudes there. Between 105° and 143° only very small waves are recognizable, but there appears to be reflexion from a further discontinuity deep in the core. In addition, *P* and *S* waves incident on the central core are partly reflected and partly transmitted into the core as *P* waves. The reflected ones give the most accurate estimate of the radius of the core, which is 3473 ± 3 km. The transmitted wave derived from *S* is again broken up when it returns to the boundary, giving three parts, denoted briefly by *SAS*, *SKP* and *SKKS*. The first two re-enter the outer shell when the wave has passed through the core, the three letters in each symbol indicate the type of the wave in the three parts of its path, waves in the core being denoted by *K*. The third wave is reflected on the inside of the core, and emerges after describing another path in the core as *P* and being transmitted into the shell as *S*. The existence of all these waves was predicted by Gutenberg, who calculated their theoretical times of transmission from the known velocities of *P* and *S* at various depths, and they have all been found by observation at the predicted times by Gutenberg himself and other workers, especially Prof. H. H. Turner. The waves reflected at the inside and outside of the core are interesting because reflexion would not occur if the transition was gradual, they point to a sharp boundary between two quite different materials.

Deep Foci—It was inferred by Turner and confirmed by R. Stoney and F. J. Searse that some earthquakes occur at great depths, some are as deep as 600 km. They are important partly because they show that material so deep is still in such a state that it can undergo fracture, partly because certain additional reflexions in them give further information about the thicknesses of the upper layers.

Density at Various Depths—We have already seen that the high mean density of the earth also points to a difference of density between the interior and the exterior, comparable with that between metallic iron and ordinary rocks. There is reason to believe that the earth was once fluid, and in this state iron and silicates would not mix, thus a metallic core, sharply separated from a rocky shell, would be expected to exist. A correspondingly sharp change in properties with depth has been inferred, on entirely different evidence, from seismology. Seismology also indicates that there is no other large and sudden change. Hence we naturally infer that the two sudden transitions are identical, and that the thick outer shell, down to a depth of 2,900 km, is composed of a silicate rock resembling olivine in composition, while the central core below that depth is made of metallic iron, probably in the liquid state. The change of velocity about 450 km down is found by K. E. Bullen to be associated with a rise of density of 0.5, which J. D. Bernal interprets as due to a change of crystal form of olivine under high pressure.

The theory of the figure of the earth leads to another datum, involving the earth's "moments of inertia." The moment of inertia of a body about a line is obtained by multiplying the mass of every particle of the body by the square of its distance from the

line, and adding up for all the particles. The moment of inertia of the earth about the polar axis is denoted by *C*, and that about any diameter in the plane of the equator is denoted by *A*. *C* is greater than *A* because the earth is spheroidal, particles, on an average, are farther from the polar axis than from one in the equatorial plane. Now the rate of precession contains as a factor the ratio $\frac{C-A}{C}$, which is therefore sometimes called the

"precessional constant" or the "dynamical ellipticity." This rate being observed, and every other factor in the formula for it being known, we can therefore find the precessional constant,

which is $\frac{1}{305.6}$. But $C-A$ can also be found absolutely, because it is the only unknown in the formula for the variation of gravity over the surface of the earth and certain perturbations of the moon. Hence *C* can be found by simple division. It is conveniently expressed by the equation

$$\frac{C}{Ma^2} = 0.334$$

where *M* is the earth's mass and *a* its equatorial radius. If the earth was a uniform sphere this ratio would have been 0.400, the difference gives new evidence that the earth is much denser near the centre.

Every layer in the earth is compressed by the weight of the matter above it, but the compressibility can be inferred from the velocities of seismic waves. Bullen finds that the density must increase from about 3.3 to 3.7 between 30 and 450 km of depth, rising there to 4.2 and reaching 5.5 at the core boundary. In the core it increases from 9.9 to at least 12.5.

The density of dunite is near the mean density of the moon, for which the effect of compression is small.

The Bodily Tide—The density and the velocities of propagation of the *P* and *S* waves at any depth being by this time fairly accurately known, the elastic constants (the incompressibility and the rigidity) of the matter can be found. Hence it becomes,

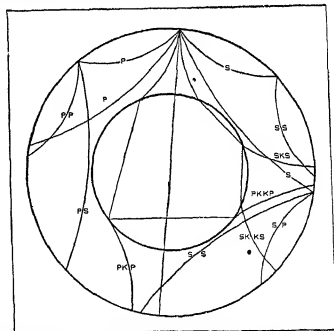


FIG. 3.—PATHS OF PRINCIPAL PULSES OBSERVED IN DISTANT EARTHQUAKES. THOSE STARTING AS *P* ARE SHOWN ON THE LEFT. THOSE STARTING AS *S* ON THE RIGHT.

theoretically, possible to calculate how the earth as a whole would yield under known forces. The 14-monthly variation of latitude and the tides both provide data capable of being compared with theory. If the earth were perfectly rigid, the period of the variation of latitude would be 306 days, if it were a fluid, the variation of latitude would not exist. If, again, the earth were fluid, the interior would yield so much to tidal forces that the ocean could

yield no more, and there would be no visible tides. The actual tides are about 0.7 as high as they would be on a rigid earth. The two sources of information are closely related, but do actually give distinct checks on any theory. Lord Kelvin showed that the tidal yielding of the solid earth was no more than that of a globe of steel of the same size. We know now, however, that the dunite at a depth of 30-40 km is about two thirds as stiff as steel, and the matter 2,900 km down is fully twice as stiff as steel. If the central core were equally stiff, it can be shown that the earth as a whole would yield less than tides and the variation of latitude show it does. It has not yet been definitely shown that a liquid central core would give complete agreement, but it would certainly fit the facts much better than any reasonable hypothesis consistent with the solidity of the core.

Summary—The structure of the earth, along a radius emerging at a typical point within a continent, would be as follows—

| | Thickness (km) | Density |
|--|----------------|---------------------------|
| Sedimentary layer | 0.5 (?) | 2-2.7 |
| Granitic layer | 18 ± 3 | 2.7 |
| Tachylite or diorite layer | 15 ± 4 | 2.9-3.0 |
| Dunite shell (possibly with eclogite near the top) | 2,900 | 3.3 (top) 5.5 (bottom) |
| Liquid iron core | 3,500 | 9.9-12 |

In oceanic regions the granitic layer may be absent, the sedimentary thin and formed of deep sea deposits, and the tachylite one replaced by matter of similar composition, but crystalline. The thicker shell and the central core are much the same below sea as below land.

THE AGE OF THE EARTH

On almost any theory of the origin of the earth it was originally fluid, probably gaseous. (See COSMOGONY.) The primitive earth would likely partly through loss of heat by radiation from the outside and partly by adiabatic expansion. The latter leads to the formation of liquid drops as in a liquid air machine, and the drops would gradually collect towards the centre. The formation of a liquid earth, probably with an atmosphere of some of its more volatile constituents, would be a matter of centuries. Further cooling would lead to solidification, the time needed for this would be longer on account of the reduced temperature and distension, but in a few thousand years at most the earth would have a thick solid shell on the outside. The further time taken for the outer surface to cool down, until its temperature was maintained almost wholly by the sun's radiation, would be only a few years. The temperature would then be near the present temperature, since the sun was in nearly its present state. The moon must be almost as old as the earth. Thus the intervals that have elapsed since the earth separated from the sun, since the moon was formed, or since the earth's outer surface became approximately as cool as it is now, do not differ by more than a few thousand years.

Denudation—As soon as the outer surface became cool, an ocean could form—though possibly only a small one at first—and rain and rivers, denudation and sedimentary rocks came into existence. Several methods are available for estimating the age of the earth, but they are not all of equal accuracy or reliability. The simplest, apparently, is that based on denudation. If we know the total mass of sedimentary rocks over the earth's surface, and the annual amount of sediments carried to the sea by rivers, a simple division gives an estimate of how long this process has been going on. The transport of sediments to the sea, together with the present total amount of salt in the sea, gives another estimate. Both methods suggest ages of about 300,000,000 years. But it is important to notice that many factors can vitiate both. In particular, purely geological evidence makes it clear that the present rate of denudation is considerably in excess of the average of the past, owing to the existence of many high and comparatively new mountain ranges and the large amount of easily denuded matter left by the last glacial period. These methods can, therefore, at most suggest an order of magnitude.

Kelvin's Arguments—Two methods were given by Lord

Kelvin, one based on the rate of supply of energy from the sun, and the other on the cooling of the earth's crust by conduction. In the former he supposed, following Helmholtz, that the sun's energy was maintained by contraction, and found that the whole energy liberated by the sun, in contracting from an infinite distension to its present size, would maintain radiation, at the present rate, for only about 20,000,000 years. In the latter he considered the cooling of the earth from the state just after solidification, and found how the rate of increase of temperature with depth in the crust depended on the time the earth has been cooling. This increase of temperature with depth is known by observation. The method, with modern data, gives about 27,000,000 years for the age of the earth.

There is now an overwhelming amount of evidence that the earth and the sun are both very much older than Kelvin's results would indicate. Yet the value of his attempts has not disappeared. Numerous astronomical sources of information have shown that the sun has been radiating as vigorously as now for thousands of millions of years, and not merely for tens of millions, and we must infer that stars can draw on some source of energy much more provident than contraction under gravity. This is probably the transformation of hydrogen into helium. A mechanism for this has been investigated by H. A. Bethe.

Radioactivity—The argument from the earth's thermal state was shown to require modification by the discovery of radioactivity. It was found that all surface rocks contained minute quantities of radioactive elements, and they were enough to indicate the probability that a large fraction of the heat being conducted out of the earth is of radioactive origin and does not arise from the original heat. But if so the original heat accounts for a smaller rate of increase of temperature with depth than was previously thought, in other words, cooling has proceeded to a greater depth and the time taken has been longer than Kelvin's theory indicates. Nevertheless, his theory is not done with. The earth is not so old that original heat has ceased to be important, and Kelvin's work shows how to estimate its importance. Its geophysical interest will not disappear till after the hot central core freezes.

Radioactivity not only showed the need of supplementing the old theory, but provided a new means of determining geological time, and this method is the best that is known. Radioactivity consists in the breaking up of elements with high atomic weights, in all known cases the disruption takes place by the loss of an α -particle, which is a charged helium atom, or by the loss of a β -particle, which is a free electron. In each case a certain amount of radiative energy is also liberated. The atomic weight of uranium is 238, that of helium is 4. Thus when an α -particle is lost the atomic weight decreases by 4, when a β -particle is lost it decreases by an insignificant amount. The products of the decay of uranium have therefore atomic weights of 234, 230, 226, 222, 218, 214, 210 and 206, but several may have nearly the same atomic weight owing to loss of β -particles. The most interesting of the products, for our purpose, are those with atomic weights 226 and 206, namely, radium and lead. Radium breaks up at a known rate, in a given sample of radium 1 part in 2,280 breaks up every year. But in spite of its short life, radium is present in all uranium minerals, in a constant proportion corresponding to 36 atoms of radium per hundred million of uranium. The explanation is that uranium itself breaks up at such a rate as to replenish the radium as fast as this in its turn breaks up. For this to be possible one atom of uranium in 6,400,000,000 must break up every year.

The final product is a kind of lead, that is to say, no chemical test will distinguish it from ordinary lead, but its atomic weight is 206 instead of 207.2. Lead is always found in uranium minerals, and when it was isolated it was actually found to have atomic weight 206. The different kinds of lead were the first examples discovered of *isotopes*, elements identical in chemical behaviour but differing in atomic weight, but numerous others are known through the work of Aston.

Now, this lead is being produced from uranium at a known rate: for every 6,400,000,000 atoms of uranium 1 atom of lead is

produced every year, or, if we allow for the difference in atomic weights, 7,400,000 parts by weight of uranium produce 1 part by weight of lead every year. Hence if a mineral contained no lead to begin with, and now contains x parts of lead to 1 of uranium, the age of the mineral is 7,400 million years. Petrologists can recognize when original lead must have been absent, and the method is therefore applicable to the determination of the ages of minerals, and hence to the absolute measurement of geological time. The element thorium behaves somewhat similarly to uranium, its final product being a lead of atomic weight 208. When uranium and lead are both present in a mineral the age can be calculated by the approximate formula of Holmes and Lawson —

$$\text{Age} = \frac{\text{Pb}}{\text{U} + 0.38\text{Th}} \times 7,400,000,000 \text{ years}$$

Holmes and Lawson give also a slightly more accurate formula, allowing for the variation of the amounts of uranium and thorium with time. The oldest known minerals to which this method is applicable have been found to have ages of about 1,800,000,000 years. The coal measures were laid down about 250,000,000 years ago. The former estimate is therefore a minimum estimate of the age of the earth.

The radioactive elements can be applied in another way, due to H. N. Russell, to find an upper limit to the age of the earth. The above method is based on the analysis of minerals specially rich in uranium and thorium. But these elements are present in all rocks, and the method could be applied to the earth's crust as a whole. A caution necessary is that some of the lead may have always been lead and not have been produced by radioactivity during the geological time. Consequently the method gives an upper limit. The amounts of the relevant elements, in parts by weight, shown by averages of analyses of rocks, are U, 6 parts per million, Th, 15 parts per million, Pb, 7.5 parts per million. The quantity of lead is too small to be consistent with the existence of the earth for more than about 3,000,000,000 years, according to Holmes's latest revision. Thus radioactivity leads to the conclusion that the age of the earth is between 1,800,000,000 and 3,000,000,000 years.

Evidence from Cosmogony *The Orbit of Mercury*—Two arguments from cosmogony also give evidence concerning the age of the earth. The first is based on the fact that planets formed by ejection from the sun would move originally in very elongated orbits, which must have been altered to their present circular form by some later influence. The only cause known that could produce such an effect is the resistance of the gaseous medium surrounding the sun, formed of the parts of the primitive filament that failed to condense into planets. The medium would meanwhile degenerate gradually on account of viscosity and diffusion. The time such a medium would take to reduce the eccentricity of the orbit of Mercury to its present value is inversely proportional to its density, the time it would take to become destroyed by viscosity and diffusion is directly proportional to its density. These times must be somewhere near equal, because, if the medium was not dense enough to begin with, it would have disappeared before it had produced its actual effect, while if it was too dense a large amount of it would still remain and would be visible. From a comparison of the two intervals of time it is found that the age must be of the order of magnitude of 3,000,000,000 years. Great accuracy is not possible.

Tidal Friction—An alternative method depends on the history of the earth and moon. The rotation of the earth is not absolutely uniform, the day is becoming longer by about one second in 120,000 years. The change affects the observed times of ancient eclipses to a measurable extent, and it is from these that the amount is determined. The explanation depends on the tides produced by the sun and moon. The tidal currents in shallow seas are resisted by friction over the bottom, and this leads to a certain amount of dissipation of energy and to a reaction on the tides in mid ocean, giving a systematic disturbance of the times of high water. If no friction took place the attraction of either the sun or the moon on the tides raised by itself would act exactly through

the centre of the earth, and would have no tendency to turn it, but the displacement of the times of high water causes the attraction to act along a line passing a little to one side of the centre, and consequently to alter the rotation of the earth. A reaction on the moon makes the moon go farther off, and explains how the moon can have receded to its present distance from its probable original close proximity to the earth's surface. The rate of change of the earth's speed of rotation due to lunar tidal friction varies inversely as the sixth power of the moon's distance, and must therefore have been much greater in the past. An estimate of the time needed to bring the moon to its present distance, based on the supposition that the phase lag of the oceanic tides has always been as at present, indicates an age of the order of 4,000,000,000 years.

These two methods are much less accurate than those based on radioactivity. Their utility is that they both depend on theories that explain a large number of other facts, and that the agreement of their conclusions in order of magnitude with those drawn from radioactivity gives independent reason to believe that the latter are not vitiated by some fundamental error of principle.

The Expanding Universe—The reddening of the light of distant nebulae, if interpreted as a Doppler shift due to velocities away from the sun, implies that all the nebulae were fairly close together about 2,000,000,000 years ago. This suggests a similar age for the universe.

THE EARTH'S THERMAL HISTORY

The primitive earth was presumably very thoroughly stirred up. But the heavy metallic constituents refused to mix with the rocky ones and quickly settled to the centre to form the core. At some stage during the solidification the granitic and basaltic layers separated from the dunite one, and, by some process so far very imperfectly understood, the granitic matter became collected into large patches, which we know now as the continents. In a few thousand years the whole of the rocky shell would be solid.

The latter history is substantially modified by radioactivity. The amount of heat being conducted out of the earth per unit surface per unit time is the product of the thermal conductivity of the surface rocks, and the increase of temperature per unit depth. Both vary appreciably from place to place. On an average about 1.4×10^{-6} calories per sq cm is being conducted out of the crust in Britain, about 1.2×10^{-6} in South Africa. But the experimental work of the present Lord Rayleigh, J. Joly, J. H. J. Poole and others has shown that average granite in the same regions contains enough radioactive matter for 1 c.c. to produce 5×10^{13} calories per second. Hence about 2.8×10^6 cm, or 28 km, of average granite would supply all the heat leaking out at the surface. The actual thickness of the granitic layer, as we have seen, is about 18 km, but other rocks are also radioactive. We are forced to suppose that unless the radioactivity is practically confined to a surface layer with a thickness comparable with 20 km, the heat coming out of the earth would exceed its actual amount.

The temperature at any depth in the crust may be regarded as made up of two parts, one due to the original heat, the other to that developed by radioactivity since solidification. The age of the earth and the other relevant physical data being roughly known, the former part can be evaluated. Subtracting from the rate of conduction out of the earth the portion due to original heat, we are left with the part due to radioactivity. This is found to be equivalent to the rate of generation of heat by about 15 km of granite, or by 10 km of granite with 20 km of basalt under it, — an excellent agreement, so far as we can tell, with the results of seismology. If we adopt the latter view, the present temperature at the base of the intermediate layer should be about 560° C. At a depth of about 300 km the rocks should have cooled by about 280° since solidification, below 600 km the present temperature in the rocky shell is nearly the melting point. We can now easily see why the central core is liquid. The melting point of dunite at ordinary pressures is 1,400°–1,600°, that of pure iron is about 1,500°, but that of the material of the central core might be lower by some hundreds of degrees on account of im-

purities. In addition, the melting point of dunite is raised by pressure, that of iron is raised much less, if at all by pressure. Accordingly we must expect that the central core would be more fusible than the surrounding rock, and if the latter is near its melting point the iron must be liquid.

The foregoing discussion concerns mainly continental conditions. Radioactivity beneath the oceans must be less, and the cooling at great depths there may be up to 50% more. The upward concentration of radioactive matter requires an explanation. It is perfectly genuine for, without it, it would be impossible to reconcile the radioactivity of the surface rocks with the rate of increase of temperature inwards. Also it can be shown easily that if the radioactive layers were twice as deep or even if the total amount of radioactive matter were the same but were uniformly distributed to a depth of 100 km, the steady temperature at the base of the radioactive layer would be so high that the interior could never have become solid. A difficulty sometimes expressed about the concentration near the surface is that the elements concerned are heavy, and might have been expected to collect near the centre of the earth. But when the total amount of a substance is too small to affect the density of its solvent appreciably, the density is often of much less importance than solubility or volatility in determining the distribution.

Actually it is found that the radioactive generation of heat in basalt is under a third of what it is in granite, and in denser rocks such as dunite the amount is much lower again. This points directly to a strong upward concentration, especially in the dunites analysed are, of course, surface samples, and have probably been enriched by contact with the more radioactive rocks that surround them. Further, Holmes has called attention to the fact that in successive igneous outpourings, even of material of similar composition, the material from the higher levels seems to have been enriched in radioactive materials at the expense of that lower down. The evidence that these substances actually do tend to collect upward is very strong. The most probable explanation is that given by Goldschmidt, who gives reasons from crystallography why uranium and thorium cannot form part of silicate crystals but remain in solution to the last. In the earth the crystals would settle to the bottom and leave a radioactive layer on top. His argument was confirmed by Pigott, who found that the radioactive elements in rocks actually occur on cleavage planes and on interfaces between crystals, not in the interiors of crystals. Later denudation would tend to transfer the radioactive substances to the ocean bottom, as Joly pointed out.

The Effects of Cooling at Great Depths.—The fall of temperature since the solidification of the crust would be associated with a contraction in volume. But we have seen that, since the solid crust formed, the greatest rate of cooling is at an intermediate depth, which is at present somewhere about 200 km. The spherical shell of cooling matter becomes too small to fit the interior, but being plastic it stretches and becomes thinner. This makes its outer boundary move towards the centre, tending to leave the uncooled outermost regions unsupported. But they are not strong enough to support themselves, and collapse under their own weight. They have to accommodate themselves to too small a surface, and consequently crumple, fold and fracture. This is the thermal contraction theory of mountain formation. It is found that every great circle in the sphere would have to contract by about 400 km. The compression required to explain all known mountains is not accurately known but it appears to be of the same order of magnitude. The chief strength of the thermal contraction theory, however, is that it certainly accounts for a large fraction of the mountains of the globe, and as no other suggested theory has been proved so capable the presumption is that thermal contraction is the chief cause of mountain formation.

Further, the rocks beneath the oceans are more basic, and therefore are probably less radioactive and have cooled more than subcontinental rocks. Even at the same temperature basalt seems to be stronger than granite and when it is cooler it will be stronger still. Hence when an ocean floor is compressed against a continent, the latter will be the first to yield. This is the probable explanation of the Pacific type of mountains—the long series of

the Rockies and Andes with the smaller ranges running nearly parallel to them and to the neighbouring coast. The theory predicts a contraction composed of two parts, about equal in magnitude up to the present time. One increases nearly uniformly with the time, the other as the square root of the time. Only the latter part had been considered until 1932, and met with the difficulty that it would make the intervals between the great epochs of mountain formation much longer now than when the earth was young. This does not appear to have been the case, and formed the basis of a serious objection to the theory. The former part, however, is free from this objection and is probably responsible for most of the mountains formed since Cambrian times.

Mountain formation, on almost any mechanical theory, would be expected to be intermittent in time and localized in position. The upper rocks are elastic solids, which have to be under a considerable stress before they give way, and when they do so the yield is at a definite place and becomes complete almost instantaneously. If then the stress is one that grows very slowly and gradually, there will be long quiescent periods when the stresses are accumulating separated by short intervals when they are relieved by folding and fracture, with mountain formation as a result. This corresponds with the facts as known to geology.

The theory has, however, still to meet several difficulties in points of detail, while the phenomena of igneous activity, shown in volcanoes and intrusions, seem at present to stand right outside it. The temperatures that seem most probable within the intermediate layer are enough to make a hard glass ready to flow, but the intermediate layer actually is, nevertheless, basalt driven up to the surface seems to be much more completely fluid and to judge by its effects on neighbouring rocks, at a much higher temperature. A curious fact noticed by Aston provides what looks like a promising clue. The "inert gases" (helium, neon, argon, krypton and xenon) are far scarcer on the earth than one might expect from comparison with the abundance of other elements of neighbouring atomic weights in the crust: the ratio is in all cases somewhere about a millionth. A very natural explanation is that when the primitive earth was highly heated and probably distended its gravitation was insufficient to control the freely moving molecules of a gaseous atmosphere, consequently the truly gaseous constituents were mostly lost from the earth and transferred to the resisting medium. The present earth consists of the constituents, such as iron, that liquefied readily, and of the materials that formed liquid or solid compounds at the high temperature concerned. From this point of view it is interesting to note that the amount of oxygen in the earth's crust is within 1% of that needed to combine with all the other elements, and the rarity of the inert gases is to be attributed precisely to the fact that they are inert gases, and could not find even a temporary place of safety in the earth's interior. But if we adopt this explanation we must suppose that most of the water and carbon compounds on the earth's surface at present have been expelled from the interior since the earth shrank to its present size. There is ample independent evidence that chemically active gases and water vapour are continually being expelled from volcanoes, and T. A. Jaggar and A. L. Dy have given reason to believe that their reactions with one another and with the oxygen of the air are the principal factors in maintaining volcanic temperatures. A continuous fused layer is not available as an explanation of volcanoes. It would imply absence of ocean tides, and a perfection of isostasy that does not exist.

Continuous heating in the deeper crust would produce expansion and hence tension in the upper crust. This would lead to vertical cracks and violent igneous outpourings. On the views just given concerning the way radioactive materials become concentrated near the surface, the earth's crust must have had such a history in its earliest days, but denudation and other factors have obliterated all traces of it. On the moon, however, there has been no denudation, and an extensive system of fissures and craters is the moon's most prominent feature. Lunar vulcanism is then to be referred to the moon's earliest days and the upward movement of radioactive matter produced by it provides the reason why the internal heating ceased and there is no vulcanism on the

moon

Isostasy—It is clear from the geological evidence that the transport of large quantities of matter horizontally, so as to thicken or thin the crust locally by several kilometres, is a common feature of the earth's history. Now, all matter produces a gravitational field, and this redistribution would therefore be expected to produce disturbances of the direction and intensity of gravity. Numerical calculations of the amount of these disturbances can be made, but when they are compared with the actual local direction and intensity of gravity, as shown by the slope of the plumb line and the period of a standard pendulum, they are always found to be wrong. It would actually be nearer the truth to say that additional matter does not appear to attract the plumb line or the pendulum bob at all, and that matter removed appears not to have attracted them. The law of gravitation cannot be wrong, the only possibility is that there is really little excess or deficiency of mass in these places, addition or removal of matter on top being compensated by the outflow or inflow of an equal mass below. This result would follow physically if the earth's upper crust was an elastic solid, but so thin as to be readily flexible, and rested everywhere on a fluid interior.

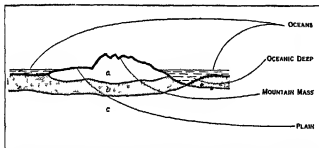
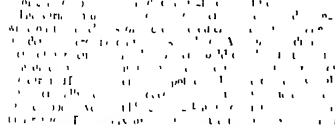


FIG 4—DIAGRAM ILLUSTRATING THEORY OF ISOSTASY ACCORDING TO WHICH EQUILIBRIUM IN THE EARTH'S CRUST IS MAINTAINED BY FLOW OF ROCK MATERIAL BENEATH THE SURFACE UNDER GRAVITATIVE STRESS
a, granitic layer, b, intermediate layer, c, lower layer

This theory was actually suggested as an explanation by Sir G. B. Airy when attention was called to the facts by Archdeacon J. H. Pratt. Extra mass on top would force the crust down, the fluid below would flow out, and the process would continue until just enough had flowed out to restore the balance, in the "isostatic" state every vertical column of the same section would have the same mass inside it. Pratt did not accept this explanation, and proposed as an alternative the idea of a "depth of compensation", according to him the extra mass of a mountain is compensated by a uniform reduction in density of all the matter below it, down to a fixed depth. This hypothesis requires that the matter should diminish in density when an extra pressure is placed on top of it, and therefore is physically implausible, and there are also weighty geological arguments against it. But most geodesists, especially J. F. Hayford and W. Bowie in the United States, have adopted Pratt's view and found it to correspond well with the facts. W. Heiskanen, however, showed that the Airy theory fits the facts at least as well, and H. Jeffreys showed that this result was inevitable from the nature of the law of gravitation. The chief modification needed in the Airy theory is that the substratum is not a fluid, but a very stiff solid, capable of transmitting distortional waves, but weaker than the outer crust. The weakness



the facts. It is nowhere exact, and in some regions is seriously wrong. Though it is true that the substratum is weaker than the outer crust, it is not devoid of strength. There are widespread

variations of gravity, which imply corresponding variations of load, too great to be supported by the strength of the outer crust alone. Their support requires considerable strength, about a third of that of surface rocks, to a depth of about 600 km which corresponds to the focal depth of the deepest earthquakes.

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EARTH, FIGURE OF THE see GEODESY

EARTH CURRENTS in the widest sense are any electric currents flowing in the earth. Technically, however, the term excludes all artificial currents due to grounding, leakage or inductive effects from power systems. It also excludes some natural currents which are purely local. Currents generated by chemical activity of certain ore bodies, or by temperature differences in the earth, and surges due to lightning discharges have this local character and are not included in a discussion of earth currents. The existence of earth currents, i.e., induced currents of wide extent and of origin quite distinct from any of those enumerated, was probably first suggested by Sir Humphry Davy, 1821. Michael Faraday, 1837, although unable to detect them with then-existing instruments, was convinced of their reality when he discovered the principle of electromagnetic induction. In 1847 W. H. Barlow obtained the first actual evidence of earth current flow from measurements on English telegraph lines, and detected a diurnal variation in it. About the same time C. V. Walker also obtained records from telegraph lines chiefly of the large currents flowing during disturbances or earth current storms. These and similar early investigations, although fragmentary in character, soon showed correlations between earth current disturbances, magnetic storms, aurorae and changes in solar activity as indicated by sunspot numbers. Thus the concept of earth currents as a world wide rather than a local phenomenon became established, and more formal investigation of them was undertaken.

Systematic continuous observations of earth currents were carried out at a number of European stations during the last third of the 19th century and several valuable series of records were obtained. Early among the important series were those at Greenwich, England, started in 1865, and continuing with some modifications until after 1890 at Berlin (1883-91) reported in detail by B. Weinstein and at Parc St. Maur, Paris, shortly afterward. The rapid expansion of electric railways toward the close of the century put a check on recording at many places. The large grounded currents from railways forced the abandonment of the programs at Greenwich and Paris and made such measurements impossible in any densely populated region. After a decade or so of neglect, the study of earth currents was undertaken once more at Ebro, Spain, in 1910. The Ebro records covering the years from 1910 to 1938 are the most extensive yet obtained and have been widely used for analyses. More recently installations for continuous recording on duplicate lines were made at Watheroo, Western Australia, in 1923, and at Huancaayo, Peru, in 1926. The use of duplicate lines made available independent records from lines of different lengths as a check on the operation of the measuring systems. Both of these stations, operated by the Carnegie Institution of Washington, were still recording in 1945. The Carnegie Institute in co-operation with the U.S. coast and geodetic survey and the Bell Telephone laboratories, also secured records on long telephone lines at Tucson, Arizona, from 1931-43. The Carnegie Institute, during the second international polar year 1932-33 secured 18 months of record at College Fairbanks, Alaska, and the Canadian Meteorological service co-operated in obtain

ing a year's record at Chesterfield Inlet, Northwest Territories, Canada. At the same time other high-latitude records were secured at Sodankylä, Finland and Tromsø, Norway. Other earth current investigations covering varying periods of time have been carried out in the United States by the Bell Telephone laboratories, in Sweden (also on communication lines by D. Stenquist), at Allahabad, India, and in Russia, South America and Japan. After 1939, wartime conditions radically curtailed most geophysical investigations and no new earth current measurements were reported up to 1945. That year the only earth current installations reporting were the stations of the Carnegie Institution of Washington at Watheroo and Huancayo and one station operated at Riverdale, N.Y., by the Bell Telephone laboratories. The Riverdale station was used chiefly for studies of disturbances in correlation with magnetic disturbances and ionospheric changes as an aid to the prediction of radio transmission conditions.

Measurements.—Direct measurements of earth currents are not practicable. Hence information on their magnitudes, directions and other characteristics must be inferred from measurements of potentials combined with records or estimates of the resistances of their paths of flow. In most cases only potential measurements have been made. For this reason the results are usually given in units of potential or potential gradient and not of current or current density. Superficially the potential measurements are simple. They are made with galvanometers or potentiometers connected between two earthed points, the orientation and distance apart of which are known. At least two pairs of points lying on lines of different azimuths are required to determine the magnitude and direction of the gradient. Evaluation of the results in terms of earth current potential gradient is not simple, because the potentials measured are almost never those due to earth current flow alone. Whenever electrical connection is made between two points in the earth, some potential will practically always be found to exist between the two electrodes making the contact, even when there is no current flowing through the ground. These contact potentials are caused by electrochemical activity between the electrodes and the surrounding soil and are quite independent of any current which may be flowing through the ground. They may also be many times as great as the potentials due to earth current flow and unless the equipment is carefully selected, may vary widely with time. The potentials recorded, then, are combinations of the contact potentials and those caused by current flow. Potentials due to extraneous local currents are also picked up where they exist. Allowance for contact potentials and for local current flow must be made if the earth current records are to have any value. Neglect of this fact has sometimes led to grossly inaccurate conclusions, such, for instance, as the existence of a large constant component or unidirectional flow of earth currents. The effects of local current flow can well be excluded by care in the selection of the site of measurement. Since contact potentials are independent of the length of line, or distance separating the two electrodes of a pair their effect can be minimized by using very long lines. This was done at Berlin where lines 120 and 260 kilometres long were used for the northerly and easterly components respectively. The next longest lines on record were those at Tucson, 57 km for the northerly and 94 km for the easterly line. Shorter lines are cheaper and more convenient and even on lines as short as 1 km effective elimination of the effects of contact potentials can be attained by using duplicate lines. This is done at Watheroo and Huancayo where independent records of each component are secured on two or more lines of different lengths. In reducing the data only those features of the records are used which are common to both records and proportional to the lengths of line.

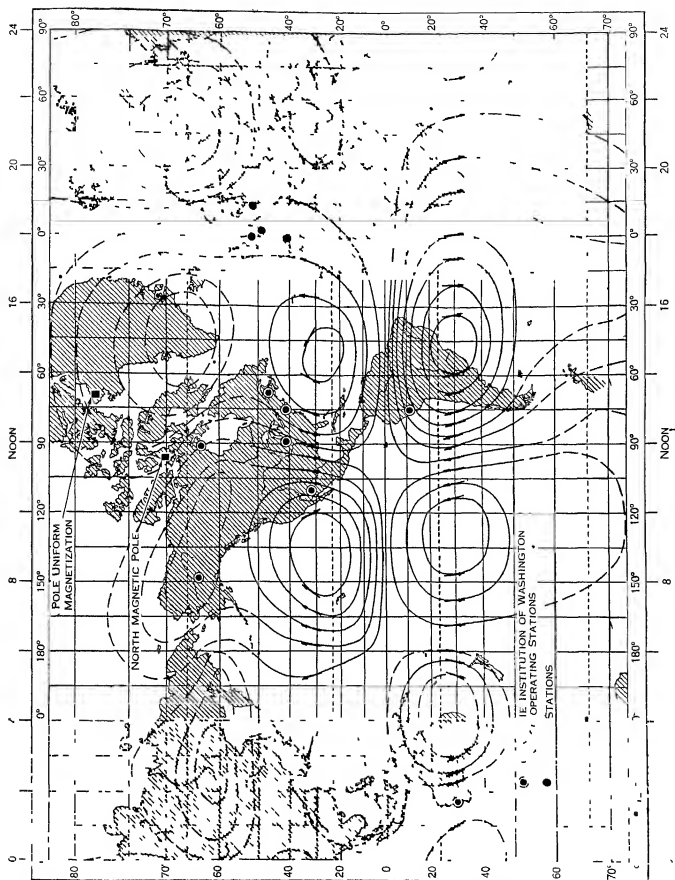
Established Facts.—The first point to be emphasized in discussing the results of these investigations is that there is no valid evidence of the existence of a constant or unidirectional part of earth current flow. Some early conclusions to the contrary resulted from mistaking contact potentials and their variations for true earth current potentials. The records obtained from the duplicate lines at Watheroo, from the long lines at Berlin and Tucson and from tests with special electrodes at Jibro and

elsewhere, demonstrate this fact conclusively. In other words, earth currents as determined at any single station are essentially pulsating or alternating currents differing from usual transitory or alternating currents in the relatively long periods of their alternation. Hence all inferences drawn from potential measurements must be based on a study of their variations and not on the absolute values recorded.

Disturbances, Earth Current Storms.—The variations most conspicuous in records of earth potentials are irregular fluctuations, sometimes of brief duration and sometimes continuing for several days. Those of short duration are referred to as disturbances, while the more lasting, and usually more intensive, fluctuations are commonly called earth current storms. Earth current storms occur on the average six or seven times each year. Most of the severe storms are world wide and are often characterized by sudden commencements at which times sharp fluctuations appear simultaneously at stations all over the world. It is difficult to fix on simple quantitative measures for these storms because of their complexity. In severe storms potential gradients as great as 100–200 mv/km. have been recorded at middle latitude stations and higher values at polar stations. A clue to the origin of earth current storms is found in the examination of other geophysical phenomena. Earth current storms always coincide in time with magnetic storms and the fluctuations noted at a given station can generally be correlated with those in one or another of the magnetic elements. The frequency and intensity of aurorae and of unsettled conditions in the ionosphere are also found to increase markedly at times of magnetic and earth current storms. These facts point definitely to a connection between all these phenomena and solar activity. Comparison with sunspot numbers shows that the intensity and frequency of both magnetic and earth current disturbances are greatest near the times of sunspot maximum and least at sunspot minimum and all three vary in much the same way throughout the well known cycle of approximately 11 years. Moreover, a 27 day recurrence, corresponding to the sun's rotation, and so to the reappearance of a group of spots, has also been found in such disturbances. Disturbances of short duration are apparently more localized. Their frequency and intensity are greatest at high latitudes both in the earth current and magnetic records. Typical disturbances are found to coincide with bright chromosphere eruptions and radio fade outs which accompany them. The intensity of these disturbances falls off with the distance from a point directly under the sun. A study of brief isolated disturbances at College Fairbanks showed a high degree of correlation with observed aurorae and comparison with records from other stations further indicates that the same disturbances, greatly reduced in magnitude and modified in appearance, can be identified in the records at middle latitude and even equatorial stations.

Periodic Variations.—Storms and disturbances are representative of unusual conditions. Less spectacular but more informative is the normal earth current flow which occurs day in and day out with remarkable regularity. Again we deal with variations, but variations which are far more regular and periodic.

Diurnal variation data, showing the changes in normal flow during the solar day, are available from a dozen or more stations. Prior to 1924 the distribution of these data was unsatisfactory since most of the earlier stations were close together in Europe. The establishment of the stations at Watheroo and Huancayo and the records obtained during the polar year, 1932–33, made it possible to compare the diurnal variation at stations distributed in latitude from 65° north to 30° south. At stations in middle latitudes the potentials measured in a north-south direction are decidedly greater most of the time than are those determined on an east-west line, and the general direction of current flow corresponds rather closely to the magnetic meridian. Here the diurnal variation curves are of double period with a marked maximum of current flow toward the equator near local noon. Greatest flow away from the equator occurs during the morning and afternoon hours. At Huancayo, close to the equator a distinctly different type of diurnal variation curve is obtained with a single pronounced maximum and minimum which occur roughly



FLEMING, TERRESTRIAL MAGNETISM AND ELECTRICITY—McGRAW HILL BOOK COMPANY INC

FIG 1—EQUATORIAL VIEW OF POSITION OF EARTH CURRENT SYSTEM AT 19 HOURS GREENWICH MEAN TIME

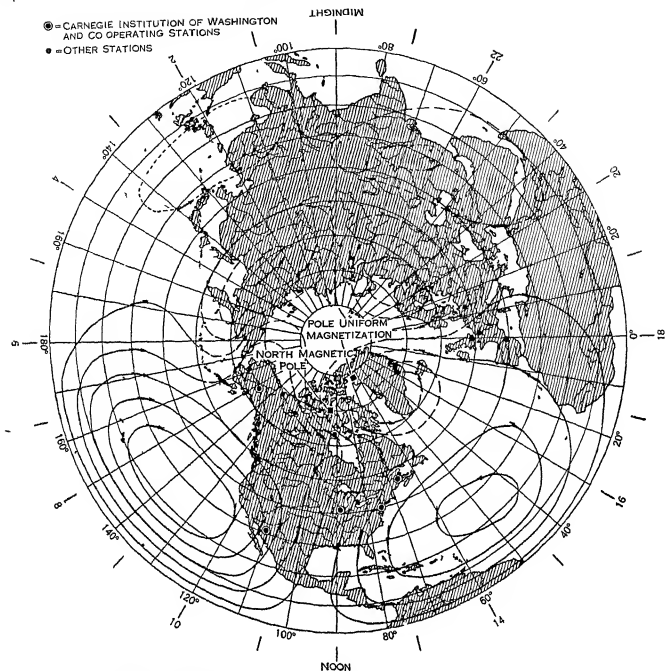


FIG. 2.—POLAR VIEW OF POSITION OF EARTH CURRENT SYSTEM AT 18 HOURS GREENWICH MEAN TIME

at the times when the flow at middle latitude stations is zero. Also the direction of current flow is more nearly at right angles to the meridian than along it. The records from the polar year stations cover only relatively short periods of time and are less accurate. They do, however, indicate that the diurnal variation changes again as high latitudes are reached with a tendency towards single periodicity and predominance of the west east component.

By combining the data from the best of the modern stations, O. H. Gish, in 1936, constructed a generalized world picture of the normal earth current circulation, based solely on observations without recourse to speculation or arbitrary assumption. Two views of this are seen in figs. 1 and 2 in which the density of the arrows represent density of current flow as obtained by integrating the longitudinal flow throughout the day and their direction is that determined directly from the diurnal variation curves. Lines drawn through the arrows to represent continuous lines of flow complete the picture of currents flowing in a number

of large whorls or eddies. At the instant shown in these charts it is midday in the western hemisphere and the four whorls which fall in this daylight section are strong and well defined. The corresponding group of eddies on the dark side of the globe indicate much feebler activity. The current system must be understood to be fixed in space with reference to the sun and not to any spot on the earth. Hence 12 hours later the stronger eddies of current will be found flowing in Europe and Asia instead of in the Americas. Fig. 2 shows a secondary series of whorls as indicated by the polar year records. If one considers what happens as a point on the map is moved from left to right across the whorls, the significance of all the main features of the diurnal variation, such as the generally longitudinal direction of flow at middle latitude stations, the large surge of current towards the equator near noon and the reversals of direction during the forenoon and afternoon, is obvious. Fig. 1 also shows why the diurnal variation curves tend to be simpler in form at stations near the equator and the direction of current flow there

is confined largely to a west east line. The picture is, of course, necessarily generalized and qualitative since only a comparatively small portion of the earth has been covered in earth current measurements. Moreover, in its preparation such factors as the resistivity of the earth and the nonuniformity of the earth's magnetic field were neglected. Even if complete data were available, an exact picture could not be presented in a single diagram since the current whorls must tend to be modified as they encompass different portions of the earth. The resistance of the current paths, for instance, is quite different for a deep oceanic region and for continental areas. Consequently the whorls themselves tend to be modified considerably in shape and in intensity as they progress around the earth. So the entire picture must be viewed as oversimplified for the sake of clarity.

The seasonal changes in normal earth current activity are chiefly changes in intensity. The magnitude of the flow observed in individual months shows a definite minimum at midwinter and less pronounced maxima at the equinoxes. A very similar seasonal variation is found in the magnetic records. Referring again to fig. 1, it appears that the current whorls become most pronounced when the sun is directly over the equator and weakest in the hemisphere farther away from it at other times. At most stations only minor changes in the type of diurnal variation are noted throughout the year. A notable exception is Tucson, which, it will be noted, is located near the centre of the northern hemisphere whorls. There, as the current pattern moves up and down following the motion of the sun, the station is apparently alternately south and north of the centre and, as a result, quite different phase relationships exist between the two components in summer and in winter months.

The annual variation in normal earth current activity again consists mostly of changes in intensity. B. Weinstein from the Berlin data, D. Stenquist and L. A. Bauer using Ebro results and W. J. Rooney from the records at Watheroo, Huancayo and Tucson, all find that the normal activity, as well as disturbance effects, follows closely the variations in sunspot number, and its changes from year to year are very like the variations found in the earth's magnetic field.

A lunar diurnal variation, consisting of a double period oscillation, was shown in the Ebro records by J. Egedal and in the Huancayo and Tucson records by Rooney. This variation is attributed to tidal action in the ionized layers of the upper atmosphere and is a clue to the mechanism causing earth current flow.

Relation of Earth Current and Magnetic Variations.—The parallelism between earth current and magnetic variations is too close and too consistent to be accidental. It extends not only to the frequency of disturbances and similarity in seasonal and annual changes but also to specific features such as the unusual seasonal variation at Tucson or the simultaneous occurrence of unexpected conditions on individual days. The relationship is, however, not a simple one and its exact nature has yet to be determined. Theories underlying the variations in the two, developed by A. Schuster, S. Chapman, R. Gunn and others have been summarized by O. H. Gish. All the more tenable theories agree in concluding that the variations in the earth's magnetic field and the flow of electric currents in its crust are the result of currents circulating in the upper atmosphere. These ionospheric currents in turn depend on its becoming highly conducting under the influence of solar radiation. There is some difference of opinion as to the precise mechanism and even as to the exact type of radiation involved but two fundamental facts are clear. The existence and general character of the ionospheric currents have been clearly demonstrated through the modern advanced technique for their investigation. And the fact that such currents must modify the earth's magnetic field and cause it to vary is undeniable. These magnetic variations then induce current flow in the earth which in turn reacts on the magnetic field to modify it still further. The net result, under normal solar conditions, is the regular periodic variations in the magnetic field and the accompanying earth current circulation such as that depicted in figs. 1 and 2. Storm and disturbance effects require some differences in radiation and in the complexity of the mechanisms

but are also quite definitely of a solar origin (See also *ELECTRICITY, TERRESTRIAL MAGNETISM*).

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EARTHENWARE, a term generally associated with a coarser type of domestic pottery, although such cups and saucers and other tableware of thin pottery are often called chint (see CHINAWARE) in error.

Earthenware can be made almost as thin as china, but it lacks translucency, it is opaque. Its chief feature is that it will absorb moisture under the glaze whereas china will not. A test adopted by the British customs officials is the application of red ink to the ware at a point where the glaze has been removed. If the ink is absorbed then it is classed as earthenware.

Earthenware embraces a wide range of pottery (see POTTERY AND PORCELAIN) known under a variety of names, which usually indicate the place where the ware was first introduced. William Burton, a well known authority writes "The word earthenware in its widest sense might be used to cover all varieties of pottery, as they are all made from some form of earthen or mineral substance taken out of the ground. In this broad sense a brick, a drainpipe and a Chinese vase might be equally described as earthenware, but though the chemical differences between them are slighter than would be supposed, they are so far apart in technique and final result that the names earthenware, stoneware and porcelain are very conveniently used to differentiate between them. In this restricted sense, the title 'earthenware' covers all articles made from a single natural clay, or from mixtures of clay and other mineral substances which when sufficiently fired for practical use, still remain porous, and need, therefore, if they are to be used for culinary, domestic, or decorative purposes, to be completed by the addition of an outer skin of glaze or glass melted on them." A handbook compiled by British experts in conjunction with the educational committee of the Pottery and Glass Trades' Benevolent Institution, gives the following definition of earthenware—

"All ware may be termed earthenware which is porous in the material itself, and requires to be glazed before it can be applied to domestic use. Earthenware is opaque, it will not transmit light."

The porosity of the "body" (the pottery itself without a glaze) may give a wrong impression to those who are not familiar with the ceramic industry. For instance, Bourry, a noted authority on the industry, points out that terra cotta and stoneware are quite distinct in their properties. One of the chief characteristics of stoneware is its impermeability, whereas terra-cotta has a porous body. If the distribution of the temperature of the kiln is irregular, some of the ware, says Bourry, will be impervious and rightly termed "stoneware," whilst other ware, in the same kiln, will have a porosity between that of terra cotta and stoneware. Judged on the basis of porosity, an article, Bourry points out, might be defined as "stoneware" if viewed from one side and as "terra-cotta" if viewed from another! Therefore it will be seen that earthenware and other types are not easily defined, but for general purposes the term "earthenware" may be applied to pottery which is absorbent under the glaze.

Types of Earthenware.—Earthenware can, however, appear under several names, each chosen to distinguish a special type of ware. These are sometimes distinguished in the trade as agate ware, onyx ware, marbled ware, porphyry ware, that is, earthenware made to imitate these various natural stones by mixing different coloured clays and glazing with a rich soft glaze.

Delft ware is a general term applied to earthenware covered by an opaque tin enamel. It takes its name from Delft in Holland, where it was largely made about 1600. Afterwards it was imitated at Lambeth, Bristol and Liverpool (England).

Talcum ware is an earthenware with a soft light glaze, generally decorated under the glaze, named after the place of its origin, "Fayence."

Majolica ware is the name given to an earthenware which is glazed with soft coloured glazes. It takes its name from Majolica.

Onychia ware is a yellow or cream coloured English earthenware first made about 1750 by Josiah Wedgwood of Etruria (England). Many imitations of it have been made, which vary much in character of colour, hardness and quality.

Some porcelain and ironstone china are only trade names given to a harder form of earthenware. They are not in reality either porcelain or china.

The above descriptions cover in the main table ware and decorative pottery, but earthenware is also used for more prosaic purposes such as sanitary utensils, and containers for food and drink. Earthenware is also produced in almost every civilized country of the world, but the quality varies considerably. In this respect Great Britain has an enviable reputation for its earthenware, just as it has for china.

Not only will the ware itself differ in its quality, according to the country of origin, but the decorations also are in most cases characteristic of the nation that produces the earthenware, unless it is made specially for export. For instance, an eastern country like Japan expresses its artistic character in its pottery decorations, but to capture the trade in western countries forsakes its national decorative schemes and adopts those common in the Western Hemisphere.

The principal raw materials used in the manufacture of earthenware are china clay, ball clay, flint and china stone.

China Clay—This mineral is found in many parts of the world, but the English mines at Cornwall and Devon are considered to produce the best clay for china making. The clay is, of course, consumed largely by the British potters, but large quantities are exported, particularly to the United States, which have not a clay of the English quality, although quite good clays are found in Georgia.

The British trade returns do not show the exports of china-clay separately, but group them with china stone. Of these two minerals 651,990 tons were sent abroad during 1926, more than half the quantity (361,797 tons) going to the United States. England follows with 64,891 tons, and the Netherlands ranks third with 40,421 tons.

According to the last census of production, published in a series of preliminary reports during 1926, the output of British china-clay was 805,000 tons, valued at £1,448,000. The previous census taken in 1907 gave the production of china-clay and china-stone together, the total being 726,000 tons, valued at £542,000.

Perhaps the next most important deposits of china-clay are to be found in Czechoslovakia, where an output of 40,000 tons per year is obtained. The best clay in Czechoslovakia is mined at Sedlice and Karlovy Vary. Czechoslovak clay is also exported to the extent of about 20,000 tons per year, a large part of this being sent to Germany.

China clay is said to have resulted from the decomposition of granite through many centuries. Its main constituents are silica and alumina, and may be described generally as a white, amorphous powder. The clay is not usually mined in the ordinary way, but is washed down from the sides of the mine by huge jets of water thrown out of hosepipes at a high pressure. The water brings down the fine clay to the bottom of the mine, where any sand is allowed to settle out. The watery mixture of clay is then pumped up to the ground level, and run through a series of troughs, known as "micas," where it undergoes a process of levigation, which consists of running the mixture into a trough from which the clay and water overflow into another trough, and so on throughout the series. While the mixture is passing through—"gradually settle out and are left behind"—the impurities such as mica "micas," the clay, now pure, is run into settling pits. From here it will pass to storage tanks and then to drying kilns. Finally it travels, in the form of lumps, to the storage room or "bin,"

from which it will be loaded into railway trucks or conveyed to ships. It is the china clay that gives plasticity to the mixture of materials used by the potter.

Ball Clay—This is found principally in Devon and in Dorsetshire, and is sometimes known as blue clay, owing to its greyish blue colour, which is due to organic matter. When fired at a moderate temperature it becomes white and remains absorbent, but some clays, if subjected to intense heat, are, according to Snydenham, rendered so hard that they are not easily scratched with a knife. Under such conditions these clays turn a yellowish colour and become non absorbent.

The clays vary, and the producer grades his clays into several qualities. Deposits will in some instances be found quite near the surface, while in other cases shafts will be sunk and the clay mined in branching "lanes," which vary in height according to the thickness of the vein of clay. It is necessary to "weather" the clay before sending it to the potter. To do this it is piled in heaps and exposed to the weather, and to the sun, rain and frost, probably for years, the whole being turned over at least once, so that all the clay may benefit from the exposure. This weathering is said to increase the plasticity of the clay, an important matter to the potter.

The production of ball clay in the United Kingdom according to the census published in 1926 was 146,000 tons, which had a selling value of £128,000. The United States bought 17,870 tons in 1926, more than half the quantity exported that year, Italy and Belgium following with 4,669 and 2,167 tons respectively.

Flint—Almost everyone is familiar with the pebbles or pieces of flint which are washed smooth by the waves on the seashore. These find their way into the body of earthenware. Not all flints are equally suitable, the best are found in France, although there are many other sources of supply. To reduce the flints to a powdery mass so that they can be incorporated into the clay, the pebbles are heated (or calcined) a process which not only turns them white, but makes them more amenable to grinding. They are first of all crushed and then ground into very small particles in water, so that a white, or greyish, thin liquid paste is produced.

The flint can withstand very high temperatures and therefore makes what might be termed a framework for the clay and other materials in the earthenware. The census of production for the United Kingdom published in 1926 gives a total of 188,000 tons for flints (including crushed and broken flints).

China Stone—This is an important ingredient in pottery, and there are deposits of a high quality in Cornwall, England, where the stone is mined by inserting explosive charges in holes drilled by compressed air boring machines. The stone has four recognized qualities or grades: hard purple (a white, hard rock with a purple tinge), mild purple (similar but softer), dry white or soft (a soft white rock), buff (similar to dry white, but with a slight yellow tinge).

Silica is the principal constituent, amounting to about 74% in the dry white and over 80% in the three other varieties. Oxide of alumina is the next important ingredient, amounting to about 18% in the dry white and from 7% to 10% in the other varieties. The British output, according to the preliminary census reports published in 1926, was 51,000 tons, valued at £82,000. China stone gives the china "body" its translucency.

Manufacture of Earthenware—Earthenware may be "thrown" on the potter's wheel or made under semimechanical conditions. In the case of the potter's wheel the prepared ball or lump of clay, revolving at the will of the potter on a small circular platform, is moulded by hand into whatever shape is aimed at. But for commercial production on a large scale, the thrower may form the ware in a mould which shapes the exterior, the clay being pressed inside until the desired thickness is attained, or the clay and other materials may be introduced in the form of "slip" (a mixture of the materials with water) into a plaster of paris mould. A further method is that of "jolleying." In this process a mould forms one side of the article. If "flat" ware, such as saucers, plates, etc., is being made, the mould shapes the top or inside, and the underside of the ware which is on top in this process, is fashioned by cutting away the clay, as it revolves, by means

of a tool which is cut to represent the profile of article to be made. The lathe also plays a part in finishing raw, or "green," clay articles. These processes are described and illustrated under CHINAWARE.

Unlike china, earthenware has little beauty of its own, also, as already stated, it is necessary to cover it with a hard glaze before it can be used for domestic or most ornamental purposes. Its decoration may be applied by painting or printing designs under or over the glaze, or the decoration may consist of coloured glaze, in one colour or a variety of shades. A glaze is really a glass, and this may be coloured with various metallic oxides. The oxides produce different colours according to the temperature of the kiln and the method of heating. A variety of colour schemes is possible, but it is a speculative method of decoration for it is difficult accurately to predict what the colours will be when they emerge from the kiln. This element of chance is made use of by some potters, for it truthfully can be said that no two pots decorated in such a manner will be identical.

To perfect the decoration of pottery by the fusing of metallic oxides and a flux on the ware the potter needs to have a scientific knowledge, that is, he must understand the chemical and physical properties of the metallic compounds, so that he may judge what their behaviour will probably be when subjected to heat in the kiln. With such knowledge some beautiful effects may be produced, but many glorious combinations of coloured glazes have been the result not of predetermined efforts, but of unforeseen happenings in the kiln. When the green or raw clay article has been made, it is fired or heated in an oven. The glaze is then applied and the ware is fired again. (See CHINAWARE.) (G C)

EARTH INDUCTOR COMPASS. The term earth inductor compass generally relates to a certain device used in some improved aircraft magnetic compasses. The inductor, in one form or another, is used as a detecting unit which by various means actuates direction-indicating devices. Representative forms of the inductor compass are shown in the schematic fig 1-5.

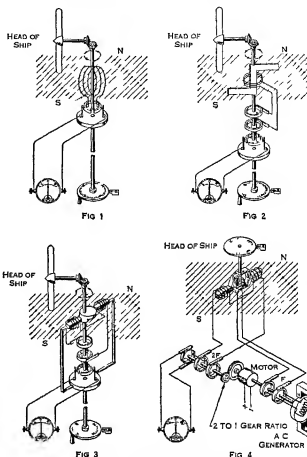
The term *inductor* designates that class of magnetic compass devices which work on the principle of induced voltages and electric currents. A voltage is induced when there is relative motion between a conductor and a magnetic field. Electrical engineers say, more properly, that voltages are generated when there is a rate of change of flux linkage. If the conductor is a closed circuit, the induced voltage causes a current to flow. A conductor may sweep through magnetic lines of force, or it may be stationary and the magnetic field may move, in either case generating a voltage. The earth's magnetic field is regarded as stationary with the earth, but it may be made to move locally by distorting a section of it. Some of the devices described herein work on the principle of voltages generated in moving conductors. Others function by periodic moving or distorting of the magnetic field. By distortion of the magnetic field is meant bending or "detouring" it (distortion of the earth's magnetic field is not shown in the illustrations).

Fig 1 is an elementary sketch of the type of instrument that was used in round-the-world and early transatlantic flights. Col Charles A. Lindbergh used this form of compass in his famous flight. The inductor in this case comprises a coil, which by its rotation in the earth's magnetic field causes variation in the flux linkage which generates an alternating current voltage. The resulting alternating current voltage is rectified by means of the commutator and brushes, as shown. The rectified current will then indicate on the D C meter. By rotating the brush assembly with respect to the earth's magnetic field, the polarity of the D C voltage is changed. At one particular brush setting, the meter indication is zero. When the brushes are fixed to the vehicle, it is possible to steer the vehicle so that the meter continues to read zero. Deviations from the course will cause the meter to deflect right or left, depending on the direction of departure. By restoring to the proper heading the meter again reads zero. To select a different heading, it is necessary only to reorient the brushes with respect to the vehicle, and a new straight course with respect to the magnetic meridian can then be steered.

Fig 2 is the second form of this device, which though operating differently, may still be considered an inductor compass. A magnetically permeable "Z" shaped core rotates while the coil is sta-

tionary in the horizontal plane. A voltage is generated in this coil by the periodic distortion of the earth's magnetic field, which causes variation in the flux linkage of the coil. The A C voltage, thereby generated is rectified to a direct current which indicates on the meter. A straight magnetic course can be maintained by selecting the heading such that the meter reads zero.

A third form is shown in fig 3. This is essentially a permeable magnetic core which concentrates the earth's magnetic field. It is mounted so that it is rotatable in the horizontal plane. When the



FIGS 1-4 —FOUR TYPES OF ELEMENTARY EARTH INDUCTOR COMPASSES. See article for full explanation. In fig 4, F indicates fundamental or supply frequency while 2F indicates twice fundamental or twice supply frequency.

core is parallel to the horizontal component of the earth's field, ϵ , north-south, it collects the maximum amount of flux. When it is at right angles to the horizontal component of the earth's magnetic field, ϵ , east-west, it does not collect the earth's field flux. By turning it slightly from the east-west direction either one way or the other, the direction of flux collected in the core reverses. Coils are wound around the core. If the middle of this core is a continuously rotating magnetically permeable section which periodically varies an air gap. This changes periodically the reluctance of the core as a whole. In any given orientation in the earth's field, therefore, that portion of the earth's field that passes through this core is periodically pulsed. This action induces an A C voltage in the coils. This voltage is minimum in the east-west orientation and is maximum when north-south. Furthermore, the phase of the voltage is reversed in rotating through the east-west position through a very small angle. After rectification by the commutator this phase change becomes a reversal in D C polarity, therefore the magnetic orientation of the magnetic core and brush assembly is detected by the meter. When the meter is in the central position the core is then oriented magnetic east and west.

A further extension of the inductor compass principle is illustrated in fig 4. This introduces the idea of the flux valve. The

term *flux valve* denotes a device in which the earth's field is pulsed or varied by periodic distortion. In the flux valve there are no rotating mechanical parts. It comprises a permeable magnetic core which has the property of collecting the lines of force of the earth's magnetic field as in the device of fig. 3. The mechanically rotating part is omitted; in its place there is a cross section of the magnetic core which serves as a path for an additional magnetic field produced by a central coil, as shown. This magnetic field alternates because the coil is excited from an alternating current source. At each half cycle the flux of this magnetic field is of such value that it tends to saturate (overload) the closed portion of the magnetic core. This saturation occurs cyclically since the flux alternates periodically. Saturation of the core changes the reluctance or the ability of the core to pass the mag-

netic flux. This is accomplished by means of gears. As in the preceding forms, a straight course can be steered by holding the meter reading to zero. The course is changed by orienting the flux valve differentially with respect to the craft. A card may be attached to the flux valve which indicates the magnetic heading when the meter is at zero.

In the four types shown fig. 1-4, there are two common defects which show up in their use as navigation compasses. The first is that they are so called "zero reader" indications and therefore do not indicate magnetic direction without manipulation. Secondly, they lack stabilization. By the latter is meant that the motion of the craft may affect the accuracy of the reading. This is explained by the fact that where the earth's magnetic field has appreciable dip angle (which prevails over 9/10 of the globe) only the horizontal component of this field may be used to determine direction. In an aeroplane, to obtain the horizontal component, the earth inductor device is put in gimbals and made pendulous so that it normally keeps the inductor in the horizontal plane. However, due to rough weather conditions, it will stay in the horizontal plane very little and the readings become so erratic that the compass is useless.

One way of avoiding these faults of elementary inductor compasses is to make the inductor in the form of a "flux valve" as shown in fig. 5. Having effectively three poles instead of a single one the respective coils on each pole cannot all have zero induced voltage at the same time. The voltage in each coil, however, is still dependent on its orientation with respect to the earth's magnetic field. Therefore, measurement of the voltages of each coil will permit, by proper interpretation, determination of magnetic north. This is done automatically without rotation of the flux valve itself and, therefore, the operation of mechanically rotating the inductor device to a zero output position is eliminated. The revolving device that interprets the voltages is called a signal transformer. The signal transformer includes a stationary unit having coils electrically connected to the three radial coils of the flux valve and distributed respectively in the same order. There is an additional part of the signal transformer, the central rotor, which carries a signal coil that is rotatable. By transformer action, the rotatable coil induces a voltage depending on its angular position relative to the voltages in the stator coil. This coil, therefore, has a zero voltage angular position in a manner similar to that of the single axis flux valve shown in fig. 4. To determine direction, the rotor of the signal transformer automatically rotates the zero voltage position.

As was indicated, the elementary types of inductor compasses have another fault, and that is lack of stability. Also shown schematically in fig. 5 is a modern method of overcoming this defect. The directional gyroscope is now introduced. This is a navigational instrument familiar to all airmen. It has the property of holding for fairly long periods of time a given heading with no oscillations or turning errors to which magnetic compasses are subject. This device, however, does slowly drift off the correct indication and therefore needs to be restored occasionally in flight. By linking a flux valve to the directional gyro, the latter is automatically and continuously oriented to the magnetic meridian, therefore, a stable continuously indicating magnetic compass is obtained. Without discussing the controls of the gyroscope, it can be stated that the rotor of the signal transformer is driven in azimuth direct from the directional gyro. There is a precision control of the gyroscope that orients it or makes it rotate slowly around the vertical axis. This precession is produced by the voltage of the signal transformer rotating coil. The resulting rotation of the gyroscope is in such a direction as to make the rotatable coil move toward its zero voltage position. In other words, the gyroscope is kept oriented to the null position. Since this null position is determined by the angular position of the flux valve in the earth's magnetic field, it satisfies the requirement of automatically and continuously restraining the gyroscope in correct alignment with the magnetic meridian. The azimuth scale attached to the gyroscope therefore indicates the magnetic heading of the aircraft at all times (See also NAVIGATION TERRESTRIAL MAGNETISM).

(O. E. F.)

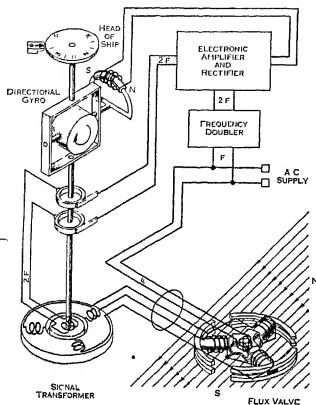


FIG 5—EARTH INDUCTOR COMPASS

An advanced type of inductor which overcomes the defects of lack of stability and inability to indicate magnetic direction without manipulation. F in diagram fundamental or supply frequency while 2F indicates twice fundamental or twice supply frequency. The Gyrocompass is built on this principle.

netic flux. This saturation is periodic, and therefore the reluctance can be said to vary periodically. The periodic change in reluctance of part of the magnetic core affects that portion of the earth's magnetic field that also passes or tends to pass through this part. Since the reluctance varies periodically the earth's field component will vary periodically. Periodic change in this component of flux induces a voltage in the coils which surround the actual members of the core. This is an AC voltage, and its magnitude varies with the average amount of earth's field threading through the core. This voltage in the same manner as in preceding examples, is therefore a measure of the position of the core relative to magnetic north. It should be mentioned that the voltage induced in the coils is at double the frequency of the excitation current. For explanatory purposes an AC generator is shown driven by a motor. The output of the flux valve is fed back through slip rings to a commutator driven by the same motor. This rectifies the signal. Since the output is twice the frequency of the excitation current, however, the commutator must go at twice the speed of the AC generator. Therefore, there must be an exact two to one increase in speed between the generator and

EARTHNUt, the English name for *Conopodium dnnuda tum*, a member of the family Umbelliferae, which has a brown, tuberlike rootstock the size of a chestnut. It grows in woods and fields. It has a slender, flexuous, smooth stem 2 to 3 ft. high, much divided leaves and small white flowers in many rayed, terminal, compound umbels. Though excellent in taste and unobjectionable as food, it is disregarded in England by all but pigs and children. In the Netherlands and elsewhere on the continent of Europe the rootstocks are generally eaten. The name is applied also to the fruit of *Arachis hypogaea* (family Leguminosae) which is also known as the peanut, groundnut (*gg v*) or monkey nut.

EARTH PILLAR, a column of soft rock, or earth which has not a homogeneous structure throughout, but contains large blocks embedded in much finer material. By exposure to conditions of denudation, especially run action, the large blocks protect the material beneath and so, by differential action the earth pillars are produced. Glacial drift and moraine deposits are ideal substances in which earth pillars can be formed and these structures are therefore found in regions of recent glaciation. Earth pillars are most likely to be found where the climate is semiarid with precipitation concentrated. The "bad lands" of western North America furnish excellent examples, and there are specimens in Tirol and other parts of the Alps, in Scotland and in the Dead Sea region.

EARTHQUAKES The study of earthquakes, called seismology, may be divided somewhat arbitrarily into three parts: (1) the geological aspect, which is concerned with the nature of the source of the earthquakes and the effects of earthquakes on rock and soil, (2) the physical aspect, which includes propagation of the waves in the earth, the recording of the earthquakes on seismographs and the interpretation of the seismograms (records) in terms of earth structure, and (3) the engineering aspect, which considers the damage to structures caused by earthquakes and the problems of earthquake resistant design.

CAUSE OF EARTHQUAKES

Explanations of earthquakes have been offered by mankind as far back as we know. Primitive peoples blamed earthquakes on animals which dwell beneath the earth or seas—a mole in India, a whale in South America, a catfish in Japan, etc. Greek philosophers offered many explanations: subterranean tempests in caverns, storms in subterranean seas, etc. Early moderns (e.g., Robert Mallet) thought of collapse of caverns. Edouard Suess in 1874 pointed out that the centres of damage of earthquakes in lower Austria lay along lines and suggested that the shocks were due to fracture and slipping out of the earth's crust along faults. In 1875 he pointed out the same phenomenon in southern Italy. Since Suess's studies the vast majority of earthquakes have been attributed to slippage along faults, the grating as the two sides rub setting up earthquake waves. These are called tectonic earthquakes. Two other types are recognized: volcanic and collapse. A volcanic earthquake is one which may reasonably be attributed to volcanic action, so it must centre near a volcano and should be associated in time with some other sign of volcanic action. Such an earthquake affects only a small area although it may be very severe over this area. The collapse of limestone caverns or abandoned mines may cause slight tremors.

Some authorities have wished to classify deep focus earthquakes separately. James B. Macelwane suggested the name "Plutonic." These deep earthquakes, the existence of which was first proven by K. Wadati in 1928, have focuses at depths of greater than, say, 100 km (62 mi.) and are known as deep as 700 km (435 mi.). It is difficult to imagine ordinary faulting at great depths although the seismograms of such shocks suggest a source similar to shallow earthquakes by the geographical distribution of compressions and rarefactions in the first wave on the seismogram. If the source of a shock is along a vertical fault running north and south and if the break is one in which the west side jumps north and the east side south, then the first wave to reach stations in northwesterly directions and southeasterly directions is a compression, a motion away from the source. In the other two quadrants, northeast and southwest, the first motion at the stations is a rarefaction, a mo-

tion toward the source. Of course this first wave is followed by very many others, but it is the beginning which leads to conclusions about the faulting direction.

Elastic Rebound Theory.—Once agreement was reached as to faulting as the cause of earthquakes, geophysicists became interested in the mechanism of faulting. After the San Francisco earthquake of 1906 Harry Fielding Reid put forth the elastic rebound theory. It was based on changes in the positions of triangulation monuments of the United States coast and geodetic survey as observed at intervals between 1851 and 1907. At the time of this earthquake the San Andreas fault broke for approximately 270 mi. from Upper Mattole in Humboldt County to San Juan in San Benito county. The displacement was almost wholly horizontal, the coastal side moving north relative to the inland side, the maximum displacement was 21 ft. at the herd of Tomles by. A thorough study was made of the shock, and a long report rendered by the State Earthquake Investigation committee. The elastic rebound theory born of this study may be stated as follows: Throughout a long period of time forces acting in the earth's crust, probably from below, tend to drag the coastal region of central and northern California northerly relative to the inland region. Eventually the strain in the rocks becomes so great that it can no longer be withstood and the rocks break. Just before the earthquake all the energy immediately to become earthquake motion is stored as elastic strain energy in the rocks. At the time of the break the rocks on either side rebound to a condition of no strain, the elastic energy being dissipated as earthquake waves and in heat through the agency of grating along the fault.

The elastic rebound theory merely pushes back the question of cause by saying that the strain accumulates slowly. This is highly reasonable, for most geologic processes are slow.

Cooling of the Earth.—One of the oldest ideas advanced as a cause of accumulation of such strain is related to the cooling of the earth. Many scientists came to accept the idea that the earth is cooling from an original molten state. Computations suggest that the temperature at considerable depths (perhaps 700 km and below) has not changed perceptibly since the solidification of the earth's mantle (the outer 2,900 km [1,800 mi.] above the core). Therefore the volume of this portion of the earth for which the temperature is constant remains constant. The hot rock just above the constant temperature and volume mass is able to flow plastically to accommodate its own shrinking and cooling about the constant sphere below it. The cooler surface layers, which are in radiation equilibrium with the sun are then too large to fit the interior and must collapse. Faulting will accompany collapse. The scars then heal, and the process repeats itself with failure at intervals.

Isostasy.—Another possible cause of slow strain is offered by the theory of isostasy. As early as 1749 Pierre Bouguer noted that the mountain mass of Chimborazo in Ecuador did not attract the plumb bob as much as he computed it should. Similar effects were later found all over the world. The phenomenon could only be explained by a deficiency of mass under the mountains. This led to statements of the theory of isostasy, namely, that at some moderate depth in the earth, probably less than 100 km, there is a level at which a pseudohydrostatic equilibrium exists, all columns of equal area of the earth's crust above this level have the same weight. According to Sir George Airy's statement of the theory, the continental masses are made of lighter rock which floats in the heavier rock of ocean basins. Mountains have roots, the lower profile of a continent is a magnified image of the upper profile. When mountains are eroded they tend to rise like an unloaded ship. Ocean bottoms sink when loaded with sediments. Such a process would explain a slow accumulation of strain in the crust of a vertical nature, and perhaps of a horizontal nature because of undrifting.

Drifting Continents.—There have been a number of advocates of the theory that the continents were once one mass which rifted apart and the several continents resulting drifted to their present positions. Foremost of these advocates was Alfred Wegener, the English translation of whose treatise appeared in 1924. Certain problems of similarities in flora and fauna on separate

continents are solved by this hypothesis but the lack of known forces of sufficient magnitude to accomplish the drift caused the theory to lose ground. Mountains pushed up on the forward borders of the Americas as they move west, with faulting and earthquakes are part of Wegener's picture.

Radioactivity—John Joly in 1915 developed an elaborate theory of cyclic effects of radioactive heat accumulated under the blanketing of continents and released when the material under the continents became so liquid that the small forces available could move them. The first of these is the Lotovos force, an equatorward force whose minimum is at latitude 45° where it has a magnitude of about one millionth of gravity. This force is due to the fact that the centre of buoyancy of a continent is below its centre of gravity. Thus the resultant upward force of the supporting medium is applied below the resultant downward gravitational force and since the direction of gravity is curved slightly in the plane of the meridian there is a tiny resultant force toward the equator. The other force exists because bodily tidal friction retards the tidal bulges so that they do not lie on the line joining the centre of the earth and the centre of the moon. This results in a larger centrifugal force on the bulge nearer the moon than on the bulge further from it. Such a couple tends to slow down the rotation and if a continent were free to move might well drive it westerly. However it would be only about one ten-millionth as effective as the Lotovos or Polkucht force. According to Joly rock which has melted under continents solidifies under oceans and vice versa. The mechanics are troublesome but the cyclic behaviour has a certain beauty.

Convection Currents—A number of theories which involve convection currents in the earth with resultant drag on surface rocks have been advanced. Some are quite local, others involve the whole mantle of the earth. Radioactive heating is generally called upon.

All of these theories involve mechanisms which would result in great strains slowly accumulated in the near surface rocks and offer ultimate sources for earthquakes.

Focus and Epicentre—The focus of an earthquake is defined as the point in the earth where the earthquake disturbance started. If the source was a fault break it is the point where the tear began. The source of the beginning of the first earthquake wave to be recorded on seismographs. The epicentre is the point on the earth's surface above the focus.

EFFECTS OF EARTHQUAKES

On Rocks and Soil—When the various types of elastic waves emanating from the fault arrive at the earth's surface they may cause considerable disturbance. Firm rocks transmit these waves with ease and they pass by the house built upon the rock without much effect. But shattered rock and soil on hillsides and uncon-

solid strata frequently cause fountains to burst forth in the epicentral region of a large earthquake. These fountains may flow for a few minutes or for days or weeks. Sometimes there may be merely a blowout of subterranean vapours. Sand is brought up from below. In the Salinas valley in 1906 one fountain brought up sand from a depth of 80 ft. In several of the great Indian earthquakes large areas of farming land were ruined by being so covered with sand. Spring fountains are often altered in the central region of a great shock. Steamboat springs near Reno, Nev., flowed muddy for days after the 1906 California earthquake.

Earth Avalanches—Large masses of dry, loose rock on mountain slopes are frequently near their natural angle of repose and an earthquake disturbs this critical equilibrium resulting in avalanches. One historic example was the avalanche of 1906 in the Santa Cruz mountains. This slide near Grizzly peak flowed down a canyon moving down many acres of redwoods. Some of these trees continued to stand at an angle to the vertical.

Earth Slumps—On hillsides during the rainy season the regolith or soil and subsoil, is frequently water soaked. Even without an earthquake slips of this wet soil often occur, a portion of the hill side slumping down with some rotation on a horizontal axis. Earthquakes greatly promote slumping.

Earth Flow—On occasion the shaking of an earthquake causes water to gush out of a hillside and the stream may carry great quantities of sand and wet soil down the hill in a river of mud. An example was the mud flow at Mt. Olivet cemetery, San Francisco, Calif., in 1906. Ninety thousand cubic yards of soil flowed 900 yd in three minutes. The greatest depth of the flow was 13 ft.

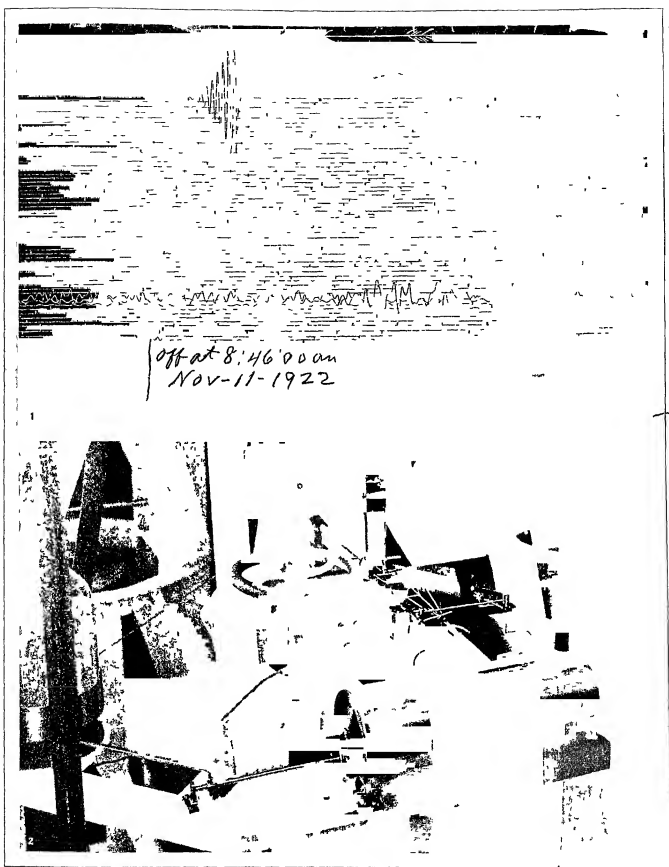
Earthquake Sounds—As will be noted in the paragraph on seismic waves the first waves of an earthquake (called P waves) are compression refraction waves. If the frequency of these waves is in the audible range we call them sound. Some earthquakes are heard by some people usually in the region where the shock is sharp. These sounds are of low pitch, near the limits of the human ear so that not all people hear them. Animals are frequently alerted just before a shock and it has been suggested that they may hear the waves before men feel them. At the time of the 1906 earthquake a farmer near Santa Rosa, Calif., observed his cows milling about the corral. He shouted to his son near the corral asking the cause, but before the boy could answer the father felt the earthquake.

Effects on the Sea—The effects of an earthquake on bodies of water are classified under three types: tsunamis, sea quakes and seismic seiches.

Tsunamis—These are gravity waves set up in the ocean by some disturbance of the sea bottom. The disturbance may be a vertical displacement of a fault on the sea floor or a submarine landslide caused by severe shaking. A great depression or (occasionally) a great mound of water is thus suddenly created over a large area. This disturbance of equilibrium starts a huge oscillation, and the long low waves set up propagate away from the source. Their theoretical speed is \sqrt{gh} where g is the acceleration of gravity and h the water depth. These waves may be more than 100 mi long and only a few feet high at sea. Thus they are not observed by ships at sea. As the waves approach shore, and the water shallows, they pile up particularly in V-shaped bays. The Sanriku (Japan) tsunami of 1933 at Atsumi had a height of 3 m at the mouth of the bay and 23 m at the head of the bay. The earlier Sanriku tsunami in 1896 attained a maximum height of 93 ft in Miyako bay. Six to eight waves were observed at intervals of 7 to 34 minutes. A schooner was carried 300 yd inland. It took this tsunami 10 hr 34 min to reach the tide gauge in San Francisco, the average speed was about 450 mi per hour. There it recorded as a wave of period 15 minutes indicating a wave length of a little over 100 mi at sea. The tsunami accompanying the Iquique (Chile) earthquake of 1877 recorded on the gauge at Hakodate, Japan, 10,300 mi away, with a height of 8 ft. The tsunami following the earthquake of April 1, 1946, which centred on the slopes of the Aleutian trench travelled to Honolulu, a distance of 2,241 mi, at an average speed of 490 mi per hour. It did great damage in the Hawaiian Islands. Tsunamis are sometimes set up by storms or sudden variation in barometric pressure.

Earth Trenches—In alluvial bottom land the soil is frequently so thrown about that cracks are left usually parallel to the river bed. The soil may be no lower after the shock than before, in fact rather than gravity is the important factor.

Wind Blows and Earthquake Fountains—Compression of under



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A SEISMOGRAPH, AND ITS RECORD OF AN EARTHQUAKE

1 Section of a seismograph record of the earthquake in Chile 1922. 2 A seismograph. The horizontal pendulum, carrying a steady mass weighing 220 lb., registers earthquake motion (magnification 80-100) on smoked paper which rolls upon a drum, the paper being marked in convenient units of time. One such instrument is set in N-S direction to record E-W motion and a second E-W to record N-S.

Sea Quakes—The compression or refraction of P waves from the earthquake focus or source are refracted into the water from the earth. The disturbance of the water as these waves propagate is called a sea quake. They were strong enough to sink fishing boats in the 1896 Sanriku quake. The sea quake accompanying the great Lisbon earthquake of 1755 opened seams in the decks of ships. Masts have been brought down by them. In shocks of less magnitude the vessel shakes as if it had run into a submerged object. Sea quakes ruffle the sea's surface in a short chop and kill or stun fish.

Seismic Seiches—A body of water landlocked, or nearly so, has a period or periods of natural oscillation peculiar to its configuration. Severe shaking of the earth or the arrival of a tsunami may set a bay or lake into its natural oscillation which may continue for several days. The great Lisbon (Portugal) earthquake of 1755 was famous for the seiches which it produced. Even rivers were greatly disturbed. As far away as the island of Corsica most of the rivers overflowed their banks. Loch Lomond in Scotland oscillated for an hour, the rise being about 2 ft. The tsunami from the Iquique earthquake of 1877 set San Francisco bay into oscillation for two days.

T Waves—There is a low velocity sound channel in the ocean at a depth of about 400 fathoms at certain seasons in certain latitudes. Small explosions in the channel can be detected by receivers in the channel at vast distances. Many West Indian earthquakes get energy into this channel, and these waves in the water are able again to enter the land and record on seismographs at stations near the Atlantic coast. Many Hawaiian earthquakes send waves through this channel to seismographic stations in northern California, often there is more energy in this water channelled wave than in the earth waves. It is necessary presumably that favourable conditions exist where the earth waves enter the water and where they leave it. The southern California seismographic stations do not receive the T waves from Hawaii. The periods of T waves are 0.7 sec or less. They are a particular kind of sea quake wave but may be classified separately, perhaps, because they (1) are observed on land and (2) propagate to great distances.

Foreshocks and Aftershocks—Every great earthquake is followed by a succession of aftershocks as the earth settles down. There are hundreds strong enough to be felt in the first few days after a big earthquake. They may last for years. It is exceedingly rare to have within the period of a few months (or even years) more than one great shock in a given locality. Two exceptions which can be cited in the United States are the three great New Madrid, Mo., earthquakes of the winter of 1811-12 and three Helena, Mont., earthquakes of 1935.

Foreshocks are smaller earthquakes which occur before a big one, say within a month, and have approximately the same centre as the great shock. Not all large earthquakes have foreshocks. There are none reported in the *Report of the State Earthquake Investigation Commission* for the San Francisco earthquake of 1906. For the Long Beach earthquake of 1933 one foreshock, 41 hr before the main shock, was reported by Harry O. Wood.

Intensity Scales—The intensity of an earthquake is rated by its effects on rock and earth, on man and on his works. The greatest intensity is demonstrated by great cracks in the earth and landslides, accompanied by ruin of buildings, bridges, etc. The least intensity is that felt only by a few experienced observers who were sitting or lying down at the time. Between these extremes various scales have inserted different numbers of divisions. Such a scale is the modification by Harry O. Wood and Frank Neumann of the older Mercalli scale (*Bulletin of the Seismological Society of America*, 11 277-283 [1931]).

Modified Mercalli Intensity Scale of 1931 (Abridged)

- I Not felt except by a very few under especially favourable circumstances
- II Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing
- III Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated

- IV Dishes, the dry felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed, walls made cracking, sound. Sensation like heavy truck striking, building. Standing motor cars rocked noticeably
- V Felt by nearly everyone, many awakened. Some dishes, windows and so forth broken. A few instances of cracked plaster, on unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop
- VI Felt by all, many frightened and run outdoors. Some heavy furniture moved. A few instances of fallen plaster or damaged chimneys. Damage slight
- VII Everybody runs outdoors. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures. Considerable in poorly built or badly designed structures. Some chimneys broken. Noticed by persons driving motor cars
- VIII Damage slight in specially designed structures, considerable in ordinary substantial buildings with partial collapse, great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in water level. Persons driving motor cars disturbed
- IX Damage considerable in specially designed structures, well designed frame structures thrown out of plumb, great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken
- X Some well built wooden structures destroyed, most masonry and frame structures destroyed with foundations, ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks

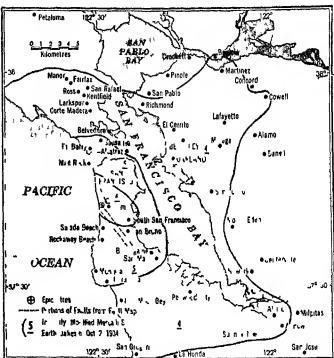


FIG 1—ISOSEISMAL MAP OF THE EARTHQUAKES OF OCT 2 1934

- XI Few if any (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly
- XII Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air

In order to rate the intensity of an earthquake a seismologist may either (1) visit the localities in which the shock was felt to make inquiries and observations or (2) he may send questionnaire reports. In 1928 the United States coast and geodetic survey commenced a program of collecting such questionnaire reports. A number of blank questionnaires are given to each prospective observer, and he is asked to send one in on the occurrence of a shock. Postmasters form the backbone of the reporting system, but a great many other reporters have been

added The questions are based on the above scale Difficulties in the assessment of the intensity from the reports usually lie in a disparity between effects on people and effects on inanimate objects, e.g., some people are frightened more easily than others In general, a man who has once felt a great earthquake is more frightened by small ones than is an inexperienced person Familiarity does not breed contempt for earthquakes Having assessed the intensity the seismologists plot on a map of the area the intensity number for each town They then draw closed curves bounding the areas corresponding to each intensity These curves are called isoseismal curves They are frequently oval in shape indicating a linear source or a vertical plane source These central areas are frequently along a known fault and give confirmation of the theory that faults are the source of earthquake waves

GREAT EARTHQUAKES

Lisbon, Portugal—Probably the most famous of all earthquakes is that which destroyed Lisbon on Nov. 1, 1755 There were three great earthquakes (the first was the largest) at 9:40 A.M., 2 A.M. and 11 noon The main shock lasted six to seven minutes, an unusually long duration Within six minutes at least 30,000 people were killed, all large public buildings and 1,000 dwellings were demolished It was a church day and great loss of life occurred in the churches A fire followed which burned for six days A marble quayside in the riverbed disappeared into the river bottom hidden with people Alexander von Humboldt stated that the total area shaken was four times that of Europe Charles Davison concluded that the great damage in places as far apart as Lisbon, Fez (Morocco) and Algiers indicates more than one source There was some damage to buildings in the Spanish cities of Seville, Cordova and Granada In Africa Fez and Meknes were badly damaged and even in Algiers, 700 miles east, damage was reported Portions of the coastal cliffs near Lisbon fell into the sea and there were landslides and cracks throughout the mountains

The Lisbon earthquake was remarkable for its effects in water Seams opened in the deck of a ship near Lisbon during the resulting sea quake It was reported that 40 leagues west of Cape St. Vincent a man was thrown 15 ft vertically from the deck of a ship Critical students, however, do not accept this story The tsunami at Lisbon consisted of three large waves 15 to 40 ft high At Cadiz Spain it was 60 ft high It took the tsunami 10 hr to reach Marquage (1,740 mi) where it was 12 ft in height

New Madrid, Mo.—The greatest earthquakes on record in the United States are those which centered near New Madrid in southern Missouri in 1811 and 1812 There were three great shocks in the series on Dec. 16, 1811, on Jan. 20, 1812, and on Feb. 7, 1812 There were innumerable others of lesser intensity as is usual Between Dec. 16, 1811, and March 16, 1812, there were 1,874 of these shocks strong enough to be felt in Louisville, Ky., 200 mi away, 8 were classed as severe The region of New Madrid was sparsely settled and the reports are not such that observers can differentiate between the effects of the three great shocks, so they must be discussed as one The tract of greatest shaking comprised about 40,000 sq mi. southerly from New Madrid including parts of eastern Tennessee and northwestern Arkansas In this region the soil was highly disturbed by the shaking A series 150 mi long and 40 mi broad later called the "Sunken Country," sank from 3 to 9 ft, and river water rushed in Ridges left by waves were seen in the soil, the soil broke open and sand and sulphurous vapours were ejected Forests were ruined by being overthrown or having soil shaken away from the roots of the trees, low domes and depressions were formed in the soil Reelfoot Lake in Tennessee was torned by these shocks The earthquakes were strong enough to shake down chimneys in Cincinnati, O., 400 mi away (The 1906 California earthquake was not felt farther than 300 mi to the west) The New Madrid shocks were of intensity IV on the above scale in Washington D.C., 300 mi away They were felt in Canada and on the Gulf coast and as far away as the headwaters of the Missouri and the Arkansas rivers

Charleston, S.C.—On Aug. 31, 1886 at about 9:31 P.M., oc-

curred a great earthquake which centered near Charleston, S.C. On account of the great area over which it was felt it must rank with the great earthquakes of the world, and as the second largest in the United States It was felt 950 mi away on the upper Mississippi and in Bermuda In the region to the west of Charleston, near the villages of Woodstock and Rintowles, the soil was disturbed The area so disturbed was not more than 600 sq mi, small indeed compared to the similarly disturbed area of the New Madrid shocks, although the total area over which these earthquakes were felt was approximately the same In Charleston the earthquake was felt by people for about 70 sec Although no buildings were entirely demolished the damage to property was estimated at \$5,000,000 and 27 people (out of 50,000) were killed The damage was greatest on filled ground although buildings on such ground which were built on piles stood up well

California (1906)—On April 18, 1906, at about 5:12 A.M., the San Andreas fault broke for a length of approximately 270 mi from Upper Middle in Humboldt county to San Juan in San Benito county This break was accompanied by a great earthquake which was felt from Los Angeles on the south to Coos Bay, Ore., on the north a distance of about 750 mi To the east it was felt as far as Winnemucca, Nev., about 300 mi The fault break was the longest on record The greatest displacement was horizontal and amounted to 21 ft at the head of Tomales bay The vertical displacement was minor and was observed only to the north where it may have been 2 or 3 ft The main shock lasted about 40 sec Earthquake damage was great in many cities near the fault San Francisco, San Jose, Salinas, and also at Santa Rosa about 20 mi from the fault Regularly the most damage occurred on man made filled ground and the least on rock Cities on natural valley fill suffered more than cities on rocky hill slopes But the greatest loss of property resulted from the fire which followed the shock in San Francisco

Fires are frequently a consequence of an earthquake A city in an earthquake region must take great care to have several sources of water supply and to be ready for the day The number of lives lost in this earthquake was estimated at 700 John R. Freeman estimated property loss caused by the shock at \$20,000,000 in San Francisco, and \$4,000,000 elsewhere, and fire damage in the city at \$20,000,000

Tokyo, Japan (1923)—At noon on Sept. 1, 1923, occurred a great earthquake which left Tokyo and adjacent cities in ruins The violent motion lasted only half a minute In Tokyo alone 68,000 people were killed of whom 40,000 were burned by fire in the yard of the military clothing depot Throughout the area affected, the death toll was 100,000, while 43,000 remained missing Property loss was estimated at \$2,500,000,000 Fifty-four per cent of the brick buildings collapsed and 10% of those of reinforced concrete One per cent of the dwellings collapsed in Tokyo, but 700,000 houses burned The damaged area was around Tokyo and Sagami bay The shaking of the soil was so great that potatoes were thrown out of the ground at some places The epicentre of the shock was located beneath Sagami bay (the outer portion of Tokyo bay) Detailed surveys indicated great changes in the depth of the bay, these were differences between depth measured just after the earthquake and depth observed about ten years before The maximum increase in depth was 650 ft, and the maximum decrease was 820 ft Many Japanese seismologists thought that these changes all occurred at the time of the earthquake and indicated huge faulting On land about 15 small faults broke on both sides of the bay The longest was 23 mi, and the maximum displacement was 6 ft 7 in vertical The faults did not have a common direction Although the epicentral shaking was extremely violent the quake was not felt much more than 400 mi from its source The accompanying tsunami was 36 ft high at Atami, on Sagami bay where it destroyed 155 houses and killed 60 people

GENERAL DISTRIBUTION OF EARTHQUAKES

It is well known that earthquakes occur more frequently in some parts of the earth than in others Count Ferdinand Montessus de Ballore pointed out that most have occurred in two great-

circle belts the one about the Pacific ocean and the other including the Alps, the Himalayas and the West Indies. Among exceptions are the New Madrid and the Charleston shocks described above. There is scarcely a state in the United States that has not experienced some earthquakes.

According to Ballore slightly more than half the earthquakes in the historic record have occurred in the Alps Himalayas great circle zone. According to Beno Gutenberg and Charles F. Richter about 80% of the seismic energy released on the earth is released in the circum Pacific belt. There is an interesting relationship between the positions of the focuses of deep and shallow earthquakes in regions where both occur. For example, there are shallow earthquakes (depth less than 50 km) with epicentres off the Chilean coast, intermediate depth shocks (depth between 50 km and 200 km) near the coast and under the Andes and deep earthquakes (depth 200 km to 700 km) under the Argentinian plain. In parts of the Japanese region there is a similar distribution, many of the deep shocks centring under the Japan sea and Manchuria. The distribution of earthquakes was completely discussed in *Seismology of the Earth* by Gutenberg and Richter in 1949.

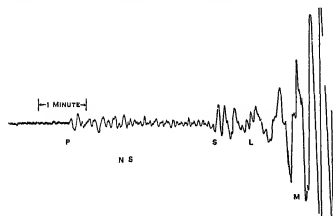


FIG 2—TRACING FROM NORTH SOUTH COMPONENT WILIP GALITZIN SEISMOGRAPH BERKELEY OF THE TEXAS EARTHQUAKE OF AUG 16 1931 EPI CENTRAL DISTANCE ABOUT 800 MI

EARTHQUAKE WAVES

Beginning about 1880 a new interest in earthquake waves was aroused, particularly in Japan where John Milne and his coworkers at Tokyo university began to build seismometers and study earthquake motion. These men equipped their seismometers with writing devices and began a careful study of the records, called seismograms. A little later Emil Wiechert in Germany built new seismographs and directed an institute at Gottingen university from which many fundamental papers on seismology appeared. Prince Galitzin in Russia embarked on a similar program.

It was found that the vibrations emitted from the source of an earthquake travel through the earth by many different paths and as several different types of wave motion. Thus the seismogram written at a distant station shows a great many groups of waves, which arrive at different times. On the seismogram the motion of a pendulum relative to its support is written on a recording drum which rotates, so the recorded motion is spread out as a function of time. (See SEISMOGRAPH) Fig 2 and 3 show tracings of two seismograms. The first shows clearly two groups of waves early named P and S for primary and secondary. These two

groups and their reflections as discussed below, were named the preliminary tremors of the earthquake while the larger waves following were called the principal portion. They were divided into two groups L, for long and M, for maximum. Another still longer wave preceding L was later called G, for Gutenberg who first called attention to it.

Preliminary Waves—R. D. Oldham suggested that P and S waves were perhaps the longitudinal and transverse waves respectively for which the theory of waves in an elastic medium called, and such indeed they proved to be. The mathematical theory of elasticity had indicated that a blow struck an elastic body, say a portion of the earth's rocky crust would result in a sudden strain which was a compound of change in volume and change in shape. The initial strained portion of the rock would vibrate about its initial form as it recovered equilibrium and would impart this vibration to neighbouring portions of rock. Thus waves would be propagated out from the centre of the disturbance. But the theory pointed out that the change in volume strain would propagate more rapidly than the change in shape, so that in a homogeneous isotropic solid with no boundaries (to reflect, refract or support surface waves) just two waves would arrive at any point. As the first of these passed the point, the medium would change volume only, the particles of the medium would vibrate back and forth in the direction of the path of the wave (i.e., longitudinally), the medium would experience compression and rarefaction. These are P waves. As the second wave passed, the medium would experience change in shape only or shear, the particles of the medium would vibrate back and forth at right angles to the path of the wave or transversely. These are S waves. Milne and other early workers obtained the times of arrival of P and S at many seismographic stations at different distances and plotted them on a "travel time curve," a graph on which epicentral distance around a great circle of the earth was plotted as abscissa and the time of travel of the wave as ordinate. They found the travel time curves of both P and S to be concave downward, i.e., the farther the wave is from the epicentre the greater is its apparent surface speed. This showed at once that P and S do not travel along the earth's surface. If they did, the observed surface speed would not increase with epicentral distance although it would vary somewhat with the nature of the surface rock. For the speed of P and S waves are known from the theory of elasticity to be respectively

$$V_p = \sqrt{\frac{\kappa + \frac{2}{3}\mu}{\rho}} \quad \text{and} \quad V_s = \sqrt{\frac{\mu}{\rho}}$$

where κ is the coefficient of incompressibility or bulk modulus of the transmitting medium, and μ is its coefficient of rigidity or shear modulus, ρ is the density. Next was considered the possibility that P and S travel along chords of the earth as they would be expected to do if their speeds were constant throughout the earth's body. Curves drawn with travel time as ordinates and chord distance from focus to station were still concave down, indicating the speed greater on deeper chords. So the speeds of P and S increase with depth, and the rays or wave paths must then be convex downward. P and S penetrate into the earth and are refracted to the surface. The seismologist studies them after this passage and draws conclusions as to the nature of the earth's interior. As above, the first contribution of seismology to the knowledge of the earth's interior was the knowledge that the speeds of P and S increase with depth, the rays or wave paths must then be convex downward. This was not to have been expected a priori, for it was known that the mean density of the earth was about

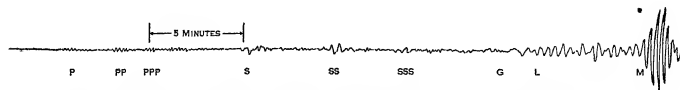


FIG 3—TRACING FROM EAST WEST COMPONENT BOSCH OMORI SEISMOGRAPH BERKELEY OF AN EARTHQUAKE CENTRING NEAR THE AZORES ON NOV 25 1941 EPICENTRAL DISTANCE IS ABOUT 6000 MI. PP AND SS REPRESENT WAVES REFLECTED AT THE EARTH'S SURFACE ABOUT HALFWAY BETWEEN THE SOURCE AND THE RECORDING STATION (see Fig 4). PPP and SSS HAVE BEEN REFLECTED TWICE

55 whereas ρ is a fair figure for the mean density of surface rocks. So it was known that density increased with depth and from the equations given above for the speeds of P and S one might have expected the increase in density to cause a decrease in speed. Laboratory experiments on rocks, particularly at the geophysical laboratory of the Carnegie Institution of Washington and at Harvard had early shown that when a rock is compressed the elastic constants k and μ increase more rapidly than does the density and that rocks of higher density invariably have elastic constants much higher also, so that the quotients $\frac{k+\frac{4}{3}\mu}{\rho}$ and $\frac{\mu}{\rho}$ are higher for denser rocks.

For epicentral distances larger than 45° (360° being the circumference of the earth) there are groups of waves observed between P and S which have been shown to be reflections of P at the earth's surface, about halfway between the epicentre and the recording station. Similar reflections of S are observed between S and G, the first surface wave, in fig 3 shows. For epicentral distances greater than 103° both P and S are very weak. The rays emerging at 103° have penetrated the earth to a depth of about 2 900 km, or 1 800 mi (the radius of the earth is about 6 370 km or 3 958 mi). So, at this depth in the earth something blocks P and S. This is the "core" of the earth. The speed of P waves drops sharply as they enter the core (see fig 4). Beyond 103° the small P and S observed have straight line travel time curves, indicating that they are diffracted around the core boundary. But at 142° a new longitudinal wave emerges in two parts. These waves are called P₁ and P₂ and represent P waves which have traversed the core. The speed of P waves drops suddenly at the core boundary so that the core acts for P waves as a spherical lens with much aberration. This results in a "shadow zone" for P between 103° and 142° . The phenomenon at 142° and beyond is somewhat analogous to the caustic surface of optics. The variation of the speed of P within the core in general increases with depth complicates the matter. S waves have not been observed to traverse the core. This indicates a fluid core if we understand by fluid the state which will not support shearing stresses. P and S waves are both reflected from the core and these reflections recorded on seismograms. When either P or S strikes a discontinuity there are in general four waves set up: P and S reflected and P and S refracted. Snell's law holds of course, i.e., the sine of the angle of incidence is to the sine of the angle of refraction (or reflection) as the speed of the incident wave is to the speed of the refracted (or reflected) wave. So we record waves incident on the core as S, refracted into it as P, refracted out of the core as S (or as P). Some of the energy in P through the core is reflected back into the core at its boundary while some is refracted out so we record waves which have two branches in the core. The possible number of paths is large. Seismograms are complicated.

It is probable that there is an "inner core" (i.e., that the properties of the core change rather sharply at a depth of about 5 000 km, or 3 105 mi). This would explain the existence of some P waves observed in the shadow zone. Some have even suspected that the inner core may not be fluid.

We have just seen that seismology has established the existence of a core of the earth which appears to be fluid at least in its outer part. Near the earth's surface other discontinuities in the earth's structure have been indicated. In 1909 A. Mohorovicic reported a Kupa valley earthquake on the records of which its near seismographic stations he observed two P waves. This phenomenon of more than one P wave near the epicentre (viz zero to 500 km) was soon recognized by all seismologists. Two or three P waves of different speeds are observed wherever there is a close network of seismographic stations in a region of earthquakes. Each of these speeds indicates transmission in a different type of rock. The waves are observed in all directions from the epicentre, so the rocks must be symmetrically disposed in horizontal layers. The speed of the first P wave very near the epicentre (within 100 km or 62 mi) is 6 to 8 km per second. This wide variation of speed seems to be due to the considerable variation in the surface rocks—observations of near earthquakes and explosions offer considerable scatter on the time distance graph. At a depth of about

10 km many studies have shown a fairly abrupt change in the speeds of P and S. The layer above 10 km depth has frequently been called the granitic layer. Below 10 km the speed of P is between 6 and 7 km per second in a layer which extends to depth of 30 to 40 km in most regions. This layer has been called basic or basaltic. At its bottom there is a quite sharp boundary called the Mohorovicic discontinuity. Just under it the speed of P is 8 km per second. It is deeper under mountains. In California P waves travelling just below the Mohorovicic discontinuity from Coast range earthquakes are blocked by the root of the southern Sierra Nevada and are not recorded at the Owens valley seismographic stations. Thus seismology has been able to prove the existence of a mountain root, a protuberance of lighter surface rock into the heavier mantle rock. Such roots had long been considered necessary by proponents of the Airy concept of the theory of isostasy—the theory that continents and mountains float effectively in the underlying mantle rock.

The existence of the Mohorovicic discontinuity is not questioned. However the type of variation in the layer above it is a moot question. Some seismologists consider the variation of the speed of seismic waves with depth in this region to be continuous. Some want it to decrease and then increase, and some to have it divided into two layers as described above.

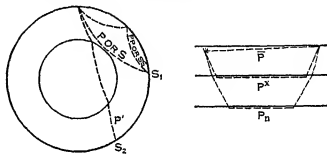


FIG. 4—(LEFT) SCHEMATIC GREAT CIRCLE SECTION OF THE EARTH SHOWING THE CORE. STATION S_1 RECEIVES P AND S WAVES AND THEIR REFLECTIONS WITHOUT DISTURBANCE FROM THE CORE. STATION S_2 CAN ONLY RECEIVE DIRECT P AND S WAVES. IT RECORDS A P WAVE REFRACTED THROUGH THE CORE.

FIG. 5—(RIGHT) THE PATHS OF THREE WAVES OBSERVED NEAR THE SOURCE OF AN EARTHQUAKE ARE SHOWN AS DOTTED LINES. THESE WAVES INDICATE THAT THE EARTH'S SURFACE IS LAYERED.

Under the oceans the Mohorovicic surface is much higher than under continents, its depth being only 5 to 10 km. The material above it, under a few kilometres of sediments, is rock of the same nature as that of the lower part of the continental layer. The lighter rocks of the granitic layer are absent.

Beneath the surface layers is the mantle of the earth which extends to the core. Possible discontinuities in the mantle have been a matter of debate among seismologists. So earthquake seismology has shown the earth to have a core and to have an outer ring. The methods of computation of the variation of speed of P (or S) with depth in the earth are not simple, some are very complex.

Surface Waves—The "principal portion" of the seismogram records large waves of three kinds, called G, L and M. The mean travel time curves of each is a straight line, but there is much scattering. For these waves travel around the surface of the earth, as the straight-line travel time curves indicate, and the surface rocks of the earth are varied. Thus surface waves travel faster under ocean basins than along continental paths. The fastest surface waves are the G waves. These are shear or transverse waves with no vertical component. Their theory was given by A. E. Love. Their existence requires an increase of speed with depth. The M wave approximates the theoretical wave of Lord Rayleigh. As a Rayleigh wave passes a particle on the earth's surface, it moves in an ellipse in the plane containing the focus, the particle and the earth's centre. The motion is retrograde and the major axis is vertical. The L waves have no theoretical counterpart. They have a vertical component. By observing the dispersion of Love and Rayleigh waves the theory allows certain conclusions about

the surface structure of the earth. The ratio of vertical to horizontal motion in Rayleigh waves has been used for the same purpose. Longer surface waves penetrate deeper into the earth where the elasticity is greater. Therefore they travel faster and dispersion results. By the 1950s, surface waves with periods as great as seven minutes had been observed and seismographs were being designed to record longer periods. Waves of such great length involve vibration penetrating deep into the mantle to give further information about the earth's core. It had become apparent that the spectrum of a great earthquake is very broad. The limits in wave lengths possible depend at the one end on molecular dimensions and at the other end on the dimensions of the earth.

LOCATION OF EPICENTRES

The methods of the seismologist for locating the epicentre of an earthquake are of much interest to the public. For the earliest workers, the epicentres were the centres of the region of greatest damage. They built rough travel-time curves for S and P, then the method of successive approximations so common in science was used. Epicentres were located using the time intervals between S and P from the graph to get distances. When these distances from various stations did not reach to a common point on the earth, the S and P curves were readjusted. It was not long until the S and P curves were so refined that the distances did agree. The simplest method of locating epicentres is called the S-P method. Over the years tables were prepared to give the epicentral distance as a function of time interval between S and P. So the seismologist soon has the distance from his station. If he can obtain the distance from two other stations, he is able to locate a point on his terrestrial globe and he has his epicentre. From the records of one station alone he may sometimes get direction as well as distance. He knows that the P waves are longitudinal. The pier on which the seismograph sits vibrates back and forth nearly in the direction which the P wave has travelled. A good record of the start of P on the three components, east-west, north-south and vertical seismographs, will allow the computation of direction of the epicentre. A more accurate method used in special studies involves the use of the arrival time of P at many stations and a least square adjustment.

SEISMIC PROSPECTING

After World War I interest was roused in investigating the very superficial part of the earth by seismographs and artificial explosions. The primary purpose was to map underground structure in regions considered to have oil-bearing possibilities. Ludwig Mintrop in Germany was the first to use the method successfully. The first work was of the type called "refraction shooting." A charge of explosive was fired and recorded on seismographs distributed along a line which was often several miles in length. Near seismographs registered waves which had travelled almost a straight line from the shot. At successively large distances waves were recorded which had travelled just below boundaries between strata at successively greater depths. The depths to these boundaries could be computed from the travel-time curves. What interested the prospectors were irregularities in these boundaries—highs or anticlines in the buried structure or salt domes rising through them, or faulting which might result in traps. A later development was the use of waves reflected at the underground boundaries. Smaller explosive charges were used and the seismic receivers were placed not far from the shot (distance measured in hundreds of feet). The reflection method reached a high degree of development in the 1930s, only P waves were used and only vertical component seismometers (see also GEOPHYSICAL PROSPECTING).

ENGINEERING ASPECTS OF SEISMOLOGY

There have been two schools of thought among engineers about the general theory of earthquake-resistant design. One of these is the "rigid" school, which holds to the thesis that a building should be as rigid as possible. In an ideal, perfectly rigid building the top and bottom would move exactly the same amount at the same time. Such motion would put large stresses into the frame which would be designed to support these stresses. The

other school, that of "flexibility," holds that a building should be able to sway during the motion. For example, in an extreme case a building built of vulcanized rubber like an automobile tire would not be damaged by a large shock although its contents would undoubtedly suffer. The stresses within the structure would probably not mount so high as in the rigid building. For very rapid ground motion the top might remain almost stationary. It must be noted that flexibility does not mean flimsiness or poor construction.

In practice, of course, builders are limited by building materials available. They cannot even approach the ideal cases cited above. Steel and brick and concrete for large structures and wood for dwellings limit rigidity and flexibility to a small range. Proponents of flexibility have suggested a first floor supported principally by columns which would allow a fair relative motion between foundation and higher floors. The rigidity advocates would thoroughly brace all parts of the structure. K. Suyehiro recommended rigid buildings on soft ground and flexible buildings on rock. His idea was that the small displacements possible in rock might be absorbed by lower floors but the large amplitudes possible in soil could not be so absorbed.

About 1928 the United States coast and geodetic survey embarked upon a program of accumulating seismological data of significance to engineers. An important part of this program was information on the effects of all earthquakes felt in the United States. Postcard questionnaires based on the modified Mercalli scale of earthquake intensities were placed in the hands of as many people as possible in seismic areas, particularly in California. Moreover, after any large shock a survey representative visited the scene of greatest effect and wrote a report.

In addition the survey undertook an instrumental program. For many years it had been assumed that the damage caused by an earthquake would be proportional to the maximum acceleration of the ground. From observation of the overthrow of monuments, assuming the earthquake force to be a continuing one rather than quickly changing in magnitude and direction, early seismologists had correlated the intensity from the scales of intensity with acceleration. From these old correlations it appeared that a horizontal acceleration of one tenth gravity might be accompanied by almost total destruction. A rule of thumb had been developed in some earthquake countries such as Japan that a building should be constructed to withstand at any level a steady horizontal force of one tenth its weight above that level. That this would make the building earthquake-resistant was not questioned but it was expensive. So the United States engineers wished to have the maximum acceleration observed instrumentally in California to see if one tenth gravity was not too high. The survey designed insensitive seismographs which would be able to record the large motions of strong earthquakes and set them up first in California and then more widely. Such instruments recorded the Long Beach earthquake of 1933, the Imperial valley shock of 1940 as well as many others. To the surprise of all, a maximum acceleration of three tenths of gravity was found not uncommon. But it accompanied waves of period around three tenths of a second or less, i.e., the forces it set up in the building changed direction very frequently. Buildings designed and constructed to withstand a steady force of only a few per cent of gravity stood up quite well. From this it became clear that the damage is not proportional to the maximum acceleration. It depends also on how often the acceleration changes directions, or on the period of the waves. The program of the coast and geodetic survey also included the measurement of the natural periods of vibration of many buildings with a view to determining how these periods may be related to later earthquake damage. Shaking-table investigations on models of buildings were carried out particularly by L. S. Jacobsen of Stanford University, Stanford, Calif. This type of work enables the prediction of maximum stresses to be expected within the structure. A large platform is caused to vibrate with a motion such as that of the earth in, say, the Long Beach earthquake. This motion is obtained from the strong-motion seismographs mentioned above. On the platform is constructed to scale a model of a building. Others have subjected arrays of pendulums to motion similar to that of

particular earthquakes and from their responses concluded something about stresses to be expected in buildings having the same free periods as the pendulums

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EARTHSHINE The earth is a luminary to the moon as the moon is to the earth, consequently the portion of the moon's



FROM LA SIO. GASTROPHYTE MUNDIALE
EARTHSTAR (GEASTER) GRAVUE
LOUIS: A KIND OF PUFF BALL
GROWING ON DECAYED LEAVES

disc which is not illuminated by the sun is illuminated by earthshine analogous to moonlight. It is a familiar observation that when the moon is a crescent the earthshine is powerful enough to make the whole disc easily visible. The phases of the earth and moon are complementary so that the earth is near "full" when the moon is near "new" and the earthshine is then strongest

EARTHSTAR (Geaster), in botany a kind of puff ball (p.v.), with a distinct outer coat which on separating from the inner, splits into several divisions, which become reflexed and spread like a star. The inner coat enveloping the spores is supported, like a ball, with or without a stalk on the upper face of the star. The spores generally escape by a distinct aperture which appears in the top of the ball. There are several species in Britain, found on the ground or on decaying leaves. They are generally distributed throughout America (See FUNGI)

EARTHWORM The term has been applied to include all terrestrial oligochaets (see ANNELIDA), but is usually restricted to larger forms belonging to the order Oligochaeta of which there are nearly 2,200 described species. Earthworms vary in size from small forms about 1 in. in length, such as the tree worms (e.g., *Brachistotus constrictus*) which live under rotting wood and bark, to very large species that have sometimes been mistaken for snakes. *Rhinodrilus fahneri*, a South American form, may be 6 ft. 10 in. (2100 mm.) long and nearly 1 in. (24 mm.) thick, while the giant Gippsland worm (*Megascaphodes australis*) is said to exceed 7 ft. when fully extended. Some earthworms are palid while many are red brown or purple, all are more or less indurate. A few are more brightly coloured, such as the green-worm (*Allolobophora chlorotica*) of Europe and North America, a Philippine species (*Pheretima opheodes*) is mottled with bright blue. The majority, when irritated, discharge a colourless fluid which may have an unpleasant odour, as in the brandling (*Eisenia foetida*), or be phosphorescent. Mature earthworms have a glandular girdle, the clitellum. They are hermaphrodite, but cross-fertilisation is effected by reciprocal copulation, eggs are deposited in cocoons secreted by the clitellum and slipped off at the anterior end of the worm. Sexual maturity is reached within six months or a year, depending on the time of hatching, and recurs annually thereafter, toward the end of the rainy season or in autumn and early winter, perhaps again in late spring. European Lumbricidae have been kept for many years in captivity.

The majority of species have a very restricted geographical distribution, owing to their poor powers of migration and to oecological barriers. Even tropical earthworms cannot withstand high temperatures and their bodies must constantly be kept cool by evaporation. As a consequence of the need for water, they cannot live in arid climates unless the soil is irrigated, and endemic (na-

tive) species are rarely found in regions that receive less than 15 in. per annum rainfall. During the dry season many species pass into a state of dormancy, coiled up within a protective coating of slime that solidifies the walls of the chamber into an earthy capsule. In this condition worms may become so dry as to be brittle and yet resume normal activity when moistened (N. A. Dmo), laboratory experiments indicate that recovery is possible after 73% of the body water has been lost. In Turkestan the activities of earthworms may be limited to 50 or 60 days of spring rainfall. Earthworms are generally most abundant in soils of approximate neutrality, but this is partly the result of improved nutritive conditions and only indirectly an effect of soil pH. Acid soils are tolerated by some species, the brandling and the gilt tail (*Den drobiana subrubicunda*) are found especially in decomposing manure. Saline habitats are favoured by a few species, such as *Pontodrilus bermudensis* which throws up sandy castings on tropical and subtropical beaches.

Important changes in the earthworm fauna result from cultivation of the land. In the steppes of central Asia, ploughing leads to a total extinction of the earthworm population, but, following irrigation, a new fauna is introduced that becomes more abundant than before. Only a relatively small number of species can withstand the special conditions of cultivation and these perigrines have been transported by man to all parts of the world. Temperate perigrines include a number of European Lumbricidae, while species of the oriental genus *Pheretima* are found in hothouses even where the winter climate is too cold for them to live out of doos. Oceanic islands are populated entirely by peregrine species.

Many earthworms are limicolous, the square tail (*Eisenella tetraedra*) occurs in river banks, sewage treatment plants, etc., some have gills and are entirely aquatic (*Alma naticola*). Even terrestrial species can live for many months in running water and the only from lack of food. *Eisenia foetida* can survive for two weeks, and *Pheretima* up to 45 hr., in an atmosphere of pure nitrogen (T. Nagano), but earthworms are readily anaesthetized by carbonic acid, and death in stagnant water must be attributed as much to this as to lack of oxygen. The appearance of large numbers of worms at the surface after heavy rains is interpreted as an effort to escape unfavourable conditions in the water-logged soil. Earthworms are also brought to the surface by poisonous chemicals, by vibration of the ground and, it is said, by electrical devices. Some terrestrial species live among decaying leaves, etc., while others are found only in the surface layers of the soil.



FROM W. NICHOLSEN IN HANDBUCH DER ZOOLOGIE

ACTIVITIES OF EARTHWORMS IN THE SOIL

Originally the surface was covered by a mosaic tile-pavement, overlying a sandy layer above the rich humus. Earthworms swilled soil to make their burrows and also at food and this is subsequently thrown up on the surface as castings. Repetition of this process has led to a sinking down of the pavement which has become covered with earth, except on the right where stone rubble prevented the settlement of the worms.

earthworm (*Microchaetus* sp.) working in shallow soil that rests on an impenetrable substratum. Many species, like the lawn-worm or night crawler, are nocturnal and come to the surface in moist humid weather to drag dead leaves and other organic matter into their burrows, the leaves are usually taken by their tips so that the stems remain protruding. Occasionally they may take fresh grass blades but there is little evidence that worms are harmful to living plants. J. K. Tarnani estimated that 10 kg. per sq. m. (over

The lawn worm (*Lumbricus terrestris*) has been taken 8 ft. below the surface but this is far exceeded by the burrows of *Den drobiana mariposensis* in south Russia, which are said to descend to a depth of more than 26 ft. The Komatie Flats of South Africa, cup-like depressions several feet in diameter, are attributed to the activities of a giant

20 lb per sq yd) of plant material may be dragged under ground during six months of activity per annum. Worms are generally very numerous under grass or in the soils of mixed and deciduous forests. K. Bretschneider recorded 2,000 per sq m from an alpine meadow, but this is exceptionally high. Estimates vary from small numbers up to about 500 per sq m, over 2,000,000 per acre, as in the irrigated soils of Lashkent, depending on the conditions.

Gilbert White noted the importance of worms as cultivators of the soil, but it was Charles Darwin who brought the subject to the attention of the world. Darwin observed how rocks and ancient ruins have become gradually buried under a layer of fine earth thrown up by earthworms. Estimates of the amount of soil that is thus transported are of the order of 15 to 40 tonnes per hectare (6.7 to 18 tons per acre) per annum with occasional maxima as high as 81.25 tonnes per hectare recorded by A. Stockli from a golf links. Such figures do not represent the total activity of the worms, part of the castings are discharged under ground and some species never come to the surface to defecate. In Rangoon an average of 12.8 tons per acre is attributed by G. E. Gates to the activities of only two of the eight species recorded from the experimental plots. Darwin estimated that a layer of soil 1 in. to 1.5 in. thick would be formed during a period of ten years and even higher values were deduced from the depths to which sunken objects had become buried. New soil ranged up to 6.6 cm (2.6 in.) with an average of about 2 cm. New soil formed in this way is not the same as the parent soil from which it was derived, although, in the case of species that live near the surface and constantly work over the same material, the difference may not be very great. The most effective soil producers are those which burrow deeply, bringing up the lower layers and dragging surface material under ground, in laboratory experiments on alpine species, H. Franz discovered that *Ocrotolus studium* is much more effective than other species which he investigated, including *Allobophora caliginosa* soil that passes through the body of an earthworm is mechanically sorted, since larger particles are rejected. The burrows of worms also improve the aeration of the soil, permit drainage of surface water, prevent water-logging, and facilitate the down growth of plant roots. Aeration affects the bacterial flora, the presence of earthworms increases the nitrifying powers and decreases putrefaction of the soil. In addition to the physical and mechanical effects of mixing, grading and aeration, the soil is benefited in other ways. Organic matter is broken down by the digestive juices and the environment is enriched by excretory products. Castings tend to be more neutral than the parent soil, irrespective of whether this be acid or alkaline. They have a lower clay content, are richer in nitrates, organic matter, total and exchangeable calcium, exchangeable potassium and magnesium, available phosphorus, base capacity, base saturation and moisture equivalent (H. A. Lunt and H. G. M. Jacobson). However, there is probably little to be gained by addition of earthworms to cultivated lands since, in the majority of cases, perennating species are already present in an established equilibrium. A temporary improvement in crop yield has been attributed to the fertilizing effect of the dead bodies of worms that were unable to survive in the new environment. On the other hand, measures that lead to improvement of the soil for plant growth also favour an increase in the earthworm population, with consequent beneficial action.

Earthworms are eaten by primitive people in various parts of the world and were considered a delicacy by the Maoris. They have also been used extensively in primitive medicine, apparently sometimes with good reason, modern investigations substantiate the fever-reducing and antispasmodic properties of certain oriental species. The bodies of earthworms are rich in pro vitamin D.

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EARWIG, an insect of the order Dermaptera, characterized by peculiar wings and a pair of horny forceps terminating the abdomen. The large, membranous, radially veined hind wings fold both radially and transversely so as to be hidden under the short leathery tegmina. Winged species rarely fly, and many are wingless. The male forceps are larger and differently shaped than those of females, in some species they are quite bizarre. The male forceps also usually fall into two sharply marked size classes, with few of intermediate length. *Forficula* affords a classic example of such bimodality, which, however, is more complex than was supposed (Chopard 1938), the cause may be a variable relation between time of last moult and beginning of rapid forceps growth (Huxley 1932). The name earwig comes from the Anglo-Saxon *eorwiga* (ear creature), and most European languages have an equivalent popular name because of an ancient, widespread but unfounded superstition that earwigs crawl into the ears of sleeping persons. Several families and more than 500 species are known, mostly from the tropics, Europe has about 30 species, Great Britain 7, and North America 15. A fossil earwig (*Protodiplax*) from Jurassic beds in Kazakhstan seems to link Dermaptera with ancestral cockroaches (Protoblattodea). The peculiar insects of the genus *Hemimerus* (family Hemimeridae), parasitic on giant African rats (*Cricetomys*), are sometimes ranked as a suborder of Dermaptera, sometimes as an order (*Hemimerina*). The Dermaptera were formerly placed in the Orthoptera (*q v*)

The common European earwig (*Forficula auricularia*) is a well known pest of gardens and houses. Commerce borne from its native Europe, it has outposts in North and South America, New Zealand and Tasmania, and seems destined to become cosmopolitan. It is omnivorous, feeding mainly on green plants, but it prefers anything more nourishing that it can find, and often swarms in kitchens. It is probably predatory, for *Labidura riparia* and other earwigs use the forceps to catch insects and hold them for eating. When alarmed or aggressive, earwigs carry the forceps over the head in scorpion fashion, the males fight sexual battles with them. *F. auricularia* overwinters in small cavities in soil, 40-60 eggs are laid therein in fall or early spring, and the mother guards and cares for the eggs and young. Nymphs hatch in April-May (Great Britain, Oregon) and remain in the nest, fed by the mother, until after the first moult. When the female opens the nest the young wander off. Four to six moults occur, after each the nymph is inflated with swallowed air and therefore is white, but it soon darkens. After the young depart the female feeds for a time and then rears a second brood. The best control is by scattering bran bait poisoned with sodium fluoride over the ground and in places where earwigs congregate, it is best done in the evening. If the bait is applied when most of the first brood of young earwigs have begun to feed at night, this brood and the adults can be poisoned before the second lot of eggs is laid. Trapping earwigs in plant pots stuffed with straw and inverted on upright sticks is a long established practice in Europe, but not a very effective one.

See L. Chopard, *Biologie des Orthoptères* (1938), J. Huxley, *Problems of Relative Growth* (1934), and works on Orthoptera (*q v*) (T. H. H.)

EASEMENT, in law, signifies a right of accommodation, or limited right of use over land belonging to another. It is distinguished from *profit à prendre* since an easement confers merely a convenience to be exercised over the land of another without any participation in the profits of it. Thus a right of way is an

an easement a right of common is a profit. An easement is distinguishable also from a licence, which, unless it is coupled with a grant, is personal to both grantor and grantee and is neither binding on the licensor, nor, in general, assignable by the licensee, while both the benefit and the burden are annexed to land.

The essential features of an easement, in the strict sense of the term, are therefore these: (i) It is an incorporeal right, a right to the use and enjoyment of land—not to the land itself, (ii) it is imposed upon corporeal property, (iii) it is a right without profit, (iv) it requires for its constitution two distinct tenements—the "dominant tenement" which enjoys the right, and the "servient tenement" which submits to it. This last characteristic excludes from the category of easements the so-called "easements in gross" (if such can subsist by English law), such as a right of way conferred by grant independently of the possession of any tenement by the grantee. The true easement is a right "appendant" or "appurtenant" to the dominant tenement.

Further classifications of easements must be noted. They are divided into (a) *affirmative* or *positivæ*, those which authorize the commission of an act by the dominant owner, e.g., rights of way, and *negativæ*, when the easement restricts the right of the servient owner over his own property, e.g., prevents him from building on land so as to obstruct ancient lights (v), (b) *continuous*, of which the enjoyment may be continual without the interference of man, e.g., access to light, and *discontinuous*, where there must be a fresh act on each occasion of the exercise of the right, e.g., a right of way, (c) *apparent*, where there are visible external signs of the exercise of the right, e.g., a right to dam up a watercourse, and *non apparent*, where such signs are absent, e.g., a right to support of one house by another.

Acquisition of Easements—Easements may be acquired (a) by express grant, (b) by an implied grant, (c) by express or implied reservation, e.g., by the owner of land in selling the fee, (d) by prescription, either at common law or under the Prescription Act, 1832. An express grant, or express reservation (*inter vivos*), of an easement cannot be effected except by deed. An easement by implied grant usually arises under the principle that a grantor cannot derogate from his own grant. Thus a man builds two houses on a close with windows deriving light from the grounds of each other. If he sells one a grant of the light derived by it over the other's ground is implied.

Easements are acquired by prescription at common law by proof of "immemorial use" by the dominant owner and those through whom he claims. A "lost grant" is presumed on proof that an easement has been enjoyed uninterruptedly for 20 years before action brought unless the contrary is shown. To avoid the difficulties of proof of prescriptive right at common law, the Prescription Act, 1832, established more definite periods of use. In the case of easements other than light, the periods of prescription are 20 years to establish a *prima facie*, and 40 years to establish an indefeasible title. (As to light, see ANCIENT LIGHTS.) The enjoyment of the easement by the dominant tenement must be open, i.e., not hidden, and of right, i.e., not by arrangement with the owner of the tenement affected by it (*Kilgour v Gaddes*, 1904, 1 K B 457).

Easements may be extinguished (i) by express release—here an instrument under seal is necessary, (ii) by "merger," i.e., where both tenements become the property of the same owner, (iii) by abandonment through non-user. In the case of discontinuous easements, the shortest period of non-user may suffice if there is direct evidence of an intention to abandon.

A word may be added here as to the right to air. The owner of a dwelling-house may acquire a right to the passage of air through it by a defined channel. If it is claimed by prescription the proof required to establish it is the old common law proof, since the air easement is not one within the Prescription Act. It may also be acquired by grant, express or implied.

In Scots law the term "easement" is unknown. Both the name "servitude" and the main species of servitudes existing in Roman law (*quæ*) have been adopted. The modes of their creation and extinction are similar to those of English law. The statutory period of prescription is 40 years (Scots Acts, 1617, c. 12), or 20

years in the case of enjoyment under any *ex facie* valid irredeemable title duly recorded in the appropriate register of sasines (Conveyancing [Scotland] Act, 1874). There are certain servitudes special to Scots law, e.g., "thirlage," by which lands are "thirled" or bound to a particular mill, and the possessors obliged to grind their grain there, for payment of certain quantities of grain or meal as the customary price of grinding. Statutory provision has been made for the commutation of these duties (Thirlage Act, 1799), and they have now almost disappeared.

The French civil code and those of Belgium, Holland, Italy and Spain closely follow Roman law. French law is in force in Mauritius, and has been followed in Quebec (Civil Code, arts 499 *et seq.*) and St. Lucia (Civil Code, arts 449 *et seq.*). In India the law is regulated, on English lines, by the Easements Act, 1882 (Act v. of 1882). The term "easements" is however, in India includes *profits à prendre*. In the South African colonies the law of easements is based on the Roman Dutch law. In most of the other colonies the law of easements is similar to English law. In some, however, it has been provided by statute that rights to the access and use of light or water cannot be acquired by prescription, but municipal by-laws must be examined in this relation.

In the United States the law of easements is founded upon, and substantially identical with, English law. The English doctrine however, as to acquisition of light and air by prescription is not accepted in most of the States.

See Gale, *Law of Easements* (8th ed., 1908), Goddard, *Law of Easements* (6th ed., 1904), Peacock, *Easements in British India* (Calcutta, 1904), W. Burge, *Commentaries on Colonial and Foreign Laws*, vol. iv, pt. 2 (new ed., 4 vols., 1907-27), Jacques Vollenweider, *Étude sur les droits distincts et permanents en droit civil suisse*, Lausanne (1923).

EAST, ALFRED (1849-1913), British painter and etcher, was born at Kettering, Northamptonshire, on Dec. 15, 1849. He studied at the Glasgow School of Art and then in Paris at the École des Beaux Arts, and under Robert Fleury and Bouguereau. He began to exhibit at the Royal Academy in 1883, and became R.A. in 1913 a few months before his death. In 1906 he became president of the Royal Society of British Artists. Many of his works are to be found in the English provincial galleries, his "Passing Storm" is at the Luxembourg, Paris, "The Nene Valley" at the Venice gallery, and "A Haunt of Ancient Peace" at the National gallery in Budapest. East visited Japan in 1889, and among his best works are the landscapes he painted there. From 1903 onwards he took a keen interest in etching, and produced a large number of plates. He also published a useful, practical book on landscape painting, *The Art of Landscape Painting in Oil Colour* (1906). Shortly before his death he presented a collection of his pictures to his native town, Kettering. He died in London on Sept. 28, 1913.

EAST AFRICA, OPERATIONS IN. When the World War broke out in 1914 the garrison of British East Africa, the territory immediately north of German East Africa, was scattered and engaged on punitive expeditions remote from the enemy frontier. In the case of each Protectorate the troops were native with European officers. The German forces, some 5,000 strong, including 260 Europeans, lay ready to the hand of their commander, Von Lettow Vorbeck, a capable and determined soldier well able to employ them to full advantage. If it is remembered how keenly sensitive the native soldier is to any shortcoming in his superior and that Von Lettow had only been with his command for six months when hostilities began and kept that command efficient and formidable through four years of steadily declining fortune, some idea may be formed of the resolute nature and soldierly qualities of the German commander-in-chief. His operations consistently bore the clear imprint of his skill and personality, and there were advantages, other than his professional capacity and steady courage, upon which he could rely.

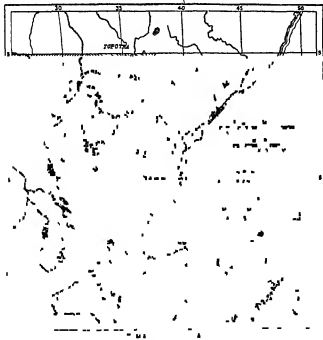
I. EARLY OPERATIONS

The country—nearly double the size of Germany in 1914—was the scene of operations, as for the most part covered by bush, dense as a rule, but occasionally thinning out to something like park land. High mountain ranges, thick with vegeta-

tion, rent themselves from bush and jungle which are fever stricken and liable to wholesale inundation during the rainy season. Rivers abound and malaria and dysentery of a malignant type, with other tropical diseases, combined to swell the casualty list of a European or Anglo-Indian force. Practically every animal imported into East Africa for the use of the British forces succumbed to the tsetse fly. The route of every British advance was marked by casualties due to diseases from which the rank and file of the enemy—askaris recruited from local tribes—were immune. Surprise by the attacker was as difficult as it was simple by the defender, who waited concealed and warned by the laborious approach of his adversary cutting roads and bridging rivers.

Supply and transport presented appalling difficulties to an advance through hundreds of miles of naturally impenetrable bush, while the defending force slowly fell back upon the magazines posted in its rear. Only an overwhelming preponderance in numbers made any advance possible, but a force starting with a strength adequate for an offensive enterprise constantly found itself reduced at best to an equality of strength on contact with the enemy. Many good cards were thus in the hand of the German commander, and he rarely failed to play them with full effect.

Naval Operations and German Advance.—On Aug. 8, 1914, two British cruisers, "Astraea" and "Pegasus," arrived opposite Dar es Salaam from Zanzibar, and, being unable to leave a garrison, the naval commander covenanted with the German governor that the latter should forbear from any hostile action in Dar es Salaam itself. Parallel to the southern frontier of British East Africa and about 500 miles distant from it ran the Uganda railway from Mombasa to Lake Victoria. This tempting and exposed objective, for the protection of which the British troops at the outset were hopelessly inadequate, at once appealed to Von Lettow, who on Aug. 15 seized Taveta, which lay in British territory at the eastern end of the gap between the southern slopes of Mt. Kilimanjaro and the northern end of the Pare mountains in the German Pro-



tection. An enemy force here was a standing menace to the British capital at Nairobi, and constantly raided the railway line.

In September the enemy cruiser "Königsberg" returned to Dar es Salaam and on Sept. 20 surprised and destroyed the "Pegasus" while undergoing repair in the Zanzibar roadstead. A combined enemy operation against Mombasa, for the execution of which the "Königsberg" was to attack the port in conjunction with a land force moving north along the coast, failed, as the "Königsberg" was driven by the ships of the Cape Squadron into the Rufiji delta, where she was run aground. The land force began its march along the coast on Sept. 20, was repulsed at Gazi, 250 miles from

Mombasa, on Sept. 23, and retired to the frontier on Oct. 8. The crew of the "Königsberg," which was blown up in July 1915, after being set on fire by the monitors "Severn" and "Meisey," joined the enemy land forces, with an armament of ten 4.7 guns.

German raids along the coast, on the Uganda railway, and into the frontier districts of Uganda, Belgian Congo, Rhodesia and Nyasaland were frequent in the opening months of the campaign. These small enterprises were much simplified by the central position of the enemy and the excellent lateral communication afforded by the central railway from Dar es Salaam to Kilimanjaro on Lake Tanganyika. This lake was under German control until Dec. 1915, when by the operations of motor boats specially brought from Capetown the enemy was deprived of the one lake which had not been in British hands since the earliest days of the campaign.

Reinforcements from India.—It soon became apparent that, unaided, the British Protectorate forces could not hold their own, and the Government of India consented to send an expedition. On Aug. 25 its leading unit reached Mombasa with Brig-Gen Stewart, who assumed command. The rest of the expeditionary force was directed on Tanga, the northernmost German port, at the southern extremity of the Usambara mountains, healthy highlands where the bulk of the German settlers resided. Coincident with an attack on Tanga an advance against Moshi by the north of Kilimanjaro was to be made by Stewart. The expeditionary force under Brig-Gen A. E. Aitken was about 7,000 strong and (except the 2nd Loyal North Lancs.) composed of Indian troops.

Failure of British Offensive.—The transports reached Tanga on Nov. 2, when the local commissioner represented the place as an open and undefended port and bombardment was deferred. Meanwhile, Von Lettow, advised of the plan by captured Indian mails, was hurrying reinforcements to the coast. When one and a half British battalions landed two miles east of the town on the evening of the arrival, they met with strong opposition and fell back. Von Lettow arrived on the evening of the following day, when British reinforcements had been landed and fighting resumed, and on Nov. 4 heavily defeated his opponent, whose casualties were 705. On the same day Stewart, checked at Longido, was compelled to retire. The British force at Tanga re-embarked and reached Mombasa on Nov. 5. The first British offensive had thus failed completely. Von Lettow's success at Tanga put an end for the time being to any general offensive against him, and it was not until 1916 that the next British advance was set in train.

The intervening period was occupied in raiding by both forces, with occasional engagements of a more ambitious nature. A British force was compelled to surrender on Jan. 17, 1915, at Jasin, in enemy territory, to a superior force, after 48 hours' fighting, which exhausted their ammunition and water. German losses, especially in officers, were serious, as was the shrinkage of ammunition. Maj-Gen M. I. Tighe assumed chief British command in April 1915 and in June, Bukoba, on Lake Victoria, was taken.

Reinforcements Arrive.—Aid was now sought from a different quarter, for, with the conquest of German South-west Africa by General Louis Botha in July 1915, the resources of the Union of South Africa became disposable to an extent which was impossible till the disappearance of the enemy from her own border. During the latter half of 1915 there was continuous preparation in South Africa of troops, depôts, supplies, medical stores, transport, animals and material of all kinds for use in East Africa. By Feb. 1916 one mounted brigade, two infantry brigades and one field artillery brigade, complete with all their auxiliary units, had arrived from South Africa to join Tighe. A second mounted brigade followed, together with a battalion of the Cape Corps (coloured men from the Cape Province). Tighe also had the following European units: the Calcutta Volunteer Battery, the 2nd Loyal North Lancs., 25th Royal Fusiliers, 2nd Rhodesians and two local settlers' corps. India sent him from her native army ten infantry regiments, one squadron of cavalry and two mountain batteries. The battalions of King's African Rifles were the original native Protectorate force. At the same time, Von Lettow's force had reached the highest limit which it attained in the campaign and was probably over 20,000. The exact combatant strength

is difficult to estimate, for there were many carriers of whom a percentage were armed and many trained as askaris. The askari in his own country is a soldier of high value. Such a force, with a strong leaven of Europeans, under a skilful and determined commander, was a formidable adversary in tropical bush country.

German Ammunition Supplies.—In April 1915 the mind of Von Lettow, which had been sorely exercised by his shortage of ammunition, was relieved in the following remarkable manner. A British ship, the "Rubens," seized at Hamburg, left that port loaded with arms and ammunition and appeared off Tanganyika on April 4, being sighted by H.M.S. "Hyacinth." Finding Manza Bay on fire and abandoned, she was boarded by bluejackets, who found her lumbered up and buttressed down. After firing more rounds the "Hyacinth" steamed away on the assumption that her quarry would burn herself out. The Germans returned and salvaged almost the entire cargo, and a largely increased volume of enemy fire from the Mauser pattern 1898 rifles which the "Rubens" had brought was the result. This operation was repeated a year later.

II OPERATIONS UNDER GENERAL SMUTS

The chief command in East Africa was assumed by General Smuts in Feb. 1916. He had previously declined the post, but when General Smith-Dorrien was compelled to relinquish the command in consequence of illness he accepted it. He reached Mombasa on Feb. 19 and found the railway completed from Voi to Serengeti, 500 miles from Salaita Hill, the German advanced position from Taveta. A week earlier an attack on Salaita had failed. The rainy season was at hand and movement would then become impossible. Smuts telegraphed to Lord Kitchener that he was ready to carry out the occupation of the Kilimanjaro area at once. The proposal was agreed to and Smuts proceeded to advance.

British Advance on Taveta.—An attack, designed primarily to hold the enemy, was to be delivered on Salaita by a force under General Malleson, while Stewart was to repeat his attempt of 1914 to reach Moshi by the north of Kilimanjaro and thence to intercept any enemy retirement in his direction. General Van Deventer with a mounted brigade, moving by Malleson's right, was to cross the Lumi river, and by way of the foothills of Kilimanjaro cut the enemy line of retreat between Taveta and Moshi. The execution of this movement unobserved was the only chance of surprising the enemy, for it was apparent to Von Lettow, who had made all preparations for retirement, that Taveta was Smuts' objective. This surprise was effected. Van Deventer moved on March 8 and on the following day his troops were astride the Moshi-Taveta road. On the same day the Germans evacuated Salaita and took up new positions on two hills, Latema and Reata, covering the gap between the Pare mountains and Kilimanjaro. The main enemy force was posted at Himo, 500 miles from the gap, whence it could move in any direction to attack or retire. The progress of Stewart's force was so slow that his movement was without effect.

The new enemy position was attacked on March 11 and, after severe fighting all day and the succeeding night, was occupied on the morning of the 12th by a general advance in support of the elements which had won their way to the two peaks during the night and caused a retirement by the enemy.

German Withdrawal.—Von Lettow now withdrew his entire force to a position (Kah-Ruvu) which situated south of the Taveta-Moshi road from Kah-Ruvu station and toward along the northern end of the Pare mountains. He was followed up and attacked on March 18 from Latema by Brig. Gen. Sheppard and on March 20 Van Deventer was sent from Moshi to turn the enemy at Kah. He seized Kah on March 21 and on the following night, after a very severe action with Sheppard, the enemy withdrew to Lembeni, 200 miles S. of Kah. Von Lettow abandoned one 4.1 gun, and had expended ammunition to an extent which he could ill afford, but his force was intact and the timely arrival of the second blockade runner at this juncture, with four 4.1 field howitzers, gun and small arm ammunition, machine guns, stores, provisions and clothing was an inestimable stroke of good fortune. Here the operations which had been undertaken before the rainy season were concluded and the British forces took up positions covering Taveta and Moshi and facing the enemy at

Lembeni.

During the ensuing rains Smuts reorganized his force and prepared to resume the offensive at the earliest possible date. He could rely for assistance in his main operations upon the Belgians in the north-west and the British force under Maj. Gen. Northey, operating from Nyiraland, to the south-west. For reasons fully recorded in his dispatches, Smuts decided at once to send Van Deventer with a mounted force rapidly by Arusha to Kondoa Irangi and thence to the central railway and east along that line to Morogoro. His own force was to move south by the Pangani, and make for the same ultimate objective, Morogoro. It was hoped that Von Lettow would there be brought to bay by the two converging forces.

New British Offensive.—Van Deventer moved on April 3 and occupied Kondoa Irangi on April 10, capturing the enemy garrison at Lol Kasale en route. He reached Kondoa Irangi after heavy casualties in men and animals from disease and was there cut off and reduced to immobility as a consequence of his losses and the advent of the rainy season. Von Lettow concentrated a force against Van Deventer and fighting ensued, but the German attacks, with one exception, lacked vigour and were all repulsed. Van Deventer's position was used by the end of May, when Smuts began his advance down the Pangani and the Belgians moved on Tabora. Maj. Kraut was in command of the German force opposite Smuts when the latter set his troops in motion southwards from Moshi on May 18, Von Lettow having assumed direction of his concentration against Van Deventer.

Systematically outflanked by his opponent, whose main advance along the Pangani was supplemented by flank movements by the Pare and Usumbara ranges, Kraut found himself compelled to leave the Tanga railway and retire upon Handeni. This place was seized by Smuts on June 19, Korogwe having been occupied four days earlier. On June 24 the Germans were attacked simultaneously on three sides, but, after determined fighting, withdrew into the Nguru hills. Smuts was now compelled to halt his force on the Mshia river. In a month 2500 had been covered, but malaria had reduced the strength of all units, combatant and non-combatant, in some instances to 30% of their original numbers. The troops were on half rations, and the transport, which included a variety of types of motor vehicles, was much damaged. The coast region was now dealt with, and with the aid of the navy, Tanga, Pangani, Sadani and Bagamoyo were successively occupied between July 17 and Aug. 15. The removal of the British base to Tanga saved 2000 miles of rail transport. Dar es Salaam was occupied on Sept. 4, but three months elapsed from its capture before it could be used as the base.

German Retreat.—Von Lettow now moved the bulk of his force once more opposite Smuts, and on June 24 Van Deventer resumed his advance and at the end of July held the central railway from Kilimanjaro to Kilombo, about 100 miles. On Aug. 9 he was ready to move on Morogoro. The Belgians were at the same time advancing on Tabora against the German force under Maj. Gen. Wahle, who was left to do his best unaided, though some reinforcements were sent south-west against Northey. Smuts moved again on Aug. 5, opposed by a detachment of the enemy whose main force was withdrawn to Kilosa, whence it proceeded south towards Mahenge, the eventual direction of the enemy retirement on all fronts. Von Lettow directed the remainder of his forces by a route through the Uluguru mountains, thus foiling the attempt to intercept him at Morogoro. Heavy fighting ensued in these mountains but Kiasa fell into British hands on Sept. 15 and Von Lettow retired to Mgeta river and there entrenched himself. On this front, during the last three months of 1916, activity was confined to such minor affairs as are usual between opposite entrenched forces. Civil administration was instituted in the occupied area behind the British forces.

Belgian Operations.—The Belgian force (also native), under Maj. Gen. Tombour with European officers, was divided into two brigades, the Northern (Col. Molitor) and the Southern (Lt. Col. Olsen) and operated in the north-west of German territory, opposed by Wahle, who was instructed to avoid a decisive action. The Belgian operations, well planned and successfully executed,

were of prime importance to the general campaign. Broadly described, they were as follows. Molitor invaded Ruanda by the north of Lake Kivu while Olsen co-operated south of him by the north of Tanganyika. The movements started on April 4, and by the end of May the Belgians were in possession of Ruanda. Molitor then sent columns south-west to join hands with Olsen and other columns south-west to Lake Victoria, which was reached on June 27.

In the middle of July, on a front between Tanganyika and Victoria, Molitor and Olsen moved south on the respective objectives of Tabora and Kigoma, the terminus of the central railway on Tanganyika. Olsen occupied Kigoma on July 28 and Ujiji on Aug. 2, and then moved east on Tabora. Co-operating with Molitor was a British column under Brig. Gen. Sir C. P. Crewe, who captured Mwanza on the southern shore of Lake Victoria on July 14. On Sept. 19 Molitor occupied Tabora which Wähle had evacuated the previous day, leaving behind him sick with civilians and prisoners of war. Crewe reached the central railway a week later.

British Advance from Rhodesia.—By this time Northey had succeeded in interposing some of his forces, which were in three columns under Lt.-Cols. Hawthorn, Murray and Rodgers (the last a South African unit), between Tabora and Mahenge. His advance was on an original front between Lakes Nyasa and Tanganyika. Murray occupied Kasanga (Bismarckburg) at the south end of Tanganyika on June 8. The Germans were defeated at Malangali on July 24, and on Aug. 29 Iringa was occupied, Lupembe having been seized ten days earlier. Northey, ordered with van Deventer, now at Kilosa, to deal with the enemy in the Mahenge district, was much outnumbered by forces already in touch with him and Wähle's columns approaching from the north, and on the night of Oct. 21 most of Wähle's troops broke through him. On the same day Kraut was heavily defeated at Mkipira. Hawthorn secured the surrender of an enemy column at Ilembe on Dec. 24. van Deventer and Northey attacked the Mahenge force. An enemy column surrendered to Northey, but the force engaged with van Deventer escaped him after fighting from Dec. 25 to 28.

Position at End of 1916.—By the beginning of 1917 Smuts had evacuated 12,000 to 15,000 white troops (South Africans), mostly victims to malaria, and they had been replaced by the Nigerian Brigade (Brig.-Gen. Cunliffe) and fresh battalions of the King's African Rifles. Kilwa and Lindi, south of Dar es Salaam, had been seized by the navy and a force under Maj. Gen. Hoskins had been concentrated at Kilwa. On Jan. 1, 1917, an advance was made on the Mgeta position, but after heavy fighting the enemy retired across the Rufiji at Kibambawe. Smuts now went to England and Hoskins assumed the chief command. The rains ensued, and to clear the north bank of the Rufiji was all that could be barely accomplished before operations ceased. Hoskins completely reorganized his command, but before operations were resumed he was ordered to Palestine. His successor was van Deventer, who assumed command at the end of May 1917.

III. VAN DEVENTER'S OPERATIONS

The enemy forces were disposed as follows. Von Lettow near Kilwa, Wähle in the Lindi area, Tafel at Mahenge, detachments between Kilwa and Lindi, and near the Ruvuma. Northey lay south and west of Tafel with another British force at Iringa, north-west of the enemy. The rest of van Deventer's troops were to act against Von Lettow. In pursuance of this decision an advance was made by the Kilwa force under Brig.-Gen. Beves on July 5 towards Luwale. The enemy fell back to Narungombe, where a severe engagement took place on July 19. The enemy retired south, but the Kilwa force was unable to move again until mid-September. In August the enemy was driven from the Lukuledi estuary to allow of an advance inland from Lindi. The Kilwa force (Hannington) was to move south and that at Lindi (Beves) west. These operations were marked by the hardest fighting of the whole campaign. Von Lettow fell back, under pressure by Hannington, towards Nyanga, 40m. S.W. of Lindi, Wähle retiring before Beves. On Oct. 15 a four days' battle began between Beves' force and the enemy under Von Lettow

joined by Wähle. The latter retained their position and it was ten days before Beves' force under the command of Cunliffe could resume the offensive.

On Oct. 8 Tafel, pressed by Northey with Belgian co-operation from the north, had retired from Mahenge, and, breaking through two weak detachments on Nov. 16, moved south-east towards Von Lettow, whom he was debarricaded from joining by the Kilwa force. Vanly endeavouring to join the main body, Tafel reached the Ruvuma, but, unable to procure food, surrendered with his entire force on Nov. 28.

Germans Retire to Portuguese Territory.—On the night of Nov. 25–26 Von Lettow, having shed all weaklings, crossed the Ruvuma into Portuguese territory and thenceforward moved as the circumstances of his position, without bases and short of ammunition, dictated. Early successes in the new sphere of action, especially at Ngomano, gave the Germans food, ammunition, arms and clothing, and when the rainy season set in, in Jan. 1918, they were able to rest for a short time.

The operations during 1918 were carried out almost entirely by natives, the King's African Rifles, and Von Lettow fell back upon guerrilla tactics. Against him in Portuguese territory were sent columns from the east and south shores of Nyasa, and another (Brig. Gen. Edwards) advanced west from Porto Amelia midway between the Ruvuma and Mozambique. After various engagements Von Lettow marched in May south to the Lurio river, 200m. from German territory, captured Ille, and in June reached the coastal region near Quelimane. On July 1 he captured Nyamakura, 25m. from Quelimane, and in the middle of August at Chalanta, eluded envelopment by converging columns. Turning north-west, he was engaged by Hawthorn (who had succeeded Northey) at Liomni, east of Lake Shirwa. After several encounters, the German force reached the Ruvuma again on Sept. 28 and, after resting at Ukena, where Wähle was left, set out for Rhodesia. On Nov. 1 Von Lettow made an unsuccessful attack on Fife and, turning south-west, took Kasama on Nov. 9. Advised on Nov. 13 of the Armistice, he accepted it the following day, and on Nov. 23 formally surrendered to General Edwards at Abercorn. With him were Dr. Schnee, the governor, and Maj. Kraut, together with a force of 30 officers and 125 other Europeans, 1,165 askaris and 2,897 other natives (including 819 women), 1 small field gun, 24 machine-guns and 14 Lewis guns.

Troops Engaged, Casualties, Etc.—The troops employed by the Allies in East Africa included 52,339 sent from India (5,403 British) and 43,477 South African whites. East African and Nyasaland settlers, Rhodesian volunteers and the 25th Fusiliers numbered about 3,000, African troops (King's African Rifles, Nigerians, Gold Coast Regiment, Gambia Company, Cape Corps) and West Indians about 15,000, an approximate total of 114,000 not reckoning Belgian native troops (about 12,000 in all), Portuguese and the naval force engaged. The greatest number in the field at any one time, May to Sept. 1916, was about 55,000, the lowest, in 1918, 10,000, all African, save administrative services. See also KENYA.

British and Indian casualties were returned at 17,823, of these 2,762 were in the South African Forces. These figures are exclusive of casualties among carriers and of deaths and invaliding through sickness, which among the South Africans alone exceeded 12,000. The cost of the campaign to Great Britain, inclusive of Indian and South African expenditure and that of the local protectorates to March 1919, was officially estimated at £72,000,000.

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EAST ANGLIA. one of the kingdoms into which Anglo-Saxon Britain was divided. Bede gives no information about its origin except that its earliest settlers were Angles. The kingdom of East Anglia comprised the two counties of Norfolk and Suffolk, with a western boundary probably formed by the fens of Cambridgeshire.

This kingdom first appears in Bede's narrative early in the 7th century, when its power was at its height. Towards the end

of the reign of Aethelbert who died about 616. Raedwald of East Angles began to win for himself the chief position among the Anglo-Saxon kings of his day. His position was assured, at least temporarily, in 617, when he decided to espouse the cause of the Northumbrian prince Edwin, then a fugitive at his court, and defeated Aethelfrith of Northumbria on the banks of the Idle, a tributary of the Trent in Mercian territory. Raedwald had been converted to Christianity in Kent, but after his return home he refused. Bede states that he was the son of Tytil, the son of Wulf, from whom the East Anglian royal family derived their name Wuffingas. According to the *Historia Brittonum* Wuffa (Wuffa) was the son of (Guecha) Wehha who first ruled the East Angles in Britain. This would put the organization of the kingdom in the first or second quarter of the 6th century. Eorpwald, the son of Raedwald, was converted to Christianity by Edwin but was soon afterward slain by Ricbert (627 or 628), whereupon the kingdom again became pagan for three years, when Sigebert, the brother of Eorpwald, became king and founded a see for Felix at Dunwich. Sigebert also founded a school in East Angles, and on the arrival of an Irish missionary named Fursey he built him a monastery at Cnobheresburg, perhaps to be identified with Burgh castle. Before 644, however, Sigebert resigned the crown in favour of his brother Egbert and retired to a monastery. Shortly afterward both brothers were slain by Penda of Mercia in his invasion of East Angles, and Anna became king. This king was an enthusiastic Christian and converted Coenwalh, king of Wessex who had fled to his court. Two of his daughters, Saethryth and Aethelberg, took the veil, while another, Seburg, was married to Loarnbert, king of Kent, a fourth, Aethelrith, after two marriages, with Fondbert of the South Gyrwe and Egrif of Northumbria, became abbess of Ely. In 654 Anna was slain by Penda of Mercia and was succeeded by his brother Aethelhere, who was killed in 655 at the Winwæd, fighting for the Mercian king against Oswiu of Northumbria. In 673 Archbishop Theodore divided the East Anglian diocese into two, Elmham being the seat of the northern Dunwich that of the southern bishop. A long blank follows in the history of this kingdom, until in 792 Offa of Mercia slew Aethelbert, king of East Angles, who is said to have been his son-in-law. East Angles was subject to the supremacy of the Mercian kings until 825, when its people slew Beornwulf of Mercia and with their king acknowledged Egbert of Wessex as their lord. In 870 Edmund, king of East Angles, was killed by the Danes under Ivar and Ubbe, the sons of Ragnar Lothbrok.

The following is a list of the kings of East Angles of whom there is record: Wehha, Wuffa, Raedwald, son of Tytil and grandson of Wuffa (reigning 617), Eorpwald, son of Raedwald (d. 627 or 628), Sigebert, brother of Eorpwald, Egbert, brother of Sigebert (both slain before 644), Anna, son of Ene and grandson of Tytil (d. 654), Aethelhere, brother of Anna (d. 655), Aethelwald, third brother, Aldwulf (succ. 663, d. 713), son of Aethelric and grandson of Ene, Elfwald, son of Aldwulf (d. 749), Hun Beonna and Albert, Aethelbert (792), Edmund (870).

After the death of Ragnar Lothbrok's sons East Angles was occupied by the Danish king Guthrum, who made a treaty with Alfred settling their respective boundaries, probably about 880. Guthrum died in 890. A later king named Eohric took up the cause of Aethelwald, the son of Aethelred I, and was slain in the fight with the Kentish army at the Holm in 905. A war broke out with King Edward the Elder in 913, in 921 a king whose name is unknown was killed at the fall of Tempsford, and in the same year the Danes of East Angles submitted to Edward the Elder. From this time, probably, East Angles was governed by English earls, the most famous of whom were Aethelstan, surnamed Half King (912-926), and his sons Aethelwold (926-962) and Aethelwine, surnamed *Dei amicus* (962-992).

See Beck, *Hist. Fecl.* ed. by C. Plummer, i, 5, 15, 17, 7, 8, 18-20, 22, 16, 1, 3, 5, 1 (Oxford, 1896); *Saxon Chronicle*, ed. by Earle and Plummer, i, 5, 1, 8, 18, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

EAST BENGAL (EAST PAKISTAN), the isolated eastern province of Pakistan separated from the country's main tract in the

northwest by about 1,000 mi. of Indian territory. Although it has only about one seventh of the total area of Pakistan it contains about 58% of the total population. Area 54,501 sq. mi. Population (1951 census) 42,062,610 (including about 32,200,000 Moslems, 9,200,000 Hindus). East Bengal comprises the eastern part of the former British Indian province of Bengal, partitioned between the dominions of India and Pakistan in 1947, together with most of the former Assam district of Sylhet. The provincial capital is Dacca (q.v.). East Bengal is governed by a premier and elected legislature and is administered in three divisions (Dacca, Chittagong, Rajshahi) divided into 17 districts.

History.—East Bengal's isolation from the Moslem home lands in the northwest had at least one advantage in 1947 in that the province was largely withdrawn from the kind of violent strife that accompanied the Punjab partition. In the early years of Pakistan, moreover, East Bengal alone of the provinces enjoyed reasonably tranquil relations with Karachi. Indeed on the death of Mohammed Ali Jinnah (q.v.) in Sept. 1948, the East Bengal provincial premier, Khwaja Nazimuddin, succeeded him as governor general.

After 1949, however, the province's difficulties entered around three topics: race, minorities and provincialism. Jute is almost all grown in East Bengal but is processed for export in Indian West Bengal. In 1950, consequent upon the Indian rupee's devaluation, a dispute arose over raw jute prices, India, in retaliation, stopped all supplies to East Bengal, mills, closed in Calcutta and the disastrous interstate migrations, successfully coped with in 1947-48, began again. Only by a statesmanlike agreement signed in Delhi in April 1950 was more serious communal trouble avoided.

At the same time arrangements were made to deal with difficulties arising from the numerous religious and national minorities remaining in each half of the old province. In the summer of 1953 the Indian and Pakistan prime ministers also reached agreement about the exchange of enclaves between East Bengal and Cooch Behar (West Bengal). The hope for communal peace had been emphasized in 1952 by the abolition of the representation of special interests in the East Bengal legislature.

During 1951-53 extremists in the eastern province had talked much of greater provincial autonomy, the federal government, however, anxious to bind the isolated eastern wing more closely to the centre proposed in 1953 a new federal legislature in which East Bengal would have 10 out of 50 seats in the upper house, 165 out of 300 in the lower. (See also **BENGAL**.)

EASTBOURNE, a seaside town, municipal and county borough in the Eastbourne parliamentary division of East Sussex, Eng., 63 mi. S.E. of London by road. Pop. (1951) 57,801. Area 17.7 sq. mi. Eastbourne lies partly on the coastal plain and partly on the eastern slopes of the South Downs below Beachy Head (575 ft.). Because of its position and easy access from London it became a health and holiday resort as well as a residential town with a number of boarding schools, including Eastbourne College for boys (founded 1867), and convalescent homes. The accommodation and entertainment of visitors provide the chief employment, fishing, toy-making, brewing and printing are also carried on.

The earliest settlement, East Bourne, was a mile from the sea in what is now called the Old Town, there is the parish church of St. Mary, a fine Transitional-Norman building, there too can be seen the bourne or stream to which the name alludes. Subsequently two small fishing settlements grew up South Bourne lying back from the shore and Seashouses facing the beach, but the modern development of Eastbourne dates from the early 19th century. It owes its charm as a town to the 7th duke of Devonshire, the family is one of the principal landowners, and a family seat, Compton place lies between the old and new towns. Eastbourne was one of the first English experiments in town planning, with wide, tree-lined streets and ample open spaces. The Saffrons sports ground faces the town hall, the Manor house (18th century) houses the Townier art gallery. The sea frontage extends for more than 3 mi. and is partly built in terraced promenades, the Wish tower (a Martello tower) and the Great Redoubt date from the early 19th century. The borough includes a considerable area of the neighbouring downs, about 4,000 ac. of which are preserved. The town

was incorporated in 1883 and was constituted a county borough in 1911, and the present parliamentary division was constituted in 1948.

EAST CHICAGO, a city of Lake county, Ind., U.S., on Lake Michigan, adjoining Gary, Hammond and Whiting, about 20 mi. S.E. of the Chicago Ill., loop. It is served by the Baltimore and Ohio Chicago Terminal, the Chicago, South Shore and South Bend (electric), the Elgin, Joliet and Eastern, the Indiana Harbor Belt, the Pennsylvania and the Wabash railways. The population was 54,263 in 1930 and 54,637 in 1940 by the federal census.

East Chicago became one of the rapidly growing cities in the Calumet region, an important manufacturing district. Indiana Harbor, the part of the city that lies along the lake, is connected with the Grand Calumet river by a ship canal. The commerce of the port ordinarily consists largely of incoming coal, iron ore and limestone and shipments of gasoline and steel products. There are immense steelworks and oil refineries and other important industries, including meat packing, railroad equipment, chemicals and cement. East Chicago was founded in 1888 and incorporated as a city in 1893. Its rapid growth began in the 20th century. Between 1900 and 1910 the population increased from 3,411 to 19,098, and, next decade almost doubled.

EAST CLEVELAND, a city of Cuyahoga county, O., U.S., on the New York Central railroad, adjoining Cleveland. It is a residential suburb. The population was 40,047 in 1930, 39,495 in 1940 and 39,667 in 1930 by federal census. It has a city-manager form of government.

EASTER, the most joyous of the Christian festivals, observed annually throughout Christendom in commemoration of the resurrection of Jesus Christ, on the first Sunday after the full moon following the vernal equinox.

Though Easter Sunday is the central point in the observance of the events connected with the death and resurrection of Christ the Easter season extends from Ash Wednesday, the first day of Lent, to Whitsunday, which commemorates the day of Pentecost. This period of the Easter cycle may be divided into four periods: (1) the preparatory fast of the 40 days of Lent, (2) the 15 days, beginning with the Sunday before and ending with the Sunday after Easter, during which the ceremonies of the Holy Week and the services of the octave of Easter are observed, (3) the octave of Easter, during which the newly baptized wear their white garments, (4) the paschal season beginning at Easter and lasting till Whitsunday.

Since the last days of Christ coincided with the Passover feast of the Jews and his death fell upon the day of the feast of the Passover, on the 14th day of the month of Nisan, it was natural that the early Christians should associate the sacrifice of the true Lamb of God and the joyful promise of his resurrection with the traditional Passover observances, adding to the older festival the new idea of Christ as the sacrificial Lamb, and should celebrate the old and the new feasts at the same time. Since the Jewish calendar consisted of 12 lunar months, or 354 days, with periodically an extra month inserted to bring it in line with the solar calendar, the date of the new Christian festival like that of the Passover, shifted from year to year in relation to the Julian calendar, then used by the Romans, which was calculated according to the solar year. Thus Easter has remained a movable date, falling anywhere between March 22 and April 25, and has determined the date of all the events falling within the Easter cycle.

Easter Customs—The close association of Easter with the Jewish Passover, or Pesach, is indicated by the fact that among non-Teutonic peoples the name for this holy day is derived from the same root as the Hebrew word *Pesach* (Latin, *Festa Paschalis*, French, *Pâques*). The English word "Easter," however, corresponding to the German *Ostern*, reveals Christianity's indebtedness to the Teutonic tribes of central Europe. Christianity, when it reached the Teutons, incorporated in its celebration of the great Christian feast day many of the heathen rites and customs which accompanied their observance of the spring festival. That the festival of the resurrection occurred in the spring, that it celebrated the triumph of life over death, made it easy for the church to identify with this occasion the most joyous festival of the

Teutons, held in honour of the death of winter the birth of a new year and the return of the sun.

Eostur month, or Easter month corresponding to our month of April and, according to Bede (*De Temp. Rat.*, ch. xv) dedicated to Eostre, or Ostara, goddess of the spring, gave its name to the Christian holy day.

The customs and symbols associated with the observance of Easter have ancient origins, not only in the Teutonic rites of spring but also far back in antiquity. The practice of eating eggs on Easter Sunday and of giving them as gifts to friends or to children probably arose because, in the earlier days of the church, eggs were forbidden food during Lent and were therefore always eaten on Easter Sunday. But the conception of the egg as a symbol of fertility and of renewed life goes back to the ancient Egyptians and Persians who had also the custom of colouring and eating eggs during their spring festival. This ancient idea of the significance of the egg as a symbol of new life readily became the idea of the egg as a symbol of resurrection, as it came to be interpreted by the Christians. The colour red used in dyeing the eggs has been variously interpreted as signifying the sun, the blood of Christ shed on Calvary and the joy of Easter.

In many places Easter games played with eggs were traditional, and the annual egg rolling held on the lawn of the White House in Washington, D.C., is a modern reminder of these old time sports.

Like the Easter egg, the Easter hare, now an accepted part of the traditional Easter story, came to Christianity from antiquity. The hare is associated with the moon in the legends of ancient Egypt and other peoples. It belongs to the night, since it comes out only then to feed. It is born with its eyes open and, like the moon, is "the open eyed watcher of the skies." Through the fact that the Egyptian word for hare, *mn*, means also "open" and "period," the hare came to be associated with the idea of periodicity, both lunar and human, and with the beginning of new life in both the young man and the young woman, and so a symbol of fertility and of the renewal of life. As such, the hare became linked with the Easter or paschal, eggs. In the United States where the hare is unfamiliar, it is the Easter rabbit which is fabled to lay the eggs in the nests prepared for it or to hide them for the children to find.

Various other customs and traditions are associated with Easter, many of them surviving into the 20th century, especially in more remote places. According to old superstition, the sun rising on Easter morning dances in the heavens, this belief has been traced to the old heathen festival of spring, when the spectators danced in honour of the sun. The exchange of the Easter kiss was a ceremonious and joyful Easter rite. The Easter greeting, "Christ is risen," and answered by "He is risen indeed," was universally familiar in Russia until the time of the Revolution of 1917.

The tradition that new fires should be started on Easter, lighted by the friction of wood or of flint and steel, goes back to old Teutonic superstition. According to the belief held in many places, it was unlucky not to wear some new article of clothing or personal adornment on Easter, the modern custom, seemingly entirely worldly of appearing in a new costume on Easter Sunday may go back to this belief, or perhaps may spring from the universal feeling that the Easter tide is the time of casting off the old and the beginning of the new. And those families who by custom eat ham on Easter Sunday are unwittingly following an old practice of the Roman Catholics of England, who ate a gammon of bacon on Easter to show their contempt for the Jews, to whom pork is forbidden.

The religious ceremonies of the Roman Catholic Church and of the Eastern Church in honour of Easter Sunday and the resurrection were always elaborate. The liturgical colour for Easter was white as the sign of joy, light and purity, and the churches and altars were adorned with the best ornaments that each church possessed. In England, however, the Puritans, who abhorred the Catholic ritual and the excesses which often accompanied the observance of the church festivals refused to celebrate Easter.

Thus at first in the U.S., with the exception of a few states such as Louisiana and Virginia, where the Puritan element was not dominant, Easter was not observed. It was not until the latter part of the 19th century, particularly during the Civil War, that

the Protestant churches other than the Lutheran and the Episcopalian began to mark this day by special services. The desire of the churches to bring consolation to those bereaved by the war made it natural for them to choose Easter Sunday with its promise of the victory of life over death as the occasion for special emphasis. The clergy preached special sermons and the churches and their altars were decorated with a profusion of flowers. For this purpose a Bermuda lily was used so widely that it became known as the Easter lily. As in the Roman Catholic Church from its early days Easter became a favourite time for baptism. The Protestant churches also followed the custom of holding sunrise services on Easter morning.

Fixing Date for Celebrating Easter—Confusion early arose as to the proper date for the observance of Easter. According to the Gospels Jesus celebrated the Passover on Thursday, whereas the predominant opinion on Friday the day of the crucifixion. When the church appointed Easter as a holy day, a ship controversy ensued as to whether it should be celebrated on the 14th or the 15th of the month, the disputants being respectively called the *Quartodecimans* and the *Quintodecimans*. It is uncertain, in fact, as to whether the early Easter festival commemorated the crucifixion of Christ, the resurrection or both.

Early in the history of the church a dispute arose between the Jewish and the Gentile Christians. The Jews, linking the festival of the death and resurrection of Christ with the traditional Jewish festival of the Passover, maintained that Easter should be observed like Passover on the 14th of Nisan regardless of the day of the week upon which it fell. On the other hand the Christians of Gentile descent insisted that the holy day be observed on Sunday, since it was on that day of the week that the resurrection had occurred, and that the date of the crucifixion be observed on the preceding Friday. This dispute persisted into the 4th century, the eastern churches generally celebrating Easter on Sunday and the eastern churches following the Jewish tradition.

In A.D. 325 Constantine convened the Nicæa council, where the decision was made that Easter should be observed, as it is now, on the first Sunday after the full moon following the vernal equinox, to be fixed each year at Alexandria, then the centre of astronomical science.

Further difficulties, however, stood in the way of establishing a universal date for Easter. The time of the vernal equinox, by which the date was determined, varied according to variations in the longitude, though later it was arbitrarily set upon March 21. Furthermore, the inexactness of the Julian calendar, in addition to the difficulty of adjusting the lunar calendar upon which the date of Easter partly depended, with the solar year, led to many inaccuracies in calculation and to many divergent opinions as to what date was the correct one.

The Gregorian calendar promulgated in 1582 was not at once universally adopted, and thus arose another disagreement. The western churches accepted the new calendar more or less readily, although it was not until 1752 that it was adopted in Great Britain and Ireland. The eastern churches held to the old calendar, refusing to accept a reform which came from the Roman Catholic Church, and it was not until 1926 that Bulgaria adopted the Gregorian calendar, followed in 1918 by the Soviet Union and in 1924 by the Greek Orthodox Church. Many Eastern Orthodox groups continued to hold to the older Julian calendar and could not, therefore, celebrate Easter with the western world.

The inconvenience of an Easter festival which falls upon a different date from year to year, a date which may vary as much as 35 days, is felt not only in the church calendar but in the civic community as well. Since 1900 chambers of commerce, national and international, have repeatedly passed resolutions urging a fixed date for Easter, and in 1923 such a resolution was addressed to the Holy See. The League of Nations to which the question was referred, called a conference at which were represented the Roman Catholic, the Eastern Orthodox and the Anglican churches, where the delegates reached the conclusion that the nations concerned shared a general desire that the date of Easter should be fixed. After the conference of 1923 many proposals for calendar reform were brought forward, and in 1928 the British parliament passed

the Easter act, which, contingent upon its acceptance internationally, fixed Easter day as the first Sunday after the second Saturday in April, falling between April 9 and 15. The proposed world calendar, strongly advocated by those interested in calendar reform, assigned to each day of the year its own day of the week and to both secular and religious holidays, including those of the Easter cycle a fixed date.

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EASTER ISLAND (Isla or Pascua), also known as Rapa-nui, a dependency of Chile situated in the South Pacific ocean in 27° 10' S lat and 109° 26' W long, about 2,000 mi W of Caldera, Chile and 1,100 mi E of Pitcairn, the nearest inhabited island. The first European to land on the island was the Dutch admiral Jacob Roggeveen on Easter day, 1722, whence its name. There is no evidence that the aboriginal inhabitants of this easternmost outpost of Polynesia had a name for the island. Although the population of the island prior to its discovery by Roggeveen is not known it is improbable that it ever exceeded 4,000. Death from introduced diseases, capture by slave traders, woman murder, internecine warfare, and voluntary emigration reduced the native population to 175 by 1877. Destroyed 100, was the culture as well as the knowledge of the past culture of these agricultural people, whose ancestors carved remarkable stone monuments and incised ideographic script on wooden tablets. Although Easter Island was not annexed by Chile until 1888, whites have been permanently established there since 1864. Under Chilean authority the native inhabitants were confined to the village of Hanga-roa on the west coast, where they had approximately 5,000 ac of land for subsistence purposes. The remainder of the grass-covered island (30,000 ac) was owned by the *Compañía Explotadora de la Isla de Pascua* of Chile and was devoted to the grazing of sheep and cattle. In 1934 the total population of the island was 456 of whom 22 were lepers confined to a hut about 2½ mi N of Hanga-roa.

Archaeology—Archaeology is concerned almost entirely with stone remains, together with a few small objects in shell and bone. Such skulls as have been collected from graves show no traces of high antiquity. Easter Island is destitute of metal objects and pottery, although clay suitable for potting occurs in the craters. The stone remains include houses, platforms, semipyriformal cairns, circular towers, cisterns, statues, rock carvings, adzes or chisels, obsidian spearheads and hatchets.

The most striking monuments are the burial platforms, called *ahu*, and the statues surmounting them. About 260 platforms have been counted in varying degrees of preservation, fringing the coast in almost unbroken succession, while a few are also found inland. Only about 100 of these were intended to support images.

A typical image *ahu* consists of a wall parallel with the sea, measuring up to 100 ft in length and 15 ft in height and buttressed to landward with a slope of masonry. The images stood in a single row facing inland on the central portion of the wall, which projected toward the sea and a single *ahu* might contain from 1 to 15 statues. The maximum extension of the landward slope was about 750 ft, and beyond this was a paved area. The masonry of huge polygonal or rectangular blocks is sometimes beautifully finished and fitted together but is more often of rough material. These *ahu*, which were still used within living memory, served for the exposure of dead bodies and contained vaults for the subsequent burial of the bones. There are also a number of rough, semipyriformal cairns, up to 12 ft in height, containing burial vaults, these appear to be of more recent construction than the *ahu*.

All the statues belonging to the *ahu* have now been thrown down and many broken. But by the accounts of the early voyagers the greater number of them were standing in the 18th century, and Roggeveen refers to religious ceremonies which appeared to him to indicate worship of the statues. The *ahu* were sacred places, corresponding to the Polynesian *maoe*, and some if not all of the statues were erected in honour of ancestors.

The statues were cut from compressed volcanic ash, a soft and easily worked stone. All conform to a single distinctive type, representing only the upper half of the body with an upturned face and long ears, but vary in height from 3 ft to 36 ft. One example has even been found in the quarry with a length of 66 ft., but it had never been moved. The usual height of the images on the *ahu* was from 12 ft to 20 ft., and they were surmounted by tall cylindrical hats or crowns (as much as 6 ft high and 8 ft in diameter) in proportion. These consisted of a red volcanic tuff and were quarried in a different crater from the statues.

The quarry for the statues was both inside and outside the large crater of the volcano called Rano-raraku at the northeast end of the island, there they are found in large numbers and in all stages of completion, as though the work had been suddenly interrupted and never afterward resumed. The sculptors worked in niches surrounding the statues, and the carving was completed before the back was detached by undercutting. The stone chisels used were found *in situ* and are of two main types. The rougher kinds somewhat resembling a European Palaeolithic hand axe, occur in large numbers and were evidently employed for roughing out the contours of the figures. The finer kinds, of hard stone, are without shaped butts and resemble the adzes of western Polynesia and New Zealand more closely than eastern Polynesian types. The tanged spearheads of flaked obsidian are peculiar to the island. Apart from the statues on the *ahu* and in the quarry, there are a large number standing about the slopes of Rano-raraku facing westward, others in isolated positions, and a series placed at intervals along an ancient processional road running westward from the quarry for 6 mi. This road, and two others less distinctly visible, probably served for transporting the statues. It is about ten feet wide and levelled by shallow cuttings and embankments.

The means of transporting the larger images, the heaviest of which must have weighed about 50 tons, has never been satisfactorily explained. But a native account states that they were dragged to position (presumably with ropes, the native hemp and hibiscus fibre furnishing adequate materials) and that round pebbles were placed underneath to serve as rollers. Seaweed may also have been used to minimize friction with the ground. The statues were probably erected on the *ahu* by being hauled up an incline of earth or stones and then gradually up-ended into position by withdrawing the supporting material from under their bases.

Habitations, though generally constructed of perishable materials, were sometimes provided with wrought foundation stones, resembling curbstones, sunk into the ground and provided with holes in their upper surface for inserting the wooden rods which provided the framework of the houses. Their ground plan was long, narrow and boat-shaped, and they were large enough to accommodate from 10 to 30 persons. There are also remains of stone chickenhouses, and of round-chambered towers on the coast used as fishing lookouts. Natural caves were widely used as habitations, frontal walls supplementing some.

Apart from these houses, there is one sacred valley at the south-west corner of the island, called Orongo, situated in a romantic position on a narrow and precipitous ridge between cliff and crater. It contains 45 houses built entirely of stone, the only examples of their kind in Polynesia. They were roofed by partial corbeling and a flat capstone, over which earth was heaped. Their low and narrow interiors, illuminated only by small doors, were often decorated with designs and figures in colour.

This village was connected with a bird cult (still remembered) which played an important part in native life. A leading feature was an annual competition to secure the first egg and on an outlying site by the migratory sooty tern. Orongo was occupied by the competitors, and the numerous rock carvings in the vicinity depicting a bird-headed man, sometimes holding an egg in his hand, presumably commemorate the victors. The rock carvings, some much weathered, also depict faces and geometric designs.

There can be little doubt that the stone structures of Easter Island are the work of the ancestors of the present native inhabitants (reduced in numbers to 169 in 1934). The statues and platforms were actually in use at the time of discovery, and some of the sculptors' names are still remembered. But apart from traditional evidence, the occurrence of certain peculiar designs carved on the backs of some of the stone statues, as well as on small wooden figures of recent date, furnishes an unquestionable link between past and present culture.

Date of Settlement.—The date of the earliest settlers' arrival, their point of departure and the question whether there was more than one migration are still uncertain. Tradition states that the ancestors arrived, under a chief named Hotu-matua, in two canoes coming from the west, but supplies no clear evidence of previous inhabitants or of subsequent immigrations. On the basis of the shortest recorded genealogy of 22 chiefs descended from Hotu-matua, migration can hardly be assigned to a date earlier than the 14th century A.D., and although the monuments contain no evidence for accurate dating, their number and the weathered condition of many of them indicate an age of many centuries. There is no evidence of a succession of cultures.

Racial and Cultural Affinities.—Racially and linguistically there is no doubt that the Easter Islanders are predominantly Polynesian, with a considerable Negroid admixture. The skulls collected from graves supply corroborative evidence. It seems simpler to ac-

count for the Negroid element by presuming that the racial intermixture occurred in Melanesia previous to the arrival of the settlers than by postulating an earlier migration of Melanians to Easter Island. Nevertheless, Hotu-matua's migration may have been preceded by another, also of Polynesian stock, but with a stronger infusion of Melanesian blood and culture. This would help to explain the social dualism and clan antagonisms to which some of the traditions bear witness. Attention has also been called to a number of remarkable resemblances in the bird cult and the art associated with it as between Easter and the Solomon Islands, these seem almost to amount to proof of a special cultural affinity.

Script.—The writing engraved on wooden tablets, unique in Polynesia and first noted in 1864, is undoubtedly of considerable antiquity. It takes the form of pictographs (or ideograms), representing stylized figures of men, birds, fish, etc., arranged in the inverted position of alternating lines (boustrophedon), so that the reader of a tablet is obliged to turn it upside down at the end of each line. The figures seem to have served as mnemonic symbols and cannot be translated word for word. Some of the stones which the tablets record have been obtained from living natives, but the exact meaning of the symbols and method of interpretation have been lost, probably beyond recovery.

Bibliography.—One of the most exhaustive bibliographies on Easter Island yet published appears in Alfred Métraux's monograph *Ethnologie of Easter Island*, B. P. Bishop Museum, Bull. 160 (Honolulu, 1940). (H. J. Br., X.)

EASTERN QUESTION, THE The expression used in diplomacy from about the time of the Congress of Verona (1822) to comprehend the international problems involved in the impending dissolution of the Turkish empire. Its use in this narrow sense is a result of the conditions in which it was invented. In the early 19th century the Ottoman empire was still the only east with which European diplomatists were collectively brought into contact, for the questions of the middle and far east had not yet arisen.

The Eastern Question—though its roots are set far back in history, in the ancient contest between the cultures of Europe and Asia, the antagonism of Christian and Moslem and the perennial rivalry of the powers for the control of the trade routes to the orient—dates in its modern sense from the treaty of Kuchuk Kamardji (1774), which marked the establishment of Russia as a Black sea power and formed the basis of Russia's special claim to interfere in the internal affairs of the Ottoman empire. The actual right conceded was, however, very limited. Article vii of the treaty runs "The Sublime Porte promises to protect firmly both the Christian religion and its churches, and also permits the minister of the imperial court of Russia to make on all occasions representations in favour of the new church in Constantinople, and of those who carry on its services." In view of later Russian claims, the wording of this article is important.

The compact between Napoleon and Alexander I of Russia at Tilsit (1807) marked a new phase, which culminated in the treaty of Bucharest (1812). By this instrument the Russian frontier was advanced to the Pruth and to the northern or Kilia branch of the Danube, and Russia's claim to intervene between the sultan and his orthodox subjects received a new sanction in article v, which confirmed "the contracts and conventions which had been counted among the privileges of Moldavia," and in article viii, which stipulated for certain concessions to the insurgent Serbs.

The attitude of the various powers in the Eastern Question was now defined. Russia, apart from its interest in the Orthodox subjects of Turkey, aimed at owning or controlling the straits which were Russia's only outlet to the Mediterranean and the ocean beyond. Austria, once the champion of Europe against the Turk, saw in Russia's advance a greater danger than any to be feared from the moribund Ottoman power, and made the maintenance of Turkey's integrity a prime object of its policy, thus agreeing with Great Britain, whose traditional friendship with Turkey was strengthened by the rise of a new power whose rapid advance threatened British communications with India and the stability of British rule there. But though Austria, Great Britain and presently France were all equally interested in maintaining the Ottoman empire, the failure of the Congress of Vienna (1815) to take action regarding the guarantee of Turkey seemed to endorse Russia's claim to regard the Eastern Question as its "domestic concern" in which Europe had no right to interfere.

This was a result of the sultan's obstinate refusal to ratify the treaty of Bucharest. As Castlereagh put it, it was impossible to guarantee territories of which the boundaries were in dispute.

The Greek Revolt—When, in March 1821, the news reached the Powers assembled at the Congress of Laibach that Prince Alexander Hyspianli, a Greek officer in Russian service, had crossed the Pruth and raised the standard of revolt in the Danubian Principalities, it was feared that his claim to have Russian support was well founded. The Emperor Alexander I, however, yielding to Metternich's influence, repudiated Hyspianli's action, and the revolt, unsupported by the Rumanian people, collapsed.

It was different, however, when, on April 9, Archbishop Germanos of Patras raised the standard of revolt in the Morea, here the Greek population rose *en masse*, massacred the Muslims and by September had completed the liberation of the peninsula by capturing the capital, Tripolitza. The revolt now spread north of the Isthmus, and, above all, to the Greek islands, whose loss—since they were the only recruiting grounds of the Ottoman navy—deprived Turkey of the command of the sea, thus frustrating all efforts to suppress the rising until the intervention of Mehmet Ali of Egypt at the end of 1824.

The unexpected success of the insurgents threatened to produce a European crisis, for the heinous reprisals of the Turks, culminating in the execution of the Orthodox Patriarch Gregorios (April 22, 1821), roused intense feeling in Russia and it needed the united efforts of Castlereagh and Metternich—who met at Hanover in October—to persuade the Emperor Alexander not to stultify his mission as the peace maker of Europe by intervening in Turkey.

The accession of George Canning to office (Aug. 1822) made no immediate change in British policy, but in March 1823 he recognized the belligerence of the Greeks, in order to make their provisional Government responsible for their piracies. It was not, however, until Sultan Mahmud appealed to his vassal, Mehmet Ali of Egypt, to assist him with his trained army and fleet, that the Powers made any concerted effort to influence the situation.

The Emperor Alexander now proposed that the Powers should impose a settlement on the basis of Greek principalities tributary to the sultan. Metternich, who took this as implying an extension of Russian influence, countered by proposing an independent Greek State. A conference was summoned at St. Petersburg, but, as the majority favoured collective intervention, on a principle which Great Britain had always opposed, the British representative was withdrawn, and the meeting resulted in nothing but a futile offer of mediation (March 25, 1825).

Mehemet Ali Intervenes—Meanwhile Ibrahim, Mehmet Ali's adopted son, had landed at Modon and begun the systematic conquest of the Morea. His fleet commanded the sea, and on land the Greek guerrilla fighters had no chance against the trained Egyptian troops, only the heroic defence of Missolonghi (May 1825–April 1826) relieved the gloom of this terrible year. The death of the Tsar Alexander I (Dec. 1, 1825), however, changed the European situation. His successor, Nicholas I, had begun his reign by quelling a serious mutiny of the troops, and a war with Turkey seemed an admirable way of restoring the morale of his army. A step in this direction was taken when, at the outcome of the Duke of Wellington's congratulatory mission to the new tsar (Jan. 1826), a protocol was signed at St. Petersburg under which Great Britain and Russia were to offer their mediation with a view to a settlement on the basis of tributary principalities, and if the mediation were rejected, the Powers might take action "jointly or separately."

Nicholas now sent an ultimatum to the Porte, demanding the execution of the terms of the Treaty of Bucharest, and since the sultan had just massacred the Jamnasses (29th Turkey could not resist. On Oct. 1 was signed the Treaty of Akkerman, which concluded all the Russian claims.

The Treaty of London—This action of Russia, together with the barbarities of Ibrahim—who threatened to depopulate Greece and colonize it with fellahs and negroes—stirred the other Powers to activity. A conference met in London and on July 6, 1827, the Protocol of St. Petersburg was turned into the Treaty of London. This treaty Austria and Russia refused to sign, and the settlement of the Greek Question therefore passed into the hands of Great Britain, France and Russia, who engaged to procure the autonomy of Greece under the sultan's suzerainty. There was to be

no breach of friendly relations with Turkey, but should the sultan refuse mediation, the Powers were to send consuls to Greece. Meanwhile, an armistice was to be proposed to both sides, to be enforced by such means as might "suggest themselves to the prudence" of the contracting Powers. The readiest means seemed to be a "peaceful blockade" of Ibrahim in the Morea.

Navarino and the Russo-Turkish War—On Oct. 20, in order to bring peaceful pressure on Ibrahim, who had rejected the armistice, Admiral Codrington sailed the allied fleet into the Bay of Navarino, where the Turco-Egyptian fleet lay at anchor. A chance encounter led to a general engagement and the total destruction of the Ottoman navy. The British Government tried to explain away this "unfortunate event", but Sultan Mahmud refused to regard the demonstration as "peaceful," and proclaimed a holy war. The Emperor Nicholas seized the occasion and there followed the Russian invasion of Turkey, which ended with the Treaty of Adrianople (1829). The other Powers, meanwhile, feared that Russia would thus secure her influence over liberated Greece, and in July 1828 Britain, France and Russia signed the Protocol of London, by which France was entrusted with the task of ousting Ibrahim from the Morea. By the time the French troops arrived, however, this object had already been achieved by a naval demonstration by Codrington at Alexandria. By a protocol signed at London on Nov. 16, 1828, the conference placed the Morea and the Cyclades under the guarantee of the three Powers, this guarantee being extended on March 22, 1829—after General Church's victories over the Turks north of the Isthmus—to the mainland south of the line Arta-Volo and including the island of Euboea. These territories were to be erected into a tributary principality governed by a prince chosen by the Powers.

The Russian victory and the fact that the terms of the Treaty of London were embodied in the treaty of Adrianople led the other Powers to acquire ment by insisting on further concessions. On Feb. 3, 1830, a protocol of the London Conference settled that Greece should be an independent principality and be offered to Leopold of Coburg (afterwards King of the Belgians). Leopold having refused the honour another protocol had down that Greece should be an independent sovereignty, extended the frontier to the line Arta-Volo and proposed Prince Otto of Bavaria as its ruler. King Louis of Bavaria accepted the offer on behalf of his young son, but stipulated that he should be king. This was agreed, and on May 13, 1832, another Treaty of London (antedated the 7th) was signed, placing the new Kingdom of Greece under the guarantee of the three Powers. (See *GREECE: Modern History*.)

Revolt of Mehmet Ali—The Greek question was still unsettled when a new phase of the Eastern Question was opened by the revolt of Mehmet Ali, pasha of Egypt. The immediate occasion, though not the pretext for his revolt, was the sultan's refusal to give him the pashaliks promised as the price of his intervention in Greece, he feared, too, that if he waited till the reform of the Turkish army was completed, he would share the fate of Hussein of Bosnia and Mustafa of Scutari, whom the sultan had crushed in the spring of 1831. On Nov. 1, 1831, accordingly, an Egyptian force entered Syria, met the fleet under Ibrahim at Jaffa, and at once besieged Acre. The garrison's resistance delayed the Egyptian advance, at Constantinople efforts were made to persuade the sultan to come to terms, and only in May 1833 was the ban of outlawry launched against Mehmet Ali. Meanwhile, Ibrahim had been pushing on. He had already occupied Gaza and Jerusalem before Acre fell (May 27). On June 15 he was in Damascus. On July 9 and 11 he defeated the Ottoman advance guard at Homs and Hamah, and on the 17th crushed the main Turkish army, under Hussein Pasha, at the pass of Beilan. Pushing on into Anatolia, he gained a crowning victory at Konia over another Ottoman army under Reshid Pasha (Dec. 23), and advanced to Afium-Karhisar and Kutayah. Nothing lay between him and Constantinople but the uncertain attitude of the Powers.

After the first defeats Sultan Mahmud, in his rage and despair, had turned first to Great Britain for aid. But, though Stratford Canning wrote from Constantinople, urging the necessity for upholding the sultan's authority even by arms, Palmerston was not prepared for an isolated intervention which would involve a breach

with France and Russia. The news that no active aid could be expected from England was followed by that of the disastrous defeat at Konia, which chanced to coincide with the arrival in Constantinople of a special Russian envoy, Count Muraviev, who at once renewed the tsar's previous offer of ships and troops to protect the capital. The sultan, in desperation, accepted, and on Feb. 20, 1833, a Russian squadron entered the Bosphorus.

The French and British representatives had in vain tried to persuade Mahmud to reverse his fatal decision. They now agreed to take a new line, and induced the Porte to invite the Russians to withdraw by undertaking that France would persuade Mehemet Ali to accept the Sultan's terms. But the Emperor Nicholas sent peremptory orders for his fleet to remain until Ibrahim should have recrossed the Taurus mountains, and Mehemet Ali scornfully rejected the sultan's offers, he insisted on his full demands—Syria, Ibeli, Aleppo, Damascus and Adana. The two Western Powers, intent on getting the Russians away, now pressed the Porte to yield, and, as the result of this combined pressure on both sides, and incidentally of a famine in the capital, an arrangement was reached. On April 8 was signed the Convention of Kutayah, under which all the Egyptian demands were conceded. The immediate result, for the Powers, was to throw Turkey wholly into the arms of Russia. Russia had given the sultan deeds, not words, and to Russia he committed himself. Before the Russian forces left there was signed in the palace of Unkar Skeless the famous treaty (June 8, 1833) which, under the guise of an offensive and defensive alliance, practically made Russia the custodian of the gates of the Black sea.

This temporary settlement was nowhere expected to prove permanent. Sultan Mahmud dreamed only of revenge, and engaged German officers—Moltke among them—to reorganize his army. The crisis came in 1838. In 1834 the Syrians had revolted against Mehemet Ali's tyranny, now the Arabs of the Hauran were in arms. The sultan, urging that he must rescue his subjects from oppression, could no longer be restrained, and on April 21, 1839, the Ottoman army invaded Syria, only to meet with a crushing defeat by Ibrahim at Nezib (June 23). Before the news reached Constantinople the old sultan died (July 1), leaving his throne to Abd-ul-Mejid, a lad of 16.

Finally, the news reached the capital that Ahmed Pasha, the Ottoman admiral-in-chief, had handed over his fleet to Mehemet Ali, on the pretext that the sultan's advisers were sold to Russia. So far as the Ottoman empire was concerned, Mehemet Ali was now master of the situation. He had, however, to walk warily.

At the outset these showed an apparently united front, the ambassadors of the five Powers on July 27 presenting a joint note to the Porte, in which they declared that an agreement had been reached in the Eastern Question and urged the Ottoman Government "to suspend all definite decision made without their concurrence." But the Powers were actually agreed only on the need for agreement. Britain, especially, insisted on this, for she feared

desert had been placed between the pasha and the sultan. The deadlock thus created developed into a crisis when, on Feb. 20, 1840, Thiers came into power in France. Not only did he reject a compromise which, on May 7, Guizot, as French ambassador, arranged with Palmerston, but it presently transpired that, without openly breaking with the concert, and without informing the other Powers, he was encouraging a "direct arrangement" between Mehemet Ali and the Porte. The discovery of what seemed an underhand intrigue by France to secure her "complete individual triumph" at Constantinople and Alexandria, led at once to a strong countermove from the other Powers, who on July 15, without the concurrence of France, signed with the Porte a Convention for The Settlement of the affairs of the Levant. By the instrument it was agreed that, the terms to be given to Mehemet Ali having been arranged with the Porte, the signatory Powers would force the pasha to accept them. If he yielded within ten days he was to receive the hereditary pashalik of Egypt, the administration of southern Syria for life and possession of the fortress of Acre. After ten days the offer of Syria was to be withdrawn, and after another ten days the sultan was to be free to take such action as his own interests and the counsels of his allies might suggest.

The news of this "mortal affront" caused immense excitement in Paris, and Thiers, declaring that the alliance with Great Britain was shattered, hurried on preparation for war. The immediate effect was that Mehemet Ali, confident of French assistance, maintained a defiant attitude. The unexpected outcome of the armed intervention of the Powers, however, soon changed the situation. The allied fleet, under Sir Charles Napier, had hardly appeared off Beirut (Aug. 11) when the Syrians rose in revolt against Ibrahim's tyranny. On Sept. 11, Suleiman Pasha not having obeyed the summons to evacuate the town, the bombardment of Beirut began. On Oct. 3 the town fell, and Ibrahim, cut off from his communications by sea and surrounded by a hostile population, began a hurried retreat. On Nov. 3, Acre surrendered to the allied fleet. The Legends of Mehemet Ali's invincibility and humane and enlightened rule were now pricked bubbles. The only question was whether he should retain Egypt.

Already, on Sept. 15, the sultan had, in accordance with the terms of the Convention of London, declared him deposed. But the news of this, and of the events in Syria, produced an exceedingly dangerous temper in France, there was loud clamour for war, and it looked as though the pacific Louis Philippe were faced by the alternative of war or revolution. To most of the British cabinet it looked as though concessions must be made to France for the sake of European peace. Therefore, when Guizot, on Oct. 8, presented to Palmerston what was practically a French ultimatum, "it was determined that this intimation should be taken in a friendly spirit," and that Palmerston should come to an agreement with the ministers of the other Powers jointly to persuade the Porte not to insist on depriving Mehemet Ali so far as Egypt was concerned. This did not at once stop the war fever in Paris, but Louis Philippe did not want war, the dismissal of Thiers, and the appointment of Guizot as foreign minister in the new Government under Marshal Soult, made for more moderate counsels, and by Dec. 4, the danger was past.

Nine days earlier Sir Charles Napier had appeared with the British squadron before Alexandria and had induced Mehemet Ali to submit to the sultan and restore the Ottoman fleet, in exchange for a guarantee of the hereditary pashalik of Egypt. Gentle pressure by the combined Powers on the Porte did the rest. On Feb. 13, 1841, the sultan issued a *firman* appointing Mehemet Ali hereditary pasha of Egypt, a second *firman* of the same date investing him with the government of Nubia, Darfur, Kordofan, Sennar and their dependencies.

The Crimean War.—The Russian policy, initiated in 1829, of maintaining the integrity of Turkey while practically treating her as a vassal state, ended in 1841, the Emperor Nicholas reverted to the idea of expelling the Turks from Europe. The Eastern Question, however, slumbered for a while, the European Powers being fully engaged with the troubles which culminated in the revolutionary movements of 1848-49. In 1850, however, a new and fateful phase developed. Under the capitulations of

short, he announced through the Russian ambassador in London, Baron Brunnow, that he was prepared to accept the British views on the Turco Egyptian question, to allow the Treaty of Unkar Skeless to lapse, and to act in the Ottoman empire only in concert with the other Powers, in return for an agreement closing the Dardanelles to the warships of all nations. Brunnow was empowered to arrange a coalition to settle the Egyptian question.

To this proposal all the Powers agreed, including France, and for nearly a year negotiations continued. In France public opinion violently supported Mehemet Ali's claims, while Palmerston believed that the Ottoman empire would never be secure until "the

1740 France held the right to protect the Catholics in Turkey and the guardianship of certain holy places in Palestine. These rights had been in abeyance since the French Revolution and Russia had assumed the guardianship of the holy places. But Louis Napoleon, now Prince President of the French Republic, desiring to conciliate the clergy and to increase his prestige, instructed his ambassador in Constantinople to demand the restoration of French property and rights in the holy places. The Porte appointed a mixed commission to inquire into the matter, but since France objected to any documents being considered of later date than 1740 (which would have excluded the Treaty of Kuchuk Kinaradj) and Russia peremptorily demanded that no change should be made, no mutually satisfactory solution was possible, and on Nov. 4, 1851, the British ambassador, Stratford Canning, reported to his Government that the question had "as summed a character of extreme gravity." It had developed into a struggle between France and Russia for influence in the East.

In vain the Ottoman Government suggested various compromises. Napoleon, now Emperor of the French, needed a war, and the Emperor Nicholas' refusal to recognize him as an equal embittered him against Russia. Nicholas, too, thought the moment opportune for carrying out his plans for ousting the Turks. He believed that he could rely on the neutrality of Austria, out of gratitude for his assistance to her in crushing the Hungarian insurrection in 1849. Great Britain's benevolence seemed to be assumed when the pacific Lord Aberdeen became prime minister in Dec. 1852. The tsar even revived his earlier idea of an arrangement with Great Britain for the partition of Turkey. In the famous conversations (Jan. 9 and 14, 1853) with the British ambassador at St. Petersburg, Sir Hamilton Seymour, he spoke of Turkey as the "Sick Man," and gave his ideas as to the disposal of his inheritance. The Balkans should be divided into a series of Christian States, Great Britain receiving compensation in Egypt, Cyprus and Crete. The comment on this by Lord John Russell, on behalf of the British Government, was to deny that Turkey was sick, and to insist that the whole question must be settled by general agreement. But Nicholas was deceived by the hesitations of Aberdeen, who was hopelessly divided between his fear of Russia and his dislike of the Turks, he was deceived, too, by his ambassador, Baron Brunnow, who reported that in England the pacific influence of Bright and Cobden was supreme. Accordingly, after ordering the mobilization of his forces, he despatched Gen. Meshikov to Constantinople with an ultimatum demanding the preservation of the *status quo* as regarded the holy places and Russia's right to protect Christians in Turkey.

Meshikov, a blustering soldier, reached Constantinople on April 19, but the crisis was delayed by the diplomacy of Lord Stratford de Redcliffe, the British ambassador, who persuaded the Porte to yield respecting the holy places, but to resist the demand for a protectorate over the Christians.

On May 5, arguments and threats having failed, Meshikov presented the ultimatum, on the 22nd the Porte rejected it. This meant war, and on June 22 the Russians crossed the Pruth and proceeded to occupy the Principalities.

This was met by a collective protest of the Powers, and Austria concentrated her forces on the Serbian frontier. In these circumstances Russia agreed to a conference, which met at Vienna in August. The four points on which the other Powers insisted were (1) the substitution of an international for a Russian protectorate of the Principalities; (2) freedom of navigation on the Danube; (3) maintenance of the integrity and independence of Turkey; and (4) renunciation by Russia of her claim to protect the orthodox subjects of Turkey. The conference drafted a convention, to be proposed to Russia by the Porte, confirming the rights granted by the treaties of 1774 and 1829 and by the *firmans* recently issued, and conceding to the orthodox rite a share in all privileges, etc., granted to other Churches under the Capitulations. Russia accepted this on condition that no modifications were made "under bellicose influences." But when, on Aug. 19, the Porte accepted the draft, it was with an amendment reserving to the sultan the right to protect the Christians. This amendment the tsar refused to accept, and, since this seemed to show that

he intended to press his extreme claims, the British fleet was ordered to pass the Dardanelles, ostensibly to protect the sultan from the danger of a Muslim rising. The British Government announced that no aggressive action would be taken unless the Russians crossed the Danube or attacked an Ottoman port on the Black sea. The immediate *casus belli* which opened the Crimean War was the destruction by the Russian fleet of an Ottoman squadron in the harbour of Sinope on Nov. 30, 1853. On Jan. 3, 1854, a combined British and French squadron entered the Black sea, it was not, however, till March 27 that France and Great Britain declared war against Russia.

The Russians now advanced into the Balkan peninsula, but on June 3 an Austrian ultimatum forced them to retire not only from the Balkans, but from the Danubian Principalities which Austria occupied. Although the immediate menace to Turkey was thus removed, the Allies determined to continue the war and to secure the acceptance of the Four Points, and on Sept. 14 their combined armies landed in the Crimea. (See CRIMEAN WAR.) The initial disasters of the war bent the stubborn resolution of the "Iron Tsar," and on Nov. 28, strongly urged by Frederick William IV of Prussia, he consented to accept the Four Points. It was too late. The successes of the Allies were bringing them fresh strength. On Dec. 2 Austria signed with them a formal defensive alliance, and in Jan. 1855 Cavour's determination to secure a position for the Kingdom of Sardinia in the councils of the Powers brought the Piedmontese into the Allied camp. On March 2 the Emperor Nicholas died, and the succession of Alexander II seemed to promise peace. Conferences were resumed at Vienna, but honour and prestige were involved on both sides, and the war dragged on. The fall of Sevastopol (Sept. 9) might have been taken as decisive, but it was not till December that an Austrian ultimatum persuaded the tsar to yield. The terms of peace were to be settled by a congress in Paris.

The Treaty of Paris was signed on March 30, 1856. By this instrument the Eastern Question seemed to be settled, in the sense desired by the Allies. By the cession of a portion of Bessarabia, Russia was thrust back from the mouths of the Danube, of which the navigation was declared free, Russian naval power was destroyed in the Black sea, which was made neutral, the right of Russia to intervene in Turkey was formally repudiated, and the Ottoman empire, in return for elaborate promises of reform, was admitted to the concert of the Powers. Wallachia and Moldavia, with their existing privileges, were placed under the collective guarantee of the Powers, while remaining under the suzerainty of the Porte. It was not till three years later that the union of the Rumanian nation was accomplished by the election of John Alexander Cuza as prince in both principalities.

The Russo-Turkish War, 1877-78.—It was to be expected that Russia would seize the first opportunity of repudiating the humiliating terms thus imposed upon her. This came in 1870, and she took advantage of the collapse of France to denounce the Black sea clauses of the Treaty of Paris. The action of the Conference of London in regularizing this proceeding prevented any immediate critical developments. But though for five years longer the Eastern Question was to remain quiescent, beneath the surface it was exercising a strong and disturbing influence on the relations of the Powers. In spite of the League of the three Emperors, founded in 1872, Austria and Russia were once more hatching rival plans of aggression in the East. Russia was determined to seize the first opportunity for recovering the lost strip of Bessarabia and so removing the last tangible results of the Crimean War, while Austria, encouraged by Bismarck—who wished to reconcile her to her dispositions as a German Power—was hoping to find in the Balkan peninsula compensation for her losses in Italy and Germany. Behind the Russian policy was the Pan Slav ideal, which Russian agents were busy propagating among the Balkan peoples, behind the Austrian policy was the conviction that Serbia was already aspiring to play the part played by Piedmont in Italy, and to become the head of a Southern Slav empire built up out of the ruins of the Austrian and Ottoman empires. If the rivalry between Russia and Austria did not lead to a breach, this was because Russia saw that in the event of

war Germany would have to support Austria, now once more regarded as the bulwark of Germanism against the Slavs, while Austria feared that such an alliance would merely add to the overgrown power of Germany. As for Bismarck, who was preoccupied by the reviving power of France, the last thing he wanted was a war with Russia. It was such considerations as these which determined the attitude of the three Powers when the next critical phase of the Eastern Question began.

It opened in July 1875, when the Christian Slavs of Hercegovina rose against Turkish misrule. The failure of the Turks to suppress the insurrection and the consequent danger of a general conflagration led to the intervention of the Powers, and on Dec. 30, 1875, Russia, Germany and Austria-Hungary agreed to the terms of a joint note, drawn up by Count Andrássy, for presentation to the Porte. This declared that the time had come for joint action to compel Turkey to translate her promises of reform into acts. It demanded the formal recognition of the equal status of the Christian religion, and certain reforms in Bosnia-Hercegovina which were to be watched over by a mixed commission of Christians and Muslims. Great Britain and France having adhered, the "Andrássy Note" (qv) was presented to the Porte on Jan. 31, 1876.

The sultan, as usual, promised everything and performed nothing. Meanwhile the revolt spread. In May the signs were ominous, Serbia was arming and Prince Milan gave the command of his troops to the Russian general Chernayev, Montenegro also was arming. The three emperors thought it time to take action and on May 13 signed the Berlin Memorandum, which proposed combined action of the fleets, the enforcement of a two months' armistice, and further action if no settlement were reached. This broke down on the opposition of Great Britain, Disraeli arguing that it would only encourage the insurgents to go on. On May 24 the British fleet was ordered to Besika bay, for the defence of Turkey in case of need. On June 30 Serbia declared war on Turkey, and on July 2 Montenegro followed suit. On July 8 the Emperors Alexander II and Francis Joseph met at Reichstadt and signed a convention defining the policy of Austria and Russia. There was to be no intervention so long as the contest was undecided. In the event of the defeat of Serbia, the two Powers would combine to preserve the *status quo*. In the event of her victory, Austria-Hungary was to receive Bosnia-Hercegovina and Russia the ceded portion of Bessarabia. This agreement, which was significant in the light of later events, secured the neutrality of Austria-Hungary during the forthcoming Russo-Turkish War.

Meanwhile a fresh complication had arisen. In May the Bulgarian peasants had also risen and massacred many Turkish officials. The Turks, on their march northwards, against the Serbs, took horrible vengeance, and the news of the "Bulgarian atrocities" caused immense excitement in England, and more especially in Russia. The Serbs, too, were soon in danger of being overwhelmed, and it was only a Russian ultimatum that prevented the Turks from advancing on Belgrade. In August the British Government, which wished to prevent the isolated action of Russia, persuaded Prince Milan of Serbia to ask for the mediation of the Powers, and took advantage of this to urge the Porte to come to terms with the Serbs and Montenegrins, for fear of a worse thing. This attempt at mediation, however, broke down at the obstinacy of both the Serbs and Turks. The Serbs were feeling increasingly certain of Russian support, as for the Turks, the deposition of Sultan Abd-ul-Aziz in May, and of his imbecile successor Murad in August, had infused a new spirit into their government, for the astute and ruthless Abd-ul-Hamid II was now sultan. His policy was to pose as a reformer, and, for the rest, to procrastinate in the hope of splitting the European concert. He countered a British proposal for a comprehensive scheme of reforms in the Ottoman empire, to be embodied in a protocol concluded between the Porte and the Powers, by issuing an elaborate scheme himself (Oct. 12). But the patience of Russia was now exhausted, on Oct. 15 Gen. Ignatiev arrived in Constantinople, and on the 31st presented an ultimatum demanding the conclusion of an armistice with Serbia within 48 hours. On Nov. 2 the Porte yielded, and the field was cleared for fresh

diplomatic action. On the 4th, Lord Derby proposed a conference at Constantinople on the basis of the integrity of Turkey. All the Powers accepted, but on the 8th the Emperor Alexander declared publicly that, if the Powers did not act, he would take effective measures in concert to enforce reforms, he would act alone.

The conference opened on Dec. 31, but it was soon clear that the Porte had no intention of accepting its decisions. On the 11th a constitution for the Ottoman empire was solemnly proclaimed, and the Porte rejected the demands of the conference on the ground that they must now be submitted to the new parliament. The case foreseen by the tsar had now arisen, the conference had proved abortive, and when on March 19, 1877, the new Turkish parliament met, almost its only act was to reject the demands presented by Russia. On April 24 Russia declared war.

The events of the war are described elsewhere (See RUSSO-TURKISH WARS). So far as the relations between the Powers were concerned, the most critical period was after Gen. Gurko's capture of Adrianople (Jan. 20, 1878), when the Russian advance threatened Constantinople and the tsar's. The British Government on Jan. 14 warned the tsar that any treaty between Russia and Turkey which might affect the engagements of 1856 and 1871 "would not be valid without the assent of the Powers who were parties to those treaties," and on the 23rd the British fleet was ordered to Gallipoli. On the 31st the preliminaries of peace between Russia and Turkey were signed at Adrianople, the terms of the armistice allowing the Russians to advance to within a few miles of Constantinople. The Grand Duke Nicholas now pushed forward to the lines of Chataldja, whereupon the British fleet was ordered to enter the Sea of Marmora. The situation was now extremely critical, for Austria-Hungary declared the terms of the Convention of Adrianople to be inconsistent with her interests, and it soon became clear that the only way of peace lay through a European congress. On Feb. 5 Count Andrássy formally invited the great Powers to a conference, and Russia, which was in no condition to continue the war with Great Britain and Austria ranged against her, had perforce to agree.

Before the final arrangements for the congress could be made, however, the Convention of Adrianople was converted into the Treaty of San Stefano (March 3). This seemed to realise the worst fears of the Powers. In default of the payment of a huge war indemnity, Turkey was to cede to Russia, Batumi, Ardahan and Kars in Asia, and the Dobruja in Europe—this latter to be exchanged with Rumania for Bessarabia. Serbia, Rumania and Montenegro were to be independent States, Bosnia and Hercegovina were to receive autonomous institutions under the joint control of Russia and Austria-Hungary, above all, Bulgaria was to be erected into an autonomous principality, stretching from the Danube to the Aegean and embracing Eastern Rumelia and Macedonia, and its prince was to be advised for two years by a Russian commissioner supported by an army of occupation.

The news of the conclusion of this treaty, which seemed not only to bar Austrian advance in the Balkans but to be fatal to British interests by giving Russia a crushing preponderance in the East, again brought war very near. But in the end the strong representations of the Powers, backed by the diplomacy of Bismarck, persuaded the tsar to consent to submit the treaty to the approaching congress.

This met in Berlin on June 13 and, after heated debates, arrived at a definite settlement a month later. By the Treaty of Berlin, signed on July 13, 1878, the terms of the Treaty of San Stefano were greatly modified (See BERLIN, CONGRESS AND TREATY OF). Its signature was hailed in Great Britain as a great diplomatic victory, the preponderance of Russia in the East had been checked, and Lord Beaconsfield boasted that he had secured "peace with honour," but the treaty represented, in fact, the starting-point of the latest and most disastrous phase of the Eastern Question which culminated in the World War.

Three new sovereign States were created by the treaty, Rumania, Serbia and Montenegro, but in the case of the former two at least the boundaries assigned to them left them bitterly dissatisfied. Rumania resented the enforced cession of Bessarabia to Russia in exchange for the less desirable Dobruja, and was

bound sooner or later to cast covetous eyes on Transylvania with its preponderantly Ruman population. Serbia was in even worse case. She received indeed an increase of territory, at the expense of Bulgaria, but other terms of the treaty seemed to have been specially devised to make her dream of a Southern Slav union for ever unobtainable, for the Sanjak of Novi Pazar, which was to be garrisoned by the Austrians but still administered by the Turks, cut her off from Montenegro, while the permission given to Austria-Hungary to occupy and administer Bosnia-Herzegovina gave the Habsburg Monarchy what seemed likely to prove a permanent foothold in the Balkan peninsula. The foreign trade of Serbia (mainly pigs), cut off from access to the sea, was placed almost wholly at the mercy of Austria.

The Union of Bulgaria.—The most fateful of all the provisions of the treaty, however, was the splitting up of the greater Bulgaria created by the Treaty of San Stefano, for this not only kept the Balkan peninsula in a ferment for 30 years, but opened up a new problem, that of Macedonia, which was left to Turkey and, inhabited as it was and is by an inextinguishable mixture of races, was to become a bone of contention between Greeks, Serbs and Bulgarians (see MACEDONIA). As for Bulgaria herself, the artificial severance of East Rumelia could not long endure, and after a period of agitation on both sides of the Balkans, Prince Alexander accepted the offer of the crown of united Bulgaria (Sept. 20, 1885). Union was opposed by Russia, whose efforts to dominate the councils of Bulgaria had been frustrated by Alexander and his ministers, and for this very reason Great Britain now favoured the union, since she saw in a strong Bulgaria the best possible obstacle to the extension of Russian power. Austria-Hungary, on the other hand, had no wish to see a strong barrier erected between her and the coveted seaboard on the Aegean, and Serbia, more especially, resented a growth of Bulgarian power which threatened her own ambitious plans. This led to the Serbo-Bulgarian War of Nov. 1885, and when Prince Alexander crushed the Serbs at the battle of Slivnits, Austria-Hungary interposed to save Serbia from extinction. British influence at Constantinople, however, obtained from the sultan the formal recognition of the union of the Bulgarians. But the breach between Prince Alexander and the tsar was irreparable, and led to the abdication of the prince (Sept. 7, 1886) and the election of Prince Ferdinand of Coburg in his place. The new prince, who had been an Austrian cavalry officer, was not acceptable to Tsar Alexander III, who refused to recognize him, strained relations continued between Bulgaria and Russia, and it was not till 1898, under Tsar Nicholas II, that the two courts were reconciled (See BULGARIA History).

The Greek War, 1897.—The union of Bulgaria had aroused among the Greeks too much excitement and heart burning, the Cretans proclaimed their union with the kingdom, and only a blockade by the Powers prevented Greece from declaring war on Turkey. The crisis was thus tided over for the time, but in 1894 a secret society known as the *Ethnik Hetairia* (National Society) was founded, among whose objects were the union between the Greek islands and the kingdom, and the encouragement of the Greek movement in Macedonia, in order to prevent its absorption in Bulgaria. When, in 1896, the Cretans again revolted, the influence of this society was enough to compel King George of Greece to take up their cause. The rival forces of the Powers forced the submission of the Cretans to the arbitration of Europe, but on the mainland the excitement continued, Greek irregulars were raiding into Thessaly, and in April 1897 the sultan, encouraged by the German emperor, declared war on Greece. The result was not long in doubt. The Greeks were no match for the Turkish forces, reorganized by German officers, and but for the Powers who imposed an armistice on both combatants (May 20), their ruin might have been complete. As it was, the war was a disaster for Greece. It discredited the dynasty, and by the terms of the peace treaty, signed in December, Greece had to cede a strip of Thessaly and pay a huge war indemnity (See GREECE Modern History). One gain, however, was made. Though Germany and Austria-Hungary had seceded from the European Concert in the Eastern Question,

and in spite of the critical situation as between France and Great Britain arising out of the Fashoda incident (see AFRICA, SUDAN), France, Great Britain and Russia had continued to act together in the Cretan question, had forced the Porte to withdraw its officials from the island, and on Nov. 14, 1897, had invited Prince George of Greece to act as high commissioner.

German Influence in Turkey.—The breach in the Concert of Europe in the Cretan question was significant of profound changes in the grouping of the Powers. So far as the Eastern Question was concerned, a new factor of supreme importance had been introduced. Germany, so long as Bismarck was in power, had maintained a disinterested attitude so far as she herself was concerned, though she had consistently encouraged the eastward expansion of Austria. But with the accession of the Emperor William II came a change of policy, the opening of which was marked by the State visit paid by the emperor and empress to Sultan Abd ul Hamid in Nov. 1889. More than 50 years earlier Moltke had pointed out the opportunities offered by Asia Minor for German exploitation, and the immediate object of the emperor was to forward German economic penetration, and for this and other purposes to establish his influence in Constantinople. His opportunity came in 1894, when the Turks, in their determination to stifle yet another incipient national revolt, began a systematic massacre of the Christian Armenians. All Europe stood aghast at these horrors, repeated year after year. By Art. LXI of the Treaty of Berlin the Porte had undertaken to carry out reforms in the Armenian provinces, under the superintendence of the Powers, and a special responsibility attached to Great Britain in this matter under the secret treaty which had secured her Cyprus. But even without the despairing appeal of the Armenians to treaty obligations which had never been fulfilled, public opinion in England would have forced the British Government to take some action, and in 1896 Lord Salisbury induced the other Powers to unite in urging upon the Porte the carrying out of the promised reform. Since, however, these representations were not followed up by acts, the sole result was to alienate the Turks from Great Britain, and throw them into the arms of Germany. From Berlin there came, not protests, but a signed photograph of the emperor and his family as a birthday gift for the sultan. That was in 1896. The success of the German trained troops in 1897 was followed in 1898 by a congratulatory visit of the emperor to Constantinople. The imperial pilgrimage to the Holy Land and Syria followed. It was inspired by a mixture of orthodox piety and *Realpolitik*, and was crowned on Nov. 8 by a speech at Damascus in which the emperor declared that he would at all times be the friend of the Sultan Abd ul-Hamid, and of the 300 million Mohammedans who revered him as caliph. This, according to Pastor Friedrich Naumann, was said with an eye on the time when a world war would break out, when the Caliph of Islam would once more raise the standard of a holy war and summon Egypt, the Sudan, East Africa, Persia, Afghanistan and India to war against England. The immediate outcome of the emperor's visit to Constantinople was more tangible: the concession of the port of Haider Pasha to the "German Company of Anatolian Railways." The idea of directing German capital and German emigration towards Asia Minor and Mesopotamia had taken definite shape. In 1902 it received a further development in the conclusion of a convention for the building of a railway from Constantinople to Baghdad. The contemplated extension of this line to Basra would have linked up Hamburg and Berlin with the Persian gulf, turned the flank of the British trade routes to the East, and secured the economic, if not the political, domination of Germany in the Ottoman empire. The ultimate idea, partly realized on paper during the World War, was the creation of a great Central European Customs Union, forming an "economic area" stretching from the Baltic to the Persian gulf, as a counterpoise to the United States and the British empire (See GRAZ and SCHILLER, *The Economic Policy of Austria-Hungary during the War*, Eng. trans., 1927).

The Macedonian Question.—Meanwhile the question of what was to be done with Macedonia had become acute. All the

new Balkan States claim the reversion of the lion's share of that country of inextricably mixed races, and in order to substantiate their respective claims Greeks, Serbs and Bulgars were busy exterminating each other. The efforts of the Turks to maintain order were worse than useless, and merely led to armed revolts. In 1903 a serious insurrection of Macedonian Bulgars led to the intervention of the Powers, Austria and Russia agreeing on the so called *Muritzberg Programme*, reluctantly accepted by the Porte, under which the three *vaylets* of Monastir, Salonika and Kosovo were placed under the supervision of Austrian and Russian civil agents and their gendarmerie was organized and commanded by officers appointed by the Powers. The experiment, which had but poor success, came to an end in 1908 with the breach of the *entente* between Russia and Austria and the attempt to substitute for it an Anglo-Russian programme was frustrated by the revolution in Turkey.

The Young Turk Revolution.—This revolution, by which in 1908 Abd ul Hamid and his régime were overthrown, made a profound change in the general situation. The programme of the Committee of Union and Progress, which had carried out the *coup*, appealed to the sentiment of Europe, which welcomed the birth of a liberalized Turkey, established on the basis of nationality without distinction of creed. It was soon clear, however, that the new liberalism was make-believe, while the new nationalism threatened to be more intransigent than the old Ottoman overlordship. The whole elaborate system of shams by which diplomacy had sought to disguise the disruption of Turkey was especially threatened, for in the new unified and Europeanized State there would be no room for provinces "occupied and administered" by foreign Powers, like Bosnia-Hercegovina (or possibly Egypt), or for "vassal" states like Bulgaria. Therefore, in order to forestall any attempt of a regenerated Turkey to reclaim what it considered its own, those interested took action. On Oct. 7, 1908, the Emperor Francis Joseph issued a rescript annexing Bosnia-Hercegovina to the Habsburg monarchy. Two days earlier Prince Ferdinand of Bulgaria had proclaimed his independence and assumed the title of king (*tsar*). In July 1909, after the withdrawal of the allied forces, the Cretans proclaimed their union with Greece, though the caution of King Constantine, disallowed this for the time being.

The Italian Turkish War, 1911.—The annexation of Bosnia-Hercegovina, which had only been possible owing to the weakening of Russia in the war with Japan, revealed the breakup of even the pretence of a Concert of Europe in the Eastern Question. Here too the division of Europe between the Triple Entente and the Triple Alliance made itself felt. Russia and France joined in the protest of Great Britain against the annexation of Bosnia-Hercegovina as a violation of the treaties and a blow to the very foundations of international law, but the German emperor proclaimed his readiness to support his ally "in shunning armour" and the protest began and ended in diplomatic notes.

The attitude of Italy was more doubtful. Though a member of the Triple Alliance, she resented the strengthening of Austria's position on the opposite coast of the Adriatic, for the rival ambitions of the Italians, the Serbs and the Habsburg monarchy were now adding an Adriatic question to all the others. Then, too, there was the question of Tripoli, the last remnant of the Ottoman empire in northern Africa still available for Italian expansion. The reversions of this had been reserved for Italy when France had occupied Tunis, but the disquieting activities of the Emperor William II led to suspicions of German designs upon it. The result was a rapprochement between Italy and Russia, advertised in Oct. 1909 by the proposal of the Tsar Nicholas II to pay a State visit to Rome.

The alarms of Italy were increased by the Agadir incident of July 1911, and she determined to take action at once. On Sept. 27, an Italian ultimatum was presented to the Porte demanding its consent to an Italian occupation of Tripoli under the sovereignty of the sultan, on the 29th she declared war on Turkey. But for fresh developments in the Balkans the war which followed might have dragged on indefinitely. But threatened by a new and more instant danger, the Porte suddenly came to terms

By the Treaty of Lausanne (Oct. 18, 1912), Tripoli, Rhodes and the Dodecanese archipelago were, under a thin disguise, ceded to Italy, which thus also obtained a foothold in the Aegean and was brought into conflict with Greek aspirations.

The Balkan League and Balkan Wars, 1912-13.—The new danger to Turkey which led to the hasty conclusion of the war with Italy was the formation of the often mooted league of the Christian States of the Balkan peninsula. In view of their clashing interests, especially in the matter of the reversion of Macedonia, such a league might well have seemed impossible, but the Young Turk revolution, with its threat of a revived spirit of Ottoman national aggression, drew them together, and the rapprochement was encouraged by the split in the concert of the Great Powers. The first step was the conclusion, on March 13, 1912, of a defensive alliance between Serbia and Bulgaria, in which they agreed to take common action in the event of an attack by a great Power upon Turkey and defined their respective claims in Macedonia. A military convention was also signed on May 29.

Meanwhile Greece too had, on May 10, concluded a defensive alliance with Bulgaria, though no mention was made in the treaty of Macedonia, and the Bulgarians, in the event of war arising out of the admission of the Cretan Deputies to the Greek parliament, only bound themselves to observe a benevolent neutrality. This treaty, too, was followed by a military convention (Sept. 22).

The crisis was provoked by a serious rising against the Young Turk régime in Albania. The movement rapidly spread into Macedonia, and the Albanians, flushed with victory, demanded the cession to them of the *vaylets* of Monastir and Skopje, which Greece and Serbia had earmarked respectively as their own. Clearly, if their ambitions were to be realized, it was time for the new Balkan League to intervene. Bulgaria, violently excited by the news of a terrible massacre of Macedonian Bulgars by the Turks, was more than willing to take part. The Powers, appealed to by the League to join in demanding a drastic system of reforms in Macedonia, united only in urging concession upon the Porte and patience on the members of the League, and, when preparations for the Balkan States that, if they went to war, the Powers would see that they gained nothing by it. In view of the dislocation of the European Concert it seemed safe to ignore these warnings, and on Oct. 12 Montenegro declared war on Turkey.

The story of the Balkan wars is told elsewhere. (See BALKAN WARS, 1912-13.) Here it must suffice to note their outcome. The unexpected collapse of the Turks created a wholly new situation which forced the intervention of the Powers. On Dec. 3, 1912, an armistice was concluded, and on the 13th a conference of the belligerent States met in London to settle terms of peace, the ambassadors of the five Great Powers sitting simultaneously to watch over and direct the settlements. (See LONDON, CONFERENCES OF.) The conference broke up on Feb. 1, 1913, as the result of Enver Pasha's *coup d'état* of Jan. 23 which led the Balkan States to denounce the armistice. But one thing it had accomplished. It had been agreed by the Powers that Albania should be erected into an independent principality, and that Scutari should be placed under its sovereignty. Thus, so long as Austria-Hungary held the Dalmatian coast, Serbia would be effectually cut off from the Adriatic seaboard and forced into rivalry with Bulgaria and Greece for access to the coast of the Aegean at Salonika. This would lead to the breakup of the Balkan League, which threatened to be a barrier to the eastward pressure of the Central European Powers.

The Treaty of London, signed on May 30, 1913, under the mediation of the Powers, proved less a settlement than the cause of fresh dispute. Crete and all Turkey in Europe beyond the line Enos-Midia were ceded to the Balkan allies, the question of Albania and that of the islands were left to be settled by the Powers. It was inevitable that the victors should quarrel over the spoils, the more so as the creation of an autonomous Albania had profoundly modified the conditions under which the partition treaties between them had been concluded.

The quarrel was precipitated by the complete collapse of new Turkish efforts at resistance. Greece, Serbia and Bulgaria were

alike victorious, but Greece and Serbia by the chances of war, now held the territories which Bulgaria coveted and they showed no disposition to surrender them. Rumania, too, now joined in the scramble, demanding a rectification of the frontier of the Dobruja, and though on May 7 Bulgaria signed an agreement conceding this demand Rumania concluded a military convention with Serbia and Greece. The rupture came on the night of June 29, with a sudden attack by the Bulgarians on the Serbs.

The war was soon over, and Bulgaria, utterly defeated, had to submit to hard terms. By the Treaty of Bucharest (Aug. 10, 1912) she ceded Rumania a considerable strip of the Dobruja, with the fortress of Silistra.

In the south Bulgaria received only a narrow strip to give her access to the Aegean at Dedeagitch. She restored Adrianople, Demotika and Kuk-Kilissa to Turkey. Serbia and Greece, on the other hand, received large accessions of territory. Serbia acquired central Macedonia, including Okrida and Monastir, Kosovo, and the eastern half of Novi Pazar, the western half going to Montenegro.

Greece obtained Epirus, southern Macedonia, Salonika and the seaboard as far east as Mesia, thus including the port of Kavala. Crete, too, was soon afterward assigned by the Powers to Greece, together with all the Turkish islands, except Imbros and Tenedos—which command the Dardanelles—and Rhodes and the Dodecanese archipelago, which were in the occupation of Italy.

The Crisis of 1914.—This settlement, as was inevitable, satisfied nobody. Greece desired to round off her territories to the north by acquiring southern Albania, she wished to complete her empire in the Aegean by adding to it Rhodes and the Dodecanese. This brought her into conflict with Italy, which held firmly to the islands, and regarded the new Albanian principality as her peculiar interest. Bulgaria, of course, was profoundly dissatisfied, and her sense of grievance at the settlement—especially the loss of Thrace to Turkey—was not mitigated by the consciousness that the fault was her own. The most fateful outcome of the settlement, however, was the simultaneous strengthening and discomfit of Serbia. Cut off from the Aegean by the Greek occupation of Salonika, it was inevitable that she should aspire to find an outlet to the Adriatic, which could only be done at the expense of the Habsburg monarchy. National irredentism—the vision of the oppressed Slavs of the dual monarchy united with their liberated brethren—combined with economic necessity to throw the Serbs into antagonism to Austria-Hungary. Hence the agitation which culminated in the crime of Sarajevo, the immediate occasion of World War I. Austrian statesmen now saw, or thought they saw, in the rise of the Serbian power, not only a bar to the expansion of the monarchy southwards, but an instant menace to its very existence, and so in July 1914 sent the fatal ultimatum to Belgrade.

The nightmare vision which for more than a century had tormented the cabinets of Europe was now to become a reality. Hitherto it had been possible for the powers to suppress or to isolate the perpetual fires due to the shrinkage of Turkey. Now, suddenly, they had sent out a flame which lighted conflagration in all the world.

With the end of World War I the Eastern Question, in the sense defined, also came to an end, for the Ottoman empire had ceased to exist. It left, however, a plentiful aftermath of questions, some of which—like that of Albania and the Adriatic coast generally—remained dangerous sources of unrest.

BIBLIOGRAPHY.—J. A. R. Marriott, *The Eastern Question* (1917). Very full lists of authorities for the various phases will be found attached to the chapters dealing with them in the *Cambridge Modern History*, vol. x, xi and xii. (W. A. P.)

EAST GRINSTEAD, a market town and urban district in the East Grinstead parliamentary division of East Sussex, England, 50 mi SSE of London by road. Pop. (1951) 10,845. Area 10.3 sq. mi. East Grinstead stands on a hill in an agricultural and wooded area overlooking the Medway valley and Ashdown forest to the southeast.

The urban district contains East Grinstead and the villages of Ashurst Wood and Kingscote, with agriculture and timber as its

chief industries. The buildings are of all periods from Tudor timber framed houses onward, the loveliest being Sackville college, built for an almshouse in 1608 or 1609 by Robert, 2nd earl of Dorset, and still used for that purpose. St Swinith's church, on the site of St Edmund's (960), stands on the hilltop and contains unusual fluted, concave pillars (like Perpendicular) and iron grave-slabs (from 1570), it was rebuilt after the collapse of the tower in 1735.

The Queen Victoria hospital became a centre for plastic surgery in 1939, after World War II a large wing was erected and equipped by the Canadian government, and in 1946 the U.S. surgical centre was opened.

Originally built as a clearing in the great forest of Andredswold (see WEALD, THE), Grenestede ("green place") was granted a charter in 1121. Lying directly between London and Pevensy, William I included it among the royal domains that went with Pevensy castle. It was discovered early and at the time of the Conqueror there was an iron mine there. Furnaces for the ironworks were fed from the surrounding forests until Henry VIII and Elizabeth I passed laws to preserve the trees. East Grinstead is an ancient borough which from 1307 until 1832 returned two members to parliament. In 1285 the king ordered the market to be held on Saturday instead of Sunday, and in 1516 a yearly fair was granted.

EAST HAM, a municipal, county and parliamentary borough of Essex, England, 6 mi E by N of London bridge. Pop. (1951) 120,873. Area 5.1 sq. mi. East Ham is bounded north by Wanstead, east by Ilford and Barking (the other side of the River Roding), south by the Thames and west by West Ham. The borough includes all or part of the districts of Wanstead Park, Manor Park, Forest Gate, Little Ilford, North Woolwich, Upton Park and East Ham itself. The northern part is mainly residential but along the Thames are many industries including the Bechtel works of the North Thames Gas board, there too are the larger part of the Royal Albert dock and the King George V dock. East Ham is intersected by the two main highways out of east London—the Romford and the Barking roads, a by-pass road cuts off the southern angle of the borough nearer the river on the way to Grays and Tilbury. Its growth during the end of the 19th and beginning of the 20th century was very rapid, and it now forms, geographically, part of the eastward extension of London.

A town development plan (1952) visualized a reduction in population to 110,000 within 20 years. Movement of population would be to Basildon New Town and other towns in Essex scheduled for expansion (e.g., Brentwood where the corporation was developing an estate).

East Ham belonged before the Conquest to Waltham abbey, whose possession of it was confirmed by Edward the Confessor. The parish church of St. Mary Magdalen contains Norman work in the chancel and also a monument to Edmund Nevill, who claimed the earldom of Westmorland in the 16th century, William Stukeley, the antiquary (d. 1765), is buried in the churchyard. East Ham was incorporated in 1904, became a county borough in 1915 and has been represented by two members of parliament (for East Ham North and East Ham South) since 1918.

EASTHAMPTON, a town of Hampshire county, Massachusetts, U.S., in the Connecticut river valley, 17 mi NW of Springfield at an altitude of 169 ft., just west of Mount Tom. It is served by the Boston and Maine and the New York, New Haven and Hartford railways.

Pop. (1950) 10,694, in 1940 it was 10,316. Manufactures include rubber products, fireproof doors, clothing, furniture, advertising novelties, mercerized yarns and print goods. The manufacture of cloth-covered buttons (long a leading industry but discontinued) was built up by Samuel Williston (1795-1874) and his wife Emily Graves Williston, who first did the work by hand, then (1827) experimented with machinery, and in 1848 built a factory, and who in 1841 founded Williston academy, one of the oldest preparatory schools in New England. Easthampton was formed from parts of Northampton and Southampton in 1785 and was incorporated as a town in 1809.

EAST HAMPTON, a town of Suffolk county, N.Y., occupying the peninsula of Montauk at the east end of Long Island,

served by the Long Island railroad. The population in 1950 was 6,383. The scenery is varied and picturesque, and there are many summer homes and hotels. Montauk lighthouse, on Turtle hill, was first built in 1793. At Montauk point a large military camp was established after the Spanish American War. The principal villages are Sag Harbor (partly in the adjoining town), East Hampton and Amagansett. Most of the town was bought from the Indians in 1648 for about £30 by nine men from Massachusetts, and about 20 other families settled there in 1649, and until 1664, when all Long Island passed to the duke of York, the settlement was practically independent. In 1683, Gardiner's Island, settled in 1639, was made a part of East Hampton township. There are many tales of treasure buried by Captain Kidd on Gardner's Island and Montauk point.

Sag Harbor (settled in 1730 and incorporated in 1803) was held by the British after the battle of Long Island as a strategic naval and shipping point. It was an important whaling centre from 1785 until the embargo ruined the fisheries, and again from 1830 to 1870. "Home Sweet Home," the childhood home of John Howard Payne, is at East Hampton, a summer resort.

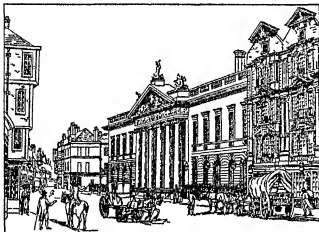
EAST INDIA COMPANY, an incorporated company for exploiting the trade with India and the Far East. In the 17th and 18th centuries East India companies were established by England, Holland, France, Denmark, Scotland, Spain, Austria and Sweden. The English, the most important of these, survived until it handed over its functions to the British government in 1858. It was founded at the end of the 16th century in order to compete with the Dutch merchants, who had obtained a practical monopoly of the trade with the Spice islands and had raised the price of pepper from 3s to 8s per lb. Queen Elizabeth incorporated it by royal charter, dated Dec. 31, 1600, under the title of "The Governor and Company of Merchants of London, trading into the East Indies." This charter conferred the sole right of trading with the East Indies, i.e., with all countries lying beyond the Cape of Good Hope or the Straits of Magellan, upon the company for a term of 15 years. Unauthorized interlopers were liable to forfeiture of ships and cargo. There were 125 shareholders in the original East India Company, with a capital of £72,000. The first governor was Sir Thomas Smythe. The early voyages of the company, from 1601 to 1612, reached as far as Japan (see Purchas' narratives), and are distinguished

Meanwhile friction was arising between the English and Dutch companies. The Dutch traders considered that they had prior rights in the Far East, and their ascendancy in the Indian archipelago was indeed firmly established on the basis of territorial dominion and authority. In 1613 they made advances to the English company with a suggestion for co-operation, but the offer was declined, and the next few years were fertile in disputes between the armed traders of both nations. In 1619 was ratified a "treaty of defence" to prevent disputes between the English and Dutch companies. When it was proclaimed in the East, hostilities solemnly ceased for the space of an hour, while the Dutch and English fleets, dressed out in all their flags and with yards manned, saluted each other, but the treaty ended in the smoke of that stately salutation, and perpetual and fruitless contentions between the Dutch and English companies went on just as before. In 1623 these disputes culminated in the "massacre of Amboyna," where the Dutch governor tortured and executed the English residents on a charge of conspiring to seize the fort. Great and lasting indignation was aroused in England, but it was not until the time of Cromwell that some pecuniary reparation was exacted for the heirs of the victims. The immediate result was that the English company tacitly admitted the Dutch claims to a monopoly of the trade in the Far East and confined their operations to India and adjoining countries.

The need for good ships for the East Indian trade had led the company in 1609 to construct their dockyard at Deptford, from which, as Monson observes, dates "the increase of great ships in England." Down to the middle of the 17th century, the famous "East Indiamen" held unquestioned pre-eminence among the merchant vessels of the world. Throughout the 17th century they had to be prepared at any moment to fight not merely Malay pirates, but the armed trading vessels of their Dutch, French, and Portuguese rivals. Many such battles, usually with successful results, are recorded in the company's history.

It was not until it had been in existence for more than a century that the English East India Company obtained a practical monopoly of the Indian trade. In 1635, a year after the Great Mogul had granted it the liberty of trading throughout Bengal, Charles I. issued a licence to Courten's rival association, known as "the Assada merchants," on the ground that the company had neglected English interests. The piratical methods of their rivals disgraced the company with the Mogul officials, and a *modus vivendi* was only reached in 1649. In 1657 Cromwell renewed the charter of 1609, providing that the Indian trade should be in the hands of a single joint stock company. The new company thus formed bought up the factories, forts, and privileges of the old one. It was further consolidated by the fostering care of Charles II., who granted it five important charters. From a simple trading company, it grew under his reign into a great chartered company—to use the modern term—with the right to acquire territory, coin money, command fortresses and troops, form alliances, make war and peace, and exercise both civil and criminal jurisdiction. It is accordingly in 1689, when the three presidencies of Bengal, Madras, and Bombay had lately been established, that the ruling career of the East India Company begins. From this moment the history of the transactions of the East India Company becomes the history of British India (see *India History*). Here we shall only trace the later changes in the constitution of the ruling body itself.

The great prosperity of the company under the Restoration and the immense profits of the Indian trade attracted a number of private traders, both outside merchants and dismissed or retired servants of the company, who came to be known as "interlopers." In 1683 the case of Thomas Sandys, an interloper, raised the whole question of the royal prerogative to create a monopoly of the Indian trade. The case was tried by Judge Jeffreys, who upheld the royal prerogative, but in spite of his decision the custom of interloping continued and laid the foundation of many great fortunes. By 1691 the interlopers had formed themselves into a new society, meeting at Dowgate, and rivaling the old company, the case was carried before the House of Commons, which declared in 1694 that "all the subjects of England have



BY COURTESY OF MESSRS. COLNAGHI, BALL AND COMPANY

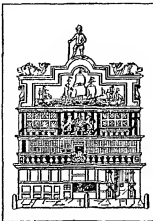
EAST INDIA HOUSE. THE LAST HOME OF THE EAST INDIA COMPANY
This building, on the site of the old house in 1726, was sold in 1859

as the "separate voyages," because the subscribers individually bore the cost of each voyage and reaped the whole profits, which seldom fell below 100%. After 1612 the voyages were conducted on the joint stock system for the benefit of the company as a whole. In 1610-11 Captain Hippon planted the first English factories on the mainland of India, at Masulipatam and at Pictaph in the Bay of Bengal. In 1609 James I. renewed the company's charter "for ever," though with a proviso that it might be revoked on three years' notice if the trade should not prove profitable to the realm.

equal right to trade to the East Indies unless prohibited by act of parliament." This decision led up to the act of 1698, which set up a new East India Company in consideration of a loan of two million to the state. The old company subscribed £315,000 and became the dominant factor in the new body, while at the same time it retained its charter for three years, its factories, forts, and assured position in India. The rivalry between the two companies continued both in England and in India, until they were finally amalgamated by a tripartite indenture between the companies and Queen Anne (1702), which was ratified under the Godolphin ward (1708). Under this award the company was to lend the nation £3,000,000, and its exclusive privileges were to cease at three years' notice after this amount had been repaid. But by this time the need for permanence in the Indian establishment began to be felt, while parliament would not relinquish its privilege of "milking" the company from time to time. In 1712 an act was passed continuing the privileges of the company even after their fund should be redeemed, in 1730 the charter was prolonged until 1766, and in 1742 the term was extended until 1783 in return for the loan of 1 million. This million was required for the war with France, which extended to India and involved the English and French companies there in long-drawn hostilities, in which Dupleix and Clive became prominent.

So long as the company's chief business was that of trade, it was left to manage its own affairs. The original charter of Elizabeth had placed its control in the hands of a governor and a committee of 24, the chairman and court of directors in London exercising unchecked control over their servants in India. But after Clive's brilliant victory at Plassey (1757) had made the company a ruling power in India, it was considered essential that the British government should have some control over the territories thus acquired. Lord North's Regulating act (1773) raised the governor of Bengal—Warren Hastings—to the rank of governor-general, and provided that his nomination, though made by a court of directors, should in future be subject to the approval of the crown, in conjunction with a council of four, he was entrusted with the power of peace and war, a supreme court of judicature was established, to which the judges were appointed by the crown, and legislative power was conferred on the governor-general and his council. In 1784 Pitt's India bill created a board of control, as a department of the English government, to exercise political, military, and financial superintendence over the British possessions in India. This bill first authorized the historic phrase "governor-general in council." From this date the direction of Indian policy passed definitely from the company to the governor-general in India and the ministry in London. In 1833 Lord Liverpool passed a bill which gave the board of control authority over the company's commercial transactions and abolished its monopoly of Indian trade. The monopoly of the valuable trade with China, chiefly in tea, was ended by Earl Grey's act of 1833. Its property was then secured on the Indian possessions, and its annual dividends of ten guineas per £100 stock were made a charge upon the Indian revenue. Henceforward the East India Company ceased to be a trading concern and exercised only administrative functions. Such a position could not, in the nature of things, be permanent, and the Indian Mutiny was followed by the entire transference of Indian administration to the crown on Aug. 2, 1858.

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BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM
OLD EAST INDIA HOUSE LEADEN HALL ST. LONDON 1714

EASTLAKE, SIR CHARLES LOCK (1793-1865), English painter, art historian and museum director, was born at Plymouth, Devon, on Nov. 17, 1793. He went to Plympton Grammar school (concurrently learning drawing from Samuel Prout, q.v.) and briefly to the Chateaufort, London. But in 1809 a resolve, "unalterably fixed," to become a painter of "history" (i.e., of scriptural, allegory, antiquity or literature as opposed to everyday life or portraits) brought him as pupil to B. R. Haydon (q.v.) and to the Royal Academy schools. By 1812 he had finished his first commission, the "Raising of Jureus's Daughter," and in 1815 came the famous "Buonaparte on Board the Bellerophon," the proceeds of whose sale took him to Rome in 1816. There till 1830 he worked in a congenial society that included Sir Thomas Lawrence, J. M. W. Turner and William Litz, Sir Humphry Davy and Thomas Moore. Rome and the Campagna deflected him from a while from "history" to landscape, his skill in which appears in his later "banditti" pictures, now also were begun his copious notebooks, many of which are preserved in the National gallery, London. He was elected A.R.A. in 1817 and R.A. in 1830, in 1840 he succeeded Sir Martin Archer Shee as president of the Royal Academy and was knighted.

With his appointment in 1855 to the new directorship of the National gallery—whose keeper he was from 1843 till his resignation in 1847 in full of unjust criticisms—the artist was finally displaced by the writer administrator and arbiter of national and court taste and Eastlake is best remembered for his part in raising the gallery to European status and for his books *Materials for a History of Oil Painting* (1847) and *Contributions to the Literature of the Fine Arts* (2 series, 1848-1870). He died at Pisa, Dec. 24, 1865.

In 1849 he had married Elizabeth Rigby, author of *Letters from the Baltic* (1841). Lady Eastlake (1809-93) was also a considerable diarist and translator of G. F. Waagen's *Treasures of Art in Great Britain* (1844-57). Their nephew CHARLES LOCK EASTLAKE (1836-1906) was keeper of the National gallery, 1878-98, and a writer on painting and industrial art.

BURTONGARY—W. Cosmo Monkhouse, *Pictures by Sir Charles Eastlake* (London 1875), Lady Eastlake, "Memor. of Sir C. L. Eastlake," in his *Contributions*, and series (London, 1870, includes catalogue of his paintings), C. Eastlake Smith (ed.), *Journals and Correspondence of Lady Eastlake*, 2 vol. (London, 1895).

EASTLEIGH, a municipal borough in the Winchester parliamentary division of Hampshire, Eng., 4 mi. NNE of Southampton. Area is 9.9 sq. mi. Population in 1951 census was 30,557. Incorporated in 1936, it includes the districts of Chandler's Ford, Alibroke, Bishopscloke and parts of North Stoneham, Otterbourne, Far Oak and Stoke Park. Lying in well-wooded country, it is in part residential and in part industrial, the chief industry being the works of the British Railways (Southern region).

The church of St. Nicolas at North Stoneham is one of the earliest ecclesiastical foundations in England, though it shows no trace of the old Saxon building. It contains the memorial to Sir Thomas Flemings, who sentenced Guy Fawkes to death, and for centuries a celebration took place every Nov. 5.

EAST LIVERPOOL, a city of Columbiana county, O., U.S., 40 mi. W by N of Pittsburgh, on the Ohio river, opposite Newell and Chester, W. Va. It is on federal highway 30 and is served by the Pennsylvania railroad and motorbuses and river steamboats. The population of East Liverpool was 24,217 in 1950, it was 23,555 in 1940 and 23,349 in 1930 by the federal census. It has large machine works, a drawn steel plant and several small machine plants, electric powerplant plants and other industries. There are pottery plants in this city and in Chester and Newell, the latter two cities are served with two large passenger and traffic bridges. The potteries employ 6,500 wage earners. The city is built on sloping ground, rising from the river bank, in the midst of beautiful scenery.

In 1798 Thomas Fawcett settled there, and in 1802 he laid out a town, which he named St. Clair but others persisted in calling Fawcettstown. The name Liverpool was adopted in 1816, and in 1834, when the town was incorporated, East was prefixed, to distinguish it from another settlement in the state. The dominating industry dates from 1839, when James Bennett, an English potter, reached the small town, and judged that the clays in the surrounding hills would make an excellent-quality yellow ware. The manufacture of white ware began in 1872, of semivitreous china about 1890, while the production of porcelain electrical fixtures

and supplies developed in the 20th century. Local clays are still used for yellow ware by one plant, but with this exception all the raw materials needed by the potteries come from a distance: the clays from Florida, North Carolina, Kentucky and England, other minerals from distant states, Canada and Italy. Labour saving machinery displaced the potter's wheel in East Liverpool at an early date.

EAST LONDON, a city of the Union of South Africa, 33° 3' S, 27° 55' E. Its population, including that of the suburbs, such as Cambridge, 4 mi away, is (1953 est.) 91,707 including 43,780 Europeans, 40,457 natives, 5,877 "coloured" (i.e., mixed) and 1,503 Asiatics. The town is situated at the mouth of the Buffalo river, 569 mi by sea from Cape Town, 253 mi from Durban and 665 mi by rail from Johannesburg. The first settlement was a military post on the west bank of the river. It was established to serve as a base port in 1846 during the border wars and was then known as Fort Rex. In 1848 it was renamed East London and in 1873 it was created a municipality, it was incorporated in 1880 and made a city in 1897. When the railway was constructed on the opposite bank in 1874, the business and commercial centre moved across the river. Buffalo bridge, a combined road and railway bridge, was completed in 1935. The main town, built on a plateau 150 to 200 ft. high, is laid out in broad, straight streets, the principal ones being Oxford, Cambridge and Buffalo streets crossed by Fleet street.

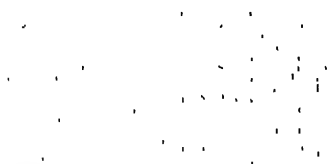
The climate is influenced by the warm Mozambique current off the coast. The mean minimum temperature is 57.1° and relative humidity about 87%. The mean annual rainfall is about 30 in., but the building of the Lang dam has ensured the water supply in times of drought.

Because of its equable climate its facilities for surf bathing and the attraction of its river, East London is one of the principal holiday resorts of the South African coast. Along the shore to the northeast of the river a fine-weather esplanade was made, there are two parks, Queens park (about 60 ac) and James Pearce park (about 30 ac). There are also a zoo, a museum and an aquarium (both opened in 1931) and an art gallery.

The silting up of the river delayed the development of the port, but in 1886 a suction dredger was put to work. Extensive harbour improvements enabled the port to accommodate the larger boats serving South Africa. In 1947 the Prince Elizabeth graving dock was opened. East London ranks as the fourth port of South Africa and is its only river port. It takes a large part of the trade of the eastern part of Cape Province of the Transkei and native territories, of Basutoland and part of the Orange Free State. There is a railway line to Witwatersrand through the Orange Free State gold fields. Important exports are wool, pineapples, citrus fruits and hides; timber is the chief import. During 1950-51 853,020 harbour tons of traffic were handled. Wool is the city's main industry, but other important ones include sweets, furniture, textiles and paints and varnishes, some fishing is done.

Seven miles from the market square, at Collondale, West Bank, is the airport.

EAST LOTHIAN (or **HADDINGTONSHIRE**), a southeastern county of Scotland, bounded north by the Firth of Forth, northeast by the North sea, east and south by Berwickshire and southwest and west by Midlothian. Land area is 267.1 sq mi. The seat of the county is Haddington.



berwick

History—Of the early Celtic inhabitants, traces are found in a few place names and circular camps (in the parishes of Garvald and Whittingehame) and hill forts (in the parish of Bolton). Excavations at Traprain Law, carried on after 1914, gave evidence that this hill, a natural stronghold strengthened by earthworks, was in occupation nearly continuously from the Bronze Age to the beginning of the 5th century A.D. Most of the objects found are Celtic, but there was also a hoard of Roman silver plate of the 4th century, weighing more than 770 oz. and believed to have been pilaged from Gaul by Saxons pirates after the Roman occupation, of which few traces remain, the district

formed part of the Saxon kingdom of Northumbria until 1018, when it was joined to Scotland by Malcolm II. It was comparatively prosperous till the wars of Bruce and Balliol, but from that period down to the union of the kingdoms it suffered from its nearness to the Border and from civil strife. The last battles fought in the county were those of Dunbar (1450) and Prestonpans (1745). Haddington (q.v.) is supposed to be the birthplace of John Knox (q.v.).

Agriculture and Industries—East Lothian has for centuries been famous for the fertility of its soil and the excellence of its agriculture. The Lothian marshes are given over largely to sheep, though the lower slopes are cultivated. In the centre of the shire occurs a belt of tenacious boulder clay on a tilly subsoil not adapted for agriculture. The coast is sandy, but farther inland the rich loam is very fertile, and barley, wheat, hay, turnips, sweedes and potatoes are grown extensively. The red soil about Dunbar yields a potato—the "Dunbar red"—highly esteemed in the markets. There are large and small holdings and much improved pasture. Some fishing is carried on at Dunbar, North Berwick and Port Seton. Fire clay is worked in association with coal mining, and limestone is quarried at Oxwellmans and East Saltcoats. Industries include the manufacture of agricultural implements, bricks, woollens and silk, besides brewing and distilling, boat building and sawmilling. Only a limited part of the Carboniferous limestone area includes the coal measures, but coal is extensively worked at Tranent, Ormiston and near Prestonpans, the coal field having an area of about 10 sq mi.

Population and Government—The population in 1951 was 52,740, of whom 40 spoke both Gaelic and English. The chief towns (pop. 1951) are Dunbar (4,115), Haddington, the county town (4,497), and North Berwick (4,001), the three royal burghs, and Prestonpans (1,907), Tranent (5,639), Cockenzie and Port Seton (3,180) and East Lothian (990), all small burghs, of which there are seven. There are five county districts. The shire, which returns one member of parliament with Berwickshire, forms part of the sheriffdom of the Lothians and Peebles, and a sheriff substitute sits at Haddington.

EASTMAN, GEORGE (1854-1932), U.S. inventor, manufacturer and philanthropist, was born at Waterville, N.Y., on July 12, 1854. He was educated at Rochester and became interested in photography. In 1880 he began to manufacture dry plates and four years later produced the first practicable roll film. In 1888 he invented the "Kodak." He devoted the greater part of his fortune to the advancement of education, and had given by 1925 a total of more than \$5,000,000 for such purposes. Of this sum the University of Rochester received more than \$2,500,000, including about \$5,500,000 for the medical school and \$500,000 for the foundation and endowment of the Eastman school of music. He gave also \$15,500,000 to the Massachusetts Institute of Technology and about \$2,000,000 to the Hampton and Tuskegee institutes. He died March 14, 1932. (See PHOTOGRAPHY.)

EAST MOLINE, a city of Rock Island county, Ill., U.S., on the Mississippi river, adjoining Moline. It is served by the Burlington, the Chicago, Milwaukee, St. Paul and Pacific, the Rock Island and the Davenport, Rock Island and Northwestern railways. Pop. (1950) 13,913, (1940) 12,359 by federal census. It has important manufactures, similar to those of the neighbouring cities, including especially ploughs, scales, laundry machinery, harvesting machinery, steel playthings, pressed steel and voltage regulators. The city was incorporated in 1907.

EASTON, a city of eastern Pennsylvania, U.S., on the Delaware river, at the mouth of the Lehigh and Bushkill rivers, opposite Phillipsburg, N.J., 60 mi N. of Philadelphia and 70 mi W. of New York city, the county seat of Northampton county. It is on federal highways 22 and 611, is served by the Jersey Central, the Lehigh Valley, the Lehigh and Hudson River and (through Phillipsburg) the Lackawanna and the Pennsylvania railways, and is at the junction of the Delaware and the Lehigh canals. The population was 35,652 in 1950, 33,580 in 1940, and 34,468 in 1930 by the federal census. The city is beautifully situated on rolling ground, commanding fine views of hills and rivers. The total bank resources are approximately \$85,000,000 and building and loan resources \$5,000,000. On a hill overlooking the city is Lafayette college, an institution for men, opened in 1832, which has an enrolment of about 2,000. It was named after the marquis de La Fayette, who was on tour through the United States when the movement to establish the college was launched in 1824. Easton is the commercial centre of a region rich in mineral and agricultural resources. Abundant hydroelectric power is available, and the city has important and varied manufactures, with a total industrial pay roll of more than \$40,000,000.

EAST SAINT LOUIS, a city of St. Clair county, Ill., U.S., on the Mississippi river, opposite St. Louis, with which it is connected by three great steel bridges, one of the great railway centres of the country and an important manufacturing city. It is the focus of 21 railroads from the east, north and south, including the Alton and Southern, the Baltimore & Ohio, the Illinois Central, the Illinois Terminal, the Burlington, the Chicago & Eastern Illinois, the New York Central, the Litchfield and Madison, the Louisville & Nashville, the Missouri Pacific, the Gulf Mobile and Ohio, the Frisco, the Nickel Plate, the Pennsylvania, the St. Louis Southwestern, the Southern, the Terminal and the Wabash, is on federal highways 40, 50, 66 and 67, and is served by many local and transcontinental bus lines. The population in 1930 was 82,295 and was 75,609 in 1940 according to the federal census.

The city occupies 13.4 sq mi of the Mississippi bottom land, not much above the high-water mark of the river, but adequately protected by strong levees.

The assessed valuation of property in 1950 was \$160,000,000. Coal is mined at its doors.

Meat packing houses employ approximately 5,000 men. Other leading manufactures are alumina, chemicals, glass bottles, paint pigments, railway equipment, roofing, brick, tile, pipe line valves and petroleum products. The stockyards are the second largest concentration point of livestock in the United States. Races are held regularly in the spring and fall.

East Saint Louis was laid out about 1808, and was chartered as a city in 1865. It grew most rapidly between 1900 and 1910, when the population almost doubled.

There is a famous prehistoric mound (Monk's mound) near the city. The village of Cahokia, at the southern edge of the city, was one of the earliest French settlements in the Mississippi valley.

EAST STROUDSBURG, a borough of Monroe county, Pa., U.S., adjoining Stroudsburg (qv) and 20 mi N of Easton, surrounded by the beautiful scenery of the Kittatinny range and the Pocono mountains.

It is on federal highway 611 and is served by the Lackawanna and the Pennsylvania railways. The population was 7,274 in 1950 and was 6,404 in 1940 and 6,099 in 1930 by the federal census. It is a resort centre.

The borough has sundry manufacturing industries, has a progressive education system and is the seat of a state teachers' college (opened 1893).

EATON, DORMAN BRIDGMAN (1823-1899), American lawyer, was born at Hardwick, Vt., June 27, 1823. He graduated at the University of Vermont in 1848 and at the Harvard law school in 1850, and in the same year was admitted to the bar in New York city. There he became associated in practice with William Kent, the son of the great chancellor. He was conspicuous in the fight against William Marcy (Boss) Tweed and his followers, by one of whom he was assaulted, he required a long period of rest, and went to Europe, where he studied the workings of the civil service in various countries. From 1873 to 1875 he was a member of the first United States civil service commission. In 1877, at the request of Pres. Rutherford B. Hayes, he made a careful study of the British civil service, and three years later published *Civil Service in Great Britain*. He drafted the Pendleton Civil Service act of 1883, and later became a member of the new commission established by it. He resigned in 1885, but was almost immediately reappointed by Pres. Grover Cleveland, and served till 1886, editing the third and fourth *Reports of the commission*. He was an organizer (1878) of the first society for the furtherance of civil service reform in New York, of the National Civil Service Reform association, and of the national conference of the Unitarian Church (1865). He died in New York city, Dec. 23, 1899. Among his publications were: *Should Judges Be Elected?* (1873), *The Spoils System and Civil Service Reform* (1882), *Problems of Police Legislation* (1895) and *The Government of Municipalities* (1899).

See the privately printed memorial volume, *Dorman B. Eaton, 1823-99* (1900).

EATON, MARGARET O'NEILL (1796-1879), better known as Fanny O'Neill, was the daughter of the keeper of a popular Washington tavern, and was noted for her beauty, wit and vivacity. About 1813, she married a purser in the United States navy, John B. Timberlake, who committed suicide while on service in the Mediterranean in 1828. In the following year she married John Henry Eaton (1790-1850), a Tennessee politician, at the time a member of the United States senate. Senator Eaton was a close personal friend of Pres. Andrew Jackson who in 1829 appointed him secretary of war. This sudden elevation of Mrs. Eaton into the cabinet social circle was resented by the wives of several of Jackson's secretaries, and charges were made against her of improper conduct with Eaton previous to her marriage to him. The refusal of the wives of the cabinet members to recognize the wife of his friend angered President Jackson, and he tried in vain to coerce them. Eventually, and partly for this reason, he almost completely reorganized his cabinet. The effect of the incident on the political fortunes of the vice president, John C. Calhoun, whose wife was one of the recalcitrants, was perhaps most important. Partly on this account, Jackson's favour was transferred from Calhoun to Martin Van Buren, the secretary of state, who had taken Jackson's side in the quarrel and had shown marked attention to Mrs. Eaton, and whose subsequent elevation to the vice-presidency and presidency through Jackson's favour is no doubt partly attributable to this incident. In 1836 Mrs. Eaton accompanied her husband to Spain, where he was United States minister in 1836-40. After the death of her husband she married a young Italian dancing master, Antonio Buchignani, but soon obtained a divorce from him. She died in Washington on Nov. 8, 1879.

See James Parton's *Life of Andrew Jackson* (1860).

EATON, THEOPHILUS (c. 1590-1658), English colonial governor in America, born at Stony Stratford, Buckinghamshire, about 1590, settled in London, where he joined the Puritan congregation of the Rev. John Davenport. The pressure upon the Puritans increasing, Eaton, who had been one of the original patentees of the Massachusetts Bay Colony in 1629, determined to use his influence and fortune to establish an independent colony of which his pastor should be the head. He emigrated with Davenport to Massachusetts, and in the following year (March 1638) he and Davenport founded New Haven. In Oct. 1639 a form of government was adopted, based on the Mosaic law, and Eaton was elected governor, a post which he continued to hold, first over New Haven alone, and after 1643 over the New Haven colony or jurisdiction, until his death at New Haven, Jan. 7, 1658. He was prominent in the affairs of the New England confederation, of which he was one of the founders (1643). In 1655 he and Davenport drew up the code of laws, popularly known as the "Connecticut blue laws."

A sketch of his life appears in Cotton Mather's *Magnalia* (London, 1702), see also J. B. Moore's "Memor of Theophilus Eaton" in the *Collections of the New York Historical Society*, second series, vol. II (New York, 1849).

EATON, WILLIAM (1764-1811), American soldier, was born in Woodstock, Conn., on Feb. 23, 1764. He was a school teacher for several years, graduated at Dartmouth college in 1790, and in 1792 entered the army as a captain, later serving against the Indians in Ohio and Georgia. In 1797 he was appointed consul to Tunis, where he arrived in Feb. 1799. In March 1799, with the consuls to Tripoli and Algiers, he negotiated alterations in the treaty of 1797 with Tunis. He rendered great service to Danish merchantmen by buying on credit several Danish prizes in Tunis and turning them over to their original owners for the redemption of his notes. In 1803 he quarrelled with the bey, was ordered from the country and returned to the United States. In 1804 he returned to the Mediterranean as US naval agent to the Barbary States with James Barron's fleet. On Feb. 23, 1805, he agreed with Ahmet that the United States should undertake to re-establish him in Tripoli, that the expenses of the expedition should be repaid to the United States by Ahmet and that Eaton should be general and commander in chief of the land forces in Ahmet's campaign. In making the arrangement Eaton far

exceeded his authority. On March 8 he started for Derna across the Libyan desert from the Atab's Tower 40 mi west of Alexan-
dra, with a force of about 500 men, including a few Americans,
about 40 Greeks and some Arab cavalry. In the march of nearly
600 mi the camel drivers and the Arab chiefs repeatedly mutinied,
and Ahmet Pasha once put himself at the head of the Arabs and
ordered them to attack Eaton. Ahmet more than once wished to
give up the expedition. But on April 27, with the assistance of
three bombarding cruisers, Eaton captured Derna—an exploit
commemorated by Whittier's poem *Derna*. In May and again in
June he successfully withstood the attacks of Tripolitan forces
sent to dislodge him. On June 12 he abandoned the town upon
orders from Commodore Rodgers, for peace had already been
made (June 4) with Yussuf, the *de facto* pasha of Tripoli. Eaton
returned to the United States and received a grant of 10,000 ac
in Maine from the Massachusetts legislature. According to a
deposition which he made in 1807 he was approached by Aaron
Burr (q.v.), who attempted to enlist him in his "conspiracy." As
he received from the government, soon after making this depo-
sition, about \$10,000 to liquidate claims for his expense in Tripoli,
which he had long pressed in vain, his good faith had been doubted.
At Burr's trial at Richmond in 1807 Eaton was one of the wit-
nesses but his testimony was unimportant. He died on June
1811, in Brimfield, Mass.

See the anonymously published *Life of the Late Gen. William Eaton*
(Brookfield, Mass., 1811) by Charles Prentiss, C. C. Felton, "Life of
William Eaton" in Sparks's *Library of American Biography*, vol. 11
(Boston, 1838), Gardner W. Allen's *Our Navy and the Barbary*
Corsairs (Boston, 1905), and William Abbott, "A Forgotten Hero,
William Eaton," *Mag. of Hist.*, vol. vi, pp. 1-10 (1907). See also
E. A. Powell, *Gentlemen Riders* (1913), and M. Minnigerode, *Lucas*
and *Times* (1914).

EATON, WYATT (1849-1896), American portrait and
figure painter, was born at Philipsburg, Canada, on May 6, 1849.
He was a pupil of the schools of the National Academy of De-
sign, New York, and in 1872 went to Paris, where he studied in
the Ecole des Beaux Arts under J. L. G. Grosse. He made the ac-
quaintance of J. F. Millet at Barbizon, and was also influenced
by his friend Jules Bastien-Lepage. After his return to the
United States in 1876 he became a teacher in Cooper Institute
and opened a studio in New York city. He was one of the or-
ganizers (and the first secretary) of the Society of American Artists.

Among his portraits are those of William Cullen Bryant and
Timothy Cole, the wood engraver ("The Man with the Violin").
Eaton died at Newport, R.I., on June 7, 1896.

EAU CLAIRE, a city of northwestern Wisconsin, U.S., 84
mi E of Saint Paul, on the Chippewa river at the mouth of the
Eau Claire, the county seat of Eau Claire county. It is on federal
highways 10, 12 and 53, and is served by the Chicago and North
Western, the Chicago, Milwaukee, St. Paul and Pacific and the
Soo line railways.

The population was 36,028 in 1930 and 30,745 in 1940, by fed-
eral census. There is abundant water power, and the city has
large and diversified manufacturing enterprises. It is the princi-
pal trading center for the prosperous Chippewa valley. The city
adopted night plowing in effect the council manager form of govern-
ment in 1939. It is the seat of a state teachers college, a county
tuberculosis hospital and a county hospital for the insane. There
are six municipal organizations and an auditorium seating 2,000.
A state fish hatchery, several wood mills in the vicinity.

Eau Claire was settled about 1817, chartered as a city in 1873
and grew rapidly with the development of the northwestern
lumber trade in the decade 1870-80.

A serious strike in 1881 necessitated the calling out of the state
militia.

EAU DE COLOGNE, a perfume so named from the city
of Cologne, where its manufacture was first established by an
Italian, Johann (or Giovanni) Maria Farina (1685-1766), who
settled at Cologne in 1709. The perfume gained a high reputation
by 1766, and Farina associated himself with his nephew, to whose
grandson the secret was ultimately imparted, the original perfume
is still manufactured by members of this family under the name

of the founder. The manufacture is, however, carried on at
Cologne, and also in Italy, by other firms bearing the name Farina,
and the scent has become part of the regular output of perfumers.
The discovery has also been ascribed to a Paul de Femins, who is
supposed to have brought his recipe from Milan to Cologne, of
which he became a citizen in 1690, and sold the perfume under the
name *Eau admirable*, leaving the secret at his death to his nephew
Johann Maria Farina. It was prepared from an alcoholic in-
fusion of certain flowers, potherbs, drugs and spices, distilling
and then adding definite quantities of several vegetable essences.
The purity and thorough blending of the ingredients are of the
greatest importance. The original perfume is simulated and even
excelled by artificial preparations. The oils of lemon, bergamot
and orange are employed, together with the oils of neroli and ro-
semary in the better class. The common practice consists in dis-
solving the oils, in certain definite proportions based on experi-
ence, in pure alcohol and distilling, the distillate being diluted by
rose water.

EAU DE VIE. *SEE* BRANDY

EAUX-BONNES, a watering place of southwestern France,
in the department of Basses-Pyrénées, 3½ mi S.E. of the small
town of Laruns, the latter being 24 mi S. of Pau by rail. Popu-
lation (1946) town, 253, commune, 510, (1952 est.) commune
500. Eaux-Bonnes stands at a height of 2,460 ft at the mouth of
a fine gorge, at the confluence of two torrents, the Valentin and
the Soudre. Its sulphurous and siline mineral waters (famous
from the 14th century) are beneficial in affections of the throat
and lungs. They vary between 50° and 90° C in temperature and
are used for drinking and bathing. There are two thermal estab-
lishments, a casino and fine promenades.

The watering place of LES EAUX-CHAUDÈS is 5 mi by road
southwest of Les Eaux-Bonnes, in a wild gorge on the Gave
d'Ossau. Population (1952 est.) 392. The springs are sulphurous,
varying in temperature from 52° to 97° C, and are used in cases
of rheumatism and for lung and skin complaints. There is fine
mountain scenery in the neighbourhood of both places. The valley
of Ossau is one of the most beautiful in the Pyrenees. Before
the Revolution it comprised a community which, though dependent
on Béarn, had its own legal organization, manners and costumes.

EAVES, in architecture, the projecting edge of a sloping roof,
which overlhangs the face of the wall so as to throw off the water.

EAVESDRIIP or **EAVESDROPP**, that width of ground
around a house or building which receives the rain water dropping
from the eaves. By an ancient Saxon law, a landowner was for-
bidden to erect any building at less than two feet from the bound-
ary of his land, and was thus prevented from injuring his neigh-
bour's house or property by the dripping of water from his eaves.
The law of eavesdrip has had its equivalent in the Roman *stillicidium*,
which prohibited building up to the very edge of an estate.
This prohibition has been adopted by some states which
follow the Roman civil law. From the Saxon custom arose the
term "eavesdropper", i.e., any one who stands within "the eaves-
drop" of a house, hence one who pries into others' business or
listens to secrets. At common law an eavesdropper was regarded
as a common nuisance and was punishable at the court leet and
inductible at the sheriff's tourn and punishable by fine and im-
prisonment for good behaviour. Though the offence of eavesdropping
still exists at common law there is no modern instance of prosecu-
tion or indictment.

EBBINGHAUS, HERMAN (1850-1909), German psychol-
ogist, was born in Birmen, studied at Berlin and rose to assistant
professor there in 1886. He was given the chair at Breslau in
1894, was called to Halle in 1905 and died there in 1909.

Ebbinghaus was an innovator in the development of methods
for experimenting on memory or rote learning. His results were
published in *Psychologie des Gedächtnisses* in 1885 (English trans-
lation, 1913). He used nonsense syllables and took as a measure
the number of repetitions required to learn them to the first
perfect repetition. Aside from means used to justify the method,
some of the more valuable results were to show that forgetting
varied as the logarithm of the time elapsed, that distributing
repetitions over different days reduced the number of repetitions

required, that the number of repetitions required for learning increased rapidly as the number of syllables in a series was increased. These experiments initiated a large series that have earned for our knowledge of learning.

Ebbwghaus wrote a two-volume survey of psychology that afforded the clearest and most comprehensive statements of psychology of its time. He is known also for an ingenious method of intelligence testing. (W B Py)

EBBW VALE, an urban district in the Ebbw Vale parliamentary division of Monmouthshire, Wales, 28 mi by road W of Monmouth. Pop (1951) 29,205. Area 10.7 sq mi. The town lies near the head of the Ebbw valley, nearly 1,000 ft above sea level and, like other mining towns of South Wales built in the second half of the 19th century, it straggles untidily along the valley. Christ Church (1870) is its chief building. Its position on the northern outcrop of the South Wales coal field made it first an important iron-smelting area and later a coal mining centre.

The extended use of coal and new processes in smelting made Ebbw Vale one of the most important steel centres in South Wales, but distance from the coast and trade depression in the 1930s caused great decline and distress. In 1935, however, a vast new steelworks, covering approximately 2½ mi by ½ mi, was established on an old but much smaller foundation. It started working in 1938–39 and after 1945 it was enlarged. Its capacity ten years later was about 600,000 tons of sheet steel and tin plate a year. Attached to the Ebbw Vale steelworks are limestone quarries, brickworks and an iron ore field in Northamptonshire. The industries of the district also include coal mining.

EBEL, HERMANN WILHELM (1820–1875), German Celtic scholar, studied at Berlin and Halle, and, after holding other professional posts, became professor of comparative philology at Berlin. He died at Misdroy on Aug. 19, 1875. His most important contribution to Celtic philology was his revised edition (1871) of Kaspar Zeuss's *Grammatica Celtica*. A selection of his papers was published in English as *Celtic Studies*, edited by Sullivan (1863).

EBEL, JOHANN GOTTFRIED (1764–1830), author of the first real guidebook to Switzerland, was born at Züllichau in Prussia on Oct. 6, 1764. He first visited Switzerland in 1790. As a result of three years' study he published *Anleitung auf die nützlichste und genussvollste Art in der Schweiz zu reisen* (Zürich, 1793). This was the best Swiss guidebook till "Murray" (1838). In 1801 he was naturalized Swiss and settled in Zürich. He died on Oct. 8, 1830.

Ebel's other works include *Schilderungen der Gebirgsvölker der Schweiz*, 2 vol. (Leipzig, 1798–1801), *Über den Bau der Erde im Alpengebirge*, 2 vol. (Zürich, 1808).

EBENACEAE, a family of dicotyledonous trees and shrubs including the ebony (*q v*) and other valuable timber trees. It has seven genera, with about 320 species, chiefly tropical or sub-tropical, and especially abundant in Malaya. The fruit is usually a berry. Several tropical species are cultivated for their edible fruits, while the Chinese persimmon (*Diospyros kaki*) is one of the most important fruits of China and Japan and is also cultivated in various parts of North America.

The family is represented in the United States by two species of persimmon (*q v*).

EBERBACH, a town of Germany, in the *Land* of Württemberg-Baden, on the Neckar river at the foot of the Katzenbuckel, 19 mi E of Heidelberg by the railway to Würzburg. The population in 1949 was 10,264.

It manufactures barrel hoops, chemicals and cigars and carries on by water an active trade in timber and wine. Eberbach was founded in 1227 by the German king Henry VII, who acquired the castle (now ruined) from the bishop of Worms.

EBERBACH, a famous Cistercian monastery of Germany, in the *Land* of Hesse, situated near Hattenheim in the Rheingau, 10 mi NW of Wiesbaden. Founded in 1116 by Archbishop Adalbert of Mainz, as a house of Augustinian canons regular, it was bestowed by him in 1131 upon the Benedictines, but was shortly afterward repurchased and conferred upon the Cistercian order.

The Romanesque church (consecrated in 1186) was despoiled during the Thirty Years' War and secularized in 1803.

EBERHARD (?–939), duke of the Franks, brother of Conrad, duke of Franconia and German king (911–918). In 915 Eberhard supported his brother against the rebel, Henry the Fowler of Saxony, but was defeated, and when Conrad died (918), Eberhard, at his brother's wish, earned to Henry the royal crown and sceptre, obtaining, however, for his support, almost complete independence for his own dukedom of Franconia. In 938 Eberhard rebelled against the new king, Otto the Great. He was defeated and hanged, and his adherents condemned to carry dogs through the streets of Magdeburg. In the following year Eberhard, allied with the king's brother Henry and Gilbert of Lorraine, rebelled again, but was surprised and slain at Andemach on the Rhine.

EBERHARD, surnamed IM BART (*Barbatus*) (1445–1496), count and afterward duke of Württemberg, was born on Dec. 11, 1445, the second son of Louis I, count of Württemberg-Urach (d. 1450), and succeeded his elder brother Louis II in 1457. In 1468 he made a pilgrimage to Jerusalem. He visited Italy, became acquainted with some famous scholars, and in 1474 married Barbara di Gonzaga, daughter of Lodovico III, marquis of Mantua. In 1484 he made with his cousin Eberhard VI, count of Württemberg-Stuttgart, the treaty of Münsingen, by which the districts of Urach and Stuttgart into which Württemberg had been divided in 1437 were again united. The country was declared indivisible, and the right of primogeniture established. (See WÜRTTEMBERG.) At the diet of Worms in 1495 the emperor Maximilian I guaranteed the treaty, and raised Eberhard to the rank of duke. Eberhard was one of the founders of the Swabian league in 1488. He gave charters to the towns of Stuttgart and Tübingen, and introduced order into the convents of his land, some of which he secularized. He took a keen interest in the new learning and founded the University of Tübingen in 1477. In 1482 he again visited Italy and received the Golden Rose from Pope Sixtus IV. He died at Tübingen on Feb. 25, 1496. The succession passed to his cousin Eberhard, who became Duke Eberhard II.

See Rossini, *Leben Eberhards im Barie* (Tübingen, 1793), Bossert, *Eberhard im Bart* (Stuttgart, 1884).

EBERHARD, CHRISTIAN AUGUST GOTTLÖB (1769–1845), a versatile German writer, was born at Belzig, near Wittenberg, on Jan. 12, 1769. His best works are *Hannchen und die Kuchlein* (1822), a narrative poem in ten parts, and an epic on the Creation, *Der erste Mensch und die Erde* (1828). He died at Dresden on May 13, 1845.

His collected works (*Gesammelte Schriften*) appeared in 20 volumes in 1830–31.

EBERHARD, JOHANN AUGUSTUS (1739–1809), German theologian and philosopher, was born at Halberstadt, Lower Saxony, where his father was singing master at the church of St. Martin's, and teacher of the school of the same name. He studied theology at the University of Halle, and took orders. At Berlin he formed a close friendship with Nicolai and Moses Mendelssohn. His *Neue Apologie des Sokrates* (1772) hindered his preferment, but in 1774 he was appointed to the living of Charlottenburg, and in 1778 became professor of philosophy at Halle. He died on Jan. 6, 1809.

His works include *Amyntor, eine Geschichte in Briefen* (Berlin, 1782), written to counteract the influence of those sceptical and Epicurean principles in religion and morals then so prevalent in France, and rapidly spreading in Germany, *Über die Zeichen der Aufklärung einer Nation*, etc. (Halle, 1783), *Theorie der schönen Künste und Wissenschaften*, etc. (Halle, 1783, 3rd ed., 1790), *Allgemeine Geschichte der Philosophie*, etc. (Halle, 1788, 2nd ed. with a continuation and chronological tables, 1796), *Versuch einer allgemeinen-deutschen Synonymik*, 6 vol. (Halle and Leipzig, 1795–1802, 4th ed., 1852–53), long reckoned the best work on the synonyms of the German language (abridged, 1 vol., Halle, 1802), *Handbuch der Aesthetik* (Halle, 1803–05, 2nd ed., 1807–20).

See F. Nicolai, *Gedächtnisschrift auf J. A. Eberhard* (Berlin and Stuttgart, 1810), K. H. Jordens, *Lexicon deutscher Dichter und Prosaisten*.

EBERLEIN, GUSTAV (1847–1926) A German sculptor born on July 14, 1847, at Spickershausen, Hanover. He studied

at the Academy of Nuremberg and at Berlin under Bleser, a follower of the classicist Rude. After a visit to Rome in 1873 where he was attracted to the Baroque he joined the group of sculptors led by Reinhold Begas. In 1887 he was made professor and in 1897 he held an important exhibition of his work at the Berlin academy. His reputation rests chiefly upon his numerous public monuments, such as those of the emperor William I (Mannheim, Elberfeld and Altona), Bismarck (Krefeld), Richard Wagner (Berlin), Goethe (Rome), Queen Luse (Tilsit). He also executed religious pieces such as the groups representing the life of Adam and Eve, and mythological pieces such as Pygmalion and Galatea. In 1898 he presented the Eberlein museum to Münden in his native Hanover which contains a representative collection of his work. In 1892 he published *Ames Bildner Seelenleben, Plastik, Malerei und Poesie*.

EBERLIN, JOHANN ERNST (1702-1762), German musician and composer, was born in Jettingen, Bavaria on March 27, 1702, and became court organist to the prince archbishop of Salzburg, where he died on June 21, 1762. Most of his compositions were for the church (oratorios, etc.), but he also wrote some important fugues, sonatas and preludes, and his pieces were at one time highly valued by Mozart.

EBERS, GEORG MORITZ (1837-1898), German Egyptologist and novelist, was born in Berlin on March 1, 1837. At Göttingen he studied jurisprudence, and at Berlin oriental languages and archaeology. He became in 1865 *dozent* in Egyptian language and antiquities at Jena, and from 1870 to 1889 he was professor at Leipzig. He had made two scientific journeys to Egypt, and his first work of importance, *Ägypten und die Bucher Moses*, appeared in 1867-68. In 1874 he edited the medical papyrus ("Papyrus Ebers") which he had discovered in Thebes (tr. by H. Joachim, 1890). Ebers early conceived the idea of popularizing Egyptology by means of historical romances. *Ebene ägyptische Königstochter* (1864) had a great success. His subsequent works of the same kind—*Uarda* (1877), *Homo sum* (1878), *Die Schwestern* (1880), *Der Kaiser* (1881), of which the scene is laid in Egypt at the time of Hadrian, *Serapis* (1885), *Die Nitkraut* (1887) and *Kleopatra* (1894), were also popular. Ebers also turned his attention to other historical periods—especially the 16th century (*Die Frau Bürgermeistern*, 1882, *Die Gred*, 1887)—without, however, attaining the success of his Egyptian novels. His other writings include a descriptive work on Egypt (*Ägypten in Wort und Bild*, 2nd ed., 1880), a guide to Egypt (1886) and a life (1885) of his old teacher, the Egyptologist Karl Richard Lepsius. He died at Tutzing, Bavaria, on Aug. 7, 1898.

Ebers' *Gesammelte Werke* appeared in 25 vols. at Stuttgart (1893-1895). Many of his books have been translated into English. For his life see *His Geschichte meines Lebens* (Stuttgart, 1893), also R. Gosche, *G. Ebers, der Forscher und Dichter* (2nd ed., Leipzig, 1887).

EBERSWALDE, a town of Germany in the *Besirk* of Frankfurt, 28 mi. N.E. of Berlin by rail, on the Finow canal and on the Berlin-Stettin railway. Pop. (1949) 40,615. It received its municipal charter in 1237 but was sacked during the Thirty Years' War. In 1747 Thuringian cutlers came to the town, but the cutlery industry has died out.

About 4 mi. to the north lies the Cistercian monastery of Chorn. The town has a 14th-century church, and there are also a forestry college and experimental station and a railway repair workshop. Industries include ironfounding and the making of roofing material and bricks.

EBERT, ADOLF (1820-1890), German romance philologist, was born at Kassel on June 1, 1820. He was professor of romance languages in Marburg, and from 1865 onwards in Leipzig, where he died on July 1, 1890. He wrote a standard work on mediaeval literature, which is still indispensable to the student and has been the basis of much subsequent work by later writers, *Allgemeine Geschichte der Literatur im Abendlande* (3 vols., 1884-87). From 1850-63 he edited, with F. Wolf, the *Jahrbuch für romanische und englische Literatur*.

EBERT, FRIEDRICH (1870-1925), German politician,

was born in Heidelberg on Nov. 4, 1870, the son of an impecunious tuior. He was in early recruit to the Socialist movement, becoming a fluent speaker and a first class trade union organizer, suffering persecution and boycott for the cause. He moved to Hanover, and later on to Bremen, where he joined the staff of the local paper of the party, and, having dropped his trade as a saddler, became labour secretary for Bremen. From 1905 Ebert played an important part in the direction of the Socialist party. He entered the reichstag in 1912. A year later he became chairman of the party, which at that time was torn between the Orthodox and Revisionists, his common sense was considered a guarantee for keeping the party together.

At the outbreak of World War I, Ebert, deeply impressed by the danger of Russian victory, led the bulk of the party who voted for war credits. His common sense repudiated the optimistic pacifism of Haase and his followers, who later became the Independent Socialist party. He continued to strive, however, at home and abroad, especially at the Stockholm conference in June 1917, for a just peace. He became leader of the Majority Socialists in 1916 and chairman of the budget commission of the reichstag in 1918. Though disapproving of the Peace of Brest-Litovsk, he opposed strikes to bring about peace. In Feb. 1918 he tried hard and fairly successfully to put an end to the Berlin strike, which threatened to become a national calamity. For the part he played at that time he was attacked later on by the Independents as well as by the representatives of the old order.

After Ludendorff's collapse in Sept. 1918 Prince Max of Baden formed the first parliamentary cabinet. Ebert induced his party to join at a time when Ludendorff's insistence on an immediate demand for an armistice was already known. The negotiations about the armistice continued over a month. The suffering working classes began to be restless. When the plans to force a great naval battle became known, a mutiny took place at Kiel. Acting on Ebert's advice, Prince Max sent Noske to Kiel who succeeded in re-establishing order.

Ebert, knowing the historical attachment of the German people to monarchy, wanted a democratic parliamentary government, on English lines, but no republic. When the organized working men began to follow the Independents, Scheidemann intimated to Prince Max (Nov. 7) that the Socialists must withdraw from the cabinet, and that if the emperor did not abdicate by the 9th of his sons, not the crown prince, should take his place. The emperor vacillated. By the 9th the masses had got out of hand. The monarchy collapsed, but the knowledge of the abdication had not the desired effect. Scheidemann proclaimed the German republic, and Prince Max offered Ebert the chancellorship, which he accepted. He formed a provisional government consisting of three Independents and two Majority Socialists besides himself.

From Nov. 1918 to Feb. 1919 it was touch and go whether Germany would be a democratic country or a soviet republic. The small group of German Bolsheviks, the Spartacus Union, led by Karl Liebknecht and Rosa Luxemburg, insisted that Russia's example should be followed, while the Independents did lip service to democracy, but wanted to postpone the elections. Ebert insisted on early elections for a constituent assembly, to give Germany a Democratic constitution. For nearly two months the government had no power. The Spartacists had armed their adherents and repeatedly tried to imprison Ebert and his colleagues. Ebert called Noske to Berlin, who succeeded in quelling the December and the January risings by means of quickly organized volunteers. When the struggle was over, the elections to the national assembly took place quietly. Democracy had won the day, thanks to Ebert and the moderate Socialists. It was but fitting that the assembly elected him the first provisional president of the German republic. Ebert stuck to his post when the Treaty of Versailles had to be signed and later when (March 1920), a military rising, the Kapp Putsch, took place. He left Berlin with his government to return after the general strike had forced the leaders to surrender.

Ebert's appointment as president was provisional. He wanted to withdraw from office at the appointed time (1922) and to subject himself to a proper election. He bowed, probably un-

wisely from his point of view, to the wishes of the majority of the reichstag, including the People's party, who asked him to accept office for a second term from their hands until 1925. When that term drew near its end, reactionary and radical forces had gained strength in Germany. This was shown by the result of the general election of May 1924. But by 1925, after stabilization had done its work, the situation had improved considerably, there appeared to be quite a fair chance that Ebert, if he chose to stand, might be re-elected.

By that time Ebert had dropped the party leadership. He remained on friendly terms with his party, but he considered himself the representative of the German people as a whole. He wielded the great but rather veiled power of the German president with consummate tact. His attitude when forming cabinets, and when reaching decisions was correct, constitutional and wise. He had gained the confidence of all persons with whom he came in contact. He had made the office of the president influential, though not conspicuous. This artisan who had not had the academic training so greatly valued in Germany succeeded in getting a firm grasp on foreign affairs. He saw a point quickly and he knew how to deal with men. Singularly modest and unassuming, his was the dominant influence, nevertheless, in the many crises the German republic had to pass through in the years that followed the peace.

But the fact that a plain man of the people was the head of the state did not commend itself to the reactionary elements of German society. A campaign of calumny was organized against him, accusing him of having fomented sedition and broken the back of the German army. He was forced to bring an action for libel against Herr Rothard, who had published in the *Mittel-deutsche Zeitung* a letter and footnote accusing Ebert of treasonable conduct in connection with the munition workers' strike in Jan. 1918. Rothard was found technically guilty, but the judge's finding was unfavourable to Ebert. As the judge's political bias was scarcely denied, the public, including the cabinet sided with Ebert. The central government and many state governments passed votes of confidence, the public assured him of their sympathy, but the strain practically killed Ebert, who had been suffering from repeated attacks of appendicitis. He did not wish to be operated upon before the case was over, and then it was too late. He died on Feb. 28, 1925, at Charlottenburg.

Ebert was a very fortunate combination of the lighthearted spirituality and sober shrewdness of the south German. He had faith in ideas and ideals, but he believed in action and in organization as well. There was passion in him, but there was common sense, there was strength in him, and there was sober suavity. He was by no means a genius towering head and shoulders above his fellow men. He was rather one of them, sharing their feelings and their qualities so that they could trust him completely, being just far enough ahead of them to make them follow him, the true leader for an incipient democracy.

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EBERT, FRIEDRICH ADOLF (1791-1834), German bibliographer, was born at Taucha, near Leipzig, on July 9, 1791, the son of a Lutheran pastor. In 1813 he was attached to the Leipzig university library, and in 1814 was appointed secretary

to the Royal library of Dresden and, in 1827, after a short period of absence, chief librarian. The rich resources open to him in the Dresden library enabled him to undertake the work on which his reputation chiefly rests, the *Allgemeines bibliographisches Lexikon* (2 vols. 1821-30). This was the first work of the kind produced in Germany, and the most scientific published anywhere. Ebert was a contributor to various journals and took part in the editing of Ersch and Gruber's great encyclopaedia. He died at Dresden on Nov. 13, 1834, in consequence of a fall from the ladder in his library.

See the article in *Ersch und Grubers Encyclopädie*, and that in the *Allg. deutsche Biog.* by his successor in the post of chief librarian at Dresden, Schnorr von Carolsfeld.

EBERTH, KARL JOSEPH (1835-1926), bacteriologist, was born in Würzburg where he studied under Albrecht von Kolliker and Rudolf Virchow (qq.v.). On Aug. 5, 1865, he was appointed extraordinary of pathology to Zunch. In 1869 he became ordinarius and in 1874 ordinarius for pathology. During 1881-95 he was at Halle, where, in 1894-95, he was director of the anatomy institute.

See J. Page, *Biographisches Lexikon hervorragender Aerzte* (Vienna, 1901), *Centralbl. f. allg. Path. u. Path. Anat.*, vol. 39, p. 226 (1907).

EBERWEIN, TRAUGOTT MAXIMILIAN (1775-1851), German violinist and composer, was born at Weimar on Oct. 27, 1775. He became a member of the court orchestra at Rudolstadt in 1797 and, in 1817, was made *Kapellmeister*. He had a part in the inception of the music festivals in Germany. He composed operas, cantatas, concertos, quartets, a mass and a symphony concertante, of which the two operas *Claudine von Villa Bella* and *Der Jahrmarkt von Plundersweisse* were most widely known.

Eberwein died at Rudolstadt on Dec. 2, 1851.

EBINGEN, a town of Germany, in the *Land* of Württemberg-Hohenzollern, on the Schmecha, a left-hand tributary of the Danube, 37 mi. W. of Ulm by rail. It manufactures velvets, knitted goods and precision tools. Pop. (1949) 14,722. Ebingen became a town in 1228 and part of Württemberg in 1805.

EBIONITES (Heb. עֲבִיּוֹנִים "poor men"), a name given to the ultra-Jewish party in the early Christian church. It is first met with in Irenaeus (*Adv. Haer.* 1, 26, 2), who sheds no light on the origin of the Ebionites, but says that while they admit the world to have been made by the true God (in contrast to the Demurge of the Gnostics), they held that Christ was a miraculously endowed man, and rejected Paul as an apostate from the Mosaic law to the customs and ordinances of which, including circumcision, they steadily adhered. A similar account is given by Hippolytus (*Haer.* vii, 35), who invents a founder named Ebion. Origen (*Contra Celsum*, v, 61, *In Matt.* tom. xvi, 12) divides the Ebionites into two classes according to their acceptance or rejection of the virgin birth of Jesus, but says that all alike reject the Pauline epistles. This is confirmed by Eusebius, who adds that even those who admitted the virgin birth did not accept the pre-existence of Jesus as Logos and Sophia. They kept both the Jewish Sabbath and the Christian Lord's day, and held extreme millenarian ideas in which Jerusalem figured as the centre of the coming Messianic kingdom. Epiphanius with his customary confusion makes two separate sects, Ebionites and Nazarenes, both names refer to the same people (the Jewish Christians of Syria), the latter going back to the designation of apostolic times (Acts xiv, 5), and the former being the term usually applied to them in ecclesiastical literature of the 2nd and 3rd centuries.

The origin of the Nazarenes or Ebionites as a distinct sect is very obscure, but may be dated with much likelihood from the edict of Hadrian which in 135 finally scattered the old church of Jerusalem. While Christians of the type of Ansto of Pella and Hierasippus, on the snapping of the old ties, were gradually assimilated to the great church outside, the more conservative section became more and more isolated and exclusive. "It may have been then that they called themselves the Poor Men, probably as claiming to be the true representatives of those who had been blessed in the Sermon on the Mount, but possibly adding to the name other associations." Out of touch with the main

stream of the church they developed a new kind of pharisaism. Doctrinally they stood not so much for a theology as for a refusal of theology, and, rejecting the practical liberalism of Paul, became the natural heirs of those early Judaizers who had caused the apostle so much annoyance and trouble. Though there is insufficient justification for dividing the Ebionites into two separate and distinct communities, labelled respectively Ebionites and Nazarenes, we have good evidence, not only that there were grades of Christological thought among them, but that a considerable section, at the end of the 2nd century and the beginning of the 3rd, exchanged their simple Judaistic creed for a strange blend of Essenism, Gnosticism—as in the Clementine literature (*q v*) of the 3rd century—and Christianity.

See W. Beveridge, art. "Ebionism" in Hastings *Encyclopaedia of Religion and Ethics*, with refs., articles "Ebionites," "Elkasaiten," "Clementines," in *Heterog-Hruch, Reaksytsyodade* with refs., & J. A. Hort, *Judaistic Christianity* (still valuable), Harnack, *History of Dogma* (Lang tr., vol. 1), Lightfoot, "St Paul and the Three" in *Commentary on Galatians*, Ottley, *Doctrine of the Incarnation*, pt. II, § 2, and the general church histories.

EBNER-ESCHENBACH, MARIE, FREIFRAU VON (1830-1916), Austrian novelist, was born at Zdravitz in Moravia, on Sept. 13, 1830, the daughter of a Count Dubsky. She lost her mother in early infancy, but received a careful intellectual training from two stepmothers. In 1848 she married the Austrian captain, and subsequent field marshal, Montz von Ebner-Eschenbach, and resided first at Vienna, then at Klosterbruck, where her husband had a military charge, and after 1860 again at Vienna. Her first essay was with the drama *Marie Stuart in Schottland*, which P. E. Devrient produced at the Karlsruhe theatre in 1860, but she found her true sphere in narrative. Commencing with *Die Prinzessin von Banalien* (1872), she graphically depicted in *Bacena* (1876, 4th ed 1899) and *Das Gemeindegeld* (1887, 4th ed 1900) the surroundings of her Moravian home, and in *Lotti, die Urmachern* (1883, 4th ed 1900), *Zwei Comtessen* (1885, 5th ed 1898, Eng. trans 1893), *Unheimlich* (1890, 5th ed 1900) and *Glaubenslos?* (1893) the life of the Austrian aristocracy in town and country. Later books are *Neue Erzählungen* (1881, 3rd ed 1894), *Aphorismen* (1880, 4th ed 1895), *Parabeln, Märchen und Glucke* (2nd ed 1892), *Aus Spätherbsttagen* (1901) and *Agave* (1903). Frau von Ebner-Eschenbach's wit and masterly character-drawing give her a foremost place among the German writers of her time. She died in Vienna on March 12, 1916.

See A. Bettelheim, 'Marie von Ebner-Eschenbach und Julius Rodenberg', *Deutsche Rundschau*, Jahrg. 46, pp. 6-21 (Berlin, 1920), A. Bettelheim, *Marie von Ebner-Eschenbach's Wirken und Vermächtnis* (Leipzig, 1920).

EBONITE, a substance manufactured by over-vulcanizing rubber. Pure rubber is mixed with about 40% of sulphur by rolling, and the resulting mass heated for from six to ten hours at a temperature of 150°. The valuable material thus obtained is a non-conductor of electricity and resists many chemical reagents. (See RUBBER PRODUCTION AND MANUFACTURE.)

EBONY, the wood of trees of the genus *Diospyros* (family Ebenaceae), widely distributed in the tropical parts of the world. The best kinds are very heavy, deep black, and consist of heart-wood only. On account of its colour, durability, hardness and susceptibility of polish, ebony is much used for cabinet work and inlaying, pianoforte keys, knife handles and turned articles. The best Indian and Ceylon ebony is furnished by *D. Ebenum*, which grows in abundance throughout the flat country west of Trincomalee in Ceylon. The tree is distinguished by the inferior width of its trunk, and its jet-black, charred-looking bark, beneath which the wood is perfectly white until the heart is reached. The wood is stated to excel all other varieties in the fineness and intensity of its dark colour. Although the centre of the tree alone is employed, reduced logs 1 to 3 ft in diameter can readily be procured. Much of the East Indian ebony is yielded by *D. melanoxylon* (Coromandel ebony), a large tree attaining a height of 60 to 80 ft, and 8 to 10 ft in circumference, with irregular rigid branches and oblong or oblong lanceolate leaves. The wood of *D. tomentosa*, a native of north Bengal, is black hard and of great weight. *D. montana*, another Indian species, produces

a yellowish grey soft but durable wood. *D. quaeata* is the tree from which is obtained the wood known in Ceylon as *Calamander*. Its closeness of grain, great hardness and fine hazel brown colour, mottled and striped with black, render it valuable for veneering and furniture making. *D. dendo*, a native of Angola, is a valuable timber tree 25 to 35 ft high, with a trunk 1 to 2 ft in diameter. The heart-wood is very black and hard and is known as black ebony, also as billet-wood, Gabun, Lagos, Calabar or Niger ebony. What is termed Jamaica or American ebony, and the green ebony of commerce, is produced by *Brya Ebenus*, a leguminous tree or shrub having a trunk rarely more than 4 ft in diameter, flexible spiny branches, and orange yellow, sweet-scented flowers. The heart-wood is rich dark brown, heavier than water, exceedingly hard and capable of receiving a high polish.

Ebony was among the articles of merchandise brought to Tyre (Ezekiel xxvii, 15), and Herodotus states (ii, 97) that the Ethiopians every three years sent a tribute of 200 logs of it to Persia. By the ancients it was esteemed of equal value for durability with the cypress and cedar (see Pliny, *Nat. Hist.* xii, 9, xvi, 79). According to Solinus (*Polyhistor*, Paris, 1621), it was employed by the kings of India for sceptres and images, also, on account of its supposed antagonism to poison, for drinking cups. The hardness and black colour of the wood appear to have given rise to the tradition, alluded to by Southey (*Thalaba*, i, 22), that the tree produced neither leaves nor fruit, and was never seen exposed to the sun.

EBBARD, JOHANNES HEINRICH AUGUST (1818-1888), German theologian, was born at Erlangen on Jan. 18, 1818. Educated in his native town and at Berlin, he became *Privatdozent* at Erlangen (1841) and then professor of theology at Zurich (1844). From 1847-61 he held a similar post at Erlangen, where in 1875 he became pastor of the French reformed church. His chief works were *Christliche Dogmatik* (2 vols., 1851), *Vorlesungen über praktische Theologie* (1864), *Handbuch der Christl. Kirchen- u. Dogmengesch.* (4 vols., 1865-66), *Apologetik* (1874-75, Eng. trans. 1886). He also edited and completed H. Olshausen's commentary, himself writing on the Epistle to the Hebrews, the Johannine Epistles and Revelation. He died at Erlangen on July 23, 1888.

EBRO (anc. *IBERUS* or *IBERUS*), the only one of the five great rivers of the Iberian peninsula which flows into the Mediterranean. The Ebro, approximately 575 mi. in length, rises at Fontibre, a hamlet among the Cantabrian mountains, in the province of Santander, at Reinosa, 4 mi. E; it is joined on the right by the Hija, and thus gains considerably in volume. It flows generally east by south through a tortuous valley as far as Miranda de Ebro. The chief cities on its banks are Logroño, Calahorra, Tudela, Saragossa and Caspe. Near Mora in Cataluña it forces a way through the coastal mountains and, passing Tortosa, falls into the Mediterranean about 80 mi. SW of Barcelona. It drains an area of nearly 32,000 sq mi. Its principal tributaries are—(right) the Jálón with its affluent the Giloca, the Huerva, Aguas, Martín, Guadalope and Matafusa, (left) the Ega, Aragón, Nela, Gallego and the Segre with its system of confluent rivers. The Ebro and its tributaries have been utilized for irrigation since the Moorish conquest, the main stream becomes navigable by small boats about Tudela, but seafaring vessels cannot proceed farther than Tortosa. The great Imperial canal begun under the emperor Charles V. proceeds along the right bank from a point about 3 mi. below Tudela, to El Buzgo de Ebro, 5 mi. below Saragossa, the irrigation canal of Fauste skirts the opposite bank for a shorter distance, and the San Carlos or New canal affords direct communication between Amposta at the head of the delta and the harbour of Los Alfaques.

EBROÏN (d. 681), Frankish "mayor of the palace," was a Neustrian and wished to impose the authority of Neustria over Burgundy and Austrasia. In 656, at the moment of his accession to power, Sigebert III, the king of Austrasia, had just died, and the Austrasian mayor of the palace, Grimoald, was attempting to usurp the authority. The great nobles, however, appealed to the king of Neustria, Clovis II, and unity was re-established. But in spite of a very firm policy Ebroïn was unable to maintain

this unity, and while Clotaire III, son of Clovis II, reigned in Neustria and Burgundy, he was obliged in 660 to give the Austrasians a special king, Childeric II, brother of Clotaire III, and a special mirror of the palace, Wulfoald. His efforts to maintain the union of Neustria and Burgundy were opposed by the great Burgundian nobles, who rose under St Leger (Leodegar), bishop of Autun, defeated Ebroin, and interned him in the monastery of Luxeuil (670). Soon, however, Leger was defeated by Wulfoald and the Austrasians, and was himself confined at Luxeuil in 673. Ebroin and Leger then left the cloister. Each looked for support to a different Merovingian king, Ebroin even proclaiming a false Merovingian as sovereign. Leger was besieged in Autun, was forced to surrender and had his eyes put out, and, on Oct. 12, 678, he was put to death after undergoing prolonged tortures. The church honours him as a saint. After his death Ebroin became sole and absolute ruler of the Franks, imposing his authority over Burgundy and subduing the Austrasians, whom he defeated in 678 at Bois du-Fay, near Laon. He was assassinated in 681.

See *Liber historiae Francorum*, edit. by B. Krusch, in *Mon Germ hist script rer Merov vol. II*, *Vita sancti Leodegarii*, by Ursinus, a monk of St Maixent (Cologne, *Pair Latine*, vol. xcvi), "Vita metrice" in *Poetas Latini aevi Carolini*, vol. II (in *Mon Germ hist*), J. B. Pitra, *Histoire de Saint Leger* (1846), and J. Friedrich "Zur Gesch des Hausmeiers Ebroin," in the *Proceedings of the Academy of Munich* (1887, pp. 42-61).

EBURACUM or **EBORACUM** (probably a later variant), Roman name of York (*qv*) in England. Established about 75-80 as fortress of the Ninth legion and garrisoned (after the annihilation of that legion about A.D. 118) by the Sixth legion, it developed outside its walls a town of civil life, which later obtained Roman municipal rank and in the 4th century was the seat of a Christian bishop. The fortress and town were separated by the Ouse. On the left bank, where the minster stands, was the fortress, of which the walls can be partly traced. At the west corner a bastion of the 4th century type (the so-called Multangular Tower) survives, while at the east corner an internal tower of earlier date has been uncovered. The municipality occupied the right bank near the present railway station. The place was important for its garrison and as an administrative centre. The name is preserved in the abbreviated form *Ebor* in the official name of the archbishop of York, but the philological connexion between *Eboracum* and the modern name York is doubtful and has probably been complicated by Danish influence. (S. N. M.)

ÊÇA DE QUEIROZ, JOSE MARIA (1843-1900), Portuguese novelist, was born at Villa do Conde, his father being a retired judge. Entering the consular service in 1872, he went to Havana, and, after a tour in the United States, was transferred two years later to Newcastle-on-Tyne and in 1876 to Bristol. In 1888 he became Portuguese consul-general in Paris and died there in 1900.

Queiroz in 1870, in collaboration with Ramalho Ortigão, wrote a sensational story, *The Mystery of the Catra Road*, but the first publication which brought him fame was *The Farpas*, a series of satirical and humorous sketches of various phases of social life. At this period French literature and French politics interested Queiroz profoundly, while he ignored the *belles-lettres* of his own country and its public affairs. He founded the Portuguese Realist-Naturalist school, of which he remained for the rest of his life the chief exponent, by a powerful romance, *The Crime of Father Amaro*, written in 1871 at Leiria but only issued in 1875. During a stay in England he produced two masterpieces, *Cousin Basil* and *The Mirror*, but they show no traces of English influence, nor again are the French in tone, for his disillusionment progressed and was complete ed when he went to Paris and had to live under the regime of the Third Republic. Seemingly at Munich, the novelist became chronicler, critic and letter writer as well as in all these capacities Queiroz displayed a spontaneity, power and artistic finish unequalled in the literature of his country since the death of Garrett. Many of his pages descriptive of natural scenery, such for instance as the episode of the return of Torres in *The City and the Mountains*, are classic examples of Portuguese prose. He manifested a predilection for middle-class type-

conditions.

Queiroz also wrote a number of short stories, some of which have been printed in a volume under the title of *Contos*. The gems of this remarkable collection are perhaps *The Peculiarities of a Fair-haired Girl*, *A Lyric Poet*, *José Mathias* and *The Corpse*.

One of Queiroz's romances and two of his short stories have been published in English. An unsatisfactory version of *Cousin Basil*, under the title *Dragon's Teeth*, appeared at Boston, U.S.A., in 1880, while *Sweet Miracle* has had three editions in England and one in America, and there is also a translation of *O Defunto* (*The Corpse*), under the name of *Our Lady of the Pillar*. See J. Pereira de Sampaio *A Geração Nova—Os Novelistas* (Oporto, 1886), and Senhor Batalha Reis's preface to some prose fragments of Queiroz edited by him and named *Prosas Barbaras* (Oporto, 1903).

ÉCARTÉ (Fr. "separated," "discarded"), a game of cards, invariably played for a stake. It was probably first played in Paris, in the first quarter of the 19th century. It is one of a family of "short" games developed from *trionphe* or *trump* (also called *French-ruff*), and is related to the American *exche*, the British *Napoleon*.

The play is two hand, though three players frequently participate by *chouette* (*qv*). The pack of 32 cards is used, the cards of each suit ranking K (high), Q, J, A, ro, p, 8, 7. Five cards are dealt to each player, in rounds of two and three at a time or vice versa. The 13th card is turned up for trump. If it is a king, dealer scores one point. After looking at his hand, non-dealer either *stands* or *proposes*. If he stands, the cards are played forthwith. If he proposes, dealer may *refuse*, equivalent to standing, or *accept*. In the latter event, each player discards as many cards as he wishes (nondealer must discard at least one, dealer may discard none) and the dealer then gives each in turn enough cards from the pack to restore his hand to five. Repeated proposals and acceptances may be made, but when the pack is exhausted the hands must be played. The card turned for trump is never changed, it fixes the trump for that deal. Either player holding the king of trumps may score one point by showing it before the opening lead.

Nondealer invariably makes the first lead. Each lead requires the other hand to follow suit if able, and also to win, if able. A trick is won by the higher trump if any is played, otherwise by the higher card of the suit led. The winner of a trick leads to the next. The object of play is to win three or four tricks, counting one point, or all five tricks (*vole*), counting two. If the original hands are played, and the one who stood fails to take three tricks, his opponent scores two points (for three, four, or five tricks). Game is five points.

Skill at Écarté consists chiefly in (a) judgment when to play, (b) inferences as to the adverse cards after a proposal has been accepted. The first matter has been reduced to a complete calculation of the *jeux de règle* (regulation hands) that have at least a 2:1 chance to win three tricks. The following table is condensed from *Traité de L'Écarté*, by Émile Dormoy.

JEUX DE RÈGLE (for nondealer)

| Plain suits | 1st | and | 3rd |
|------------------------|---|--|--------------------------|
| A Hands with no trumps | K A Q J Q, J K, J | • K K Q J K K, J | K K K Q Q |
| B Hands with one trump | K, Q, 7 K, 8, 7 Q, J, A K, A Q, J K, Q K, A K, 7 K, 7 K Q | K K J K, 7 K, 7 Q, A Q K K K K K K | 7 7 A 9, 8 7 |

| | | | |
|-------------------------------------|---|---|---|
| C Hands with two trumps | <div> <div> <div>h, 7</div> <div>J, 10</div> <div>A, 10</div> <div>J</div> <div>A</div> <div>7</div> </div> <div> <div>8</div> <div>10</div> <div>10</div> <div>J</div> <div>Q</div> <div>7</div> </div> </div> | <div> <div>9</div> <div>Q, 10</div> <div>A</div> <div>J</div> <div>Q</div> </div> | <div> <div>J</div> <div>J</div> <div>Q</div> </div> |
| D Hands with three trumps | <div> <div>8, 7</div> <div>b</div> </div> | <div> <div>9</div> </div> | |
| E Any hand with four or five trumps | | | |

The first card listed in each hand is the correct opening lead. See Ch. Van-Tenre and Louis Delaune, *Traité du jeu de l'écarté* (Paris, 1845), translated in Bohn's *Handbook of Games* (1850). ("Cavendish," *The Laws of Ecarté, adopted by the Turf Club, with a Treatise on the Game* (London, 1793). Pocket Guide to Ecarté (1807) and Emile Dornes, *Traité de l'Ecarté* (Paris).

ECBATANA (Old Persian *Hangmatana*) situated at the foot of Mount Orontes (Alwand), was the capital of Media and the summer residence of the Achaemenian kings, being afterwards also the Parthian capital. According to the Greeks (e.g., Herodotus, i, 96 ff.), it was founded by Deioces the Mede, but it appears to be mentioned in an inscription of Tiglath-Pileser I, who was much earlier. Though surrounded by seven walls and possessing a citadel that was at the same time a treasure-house it was captured by Cyrus from Astyages in 550 B.C., and was taken from the last Achaemenian by Alexander in 330 B.C. Among the Achaemenian relics found in the city in recent times is a trilingual inscription in which Artaxerxes Mnemon celebrated the building of a palace. The Ecbatana at which, according to Herodotus (iii, 64), Cambyses died, is probably a blunder for Hamath.

See Perrot and Chippiez, *History of Art in Persia* (Eng. trans. 1892), M. Daulot, *L'Art antique de la Perse*, pt. 1 (1884), J. de Morgan, *Mission scientifique en Perse*, ii (1894), W. Guger and E. Kuhn *Grundriss der iranischen Philologie*, ii (1896-1901). See also HAMADAN and PARSIA. *History*. (R. LEV.)

ECCARD, JOHANN (1553-1611), German composer of church music, was born at Mühlhausen, Thuringia, in 1553. He studied at Munich under Orlando Lasso in whose company he is said to have visited Paris. In 1583, he became assistant conductor, and in 1599 conductor, at Königsberg, to Georg Friedrich, margrave of Brandenburg-Anspach, and in 1608 he was called by the elector Joachim Friedrich to Berlin as chief conductor. He died at Königsberg in 1611. Eccard's works consist exclusively of vocal compositions, such as songs, sacred cantatas and chorales for four or five and sometimes for seven, eight, or even nine voices. Their polyphonic structure is remarkable. At the same time his works are instinct with a spirit of true religious feeling. Eccard and his school are connected with the history of the Reformation and 'Ein feste Burg' is only one of many Lutheran hymns for which he provided memorable settings.

See K. G. A. von Winterfeld, *Der Evangelische Kirchengesang* (1843), and G. Reichmann, *Joh. Eccards weltliche Werke* (Hidelberg, 1921).

ECCELINO DA ROMANO (1194-1250), Ghibelline leader, and supporter of the emperor Frederick II, was born on April 25, 1194, of a German family settled in Italy in the first half of the 11th century. They were lords of Romano, near Padua. In 1226, at the head of a band of Ghibellines, Eccelino seized Verona and became *podestà* of the city. He lost Verona, but regained it in 1230, and in 1232 Frederick II appointed him *capitano* governing him in his possessions. In 1236, the emperor gave him the government of Vicenza, Padua and Treviso, and on Nov. 27, 1237, he shared in the victory over the Lombards at Cortenuova. In 1238 he married Frederick's natural daughter, Catharina, and in 1239 was appointed imperial vicar of the march of Treviso, but in the same year was excommunicated by Pope Gregory IX. After Frederick's death in 1250 he supported his son, the German king Conrad IV. His cruelties had provoked a general disgust, and in 1254 he was again excommunicated. In 1256 Pope Alexander IV proclaimed a crusade against him, which was led by Philip archbishop of Ravenna. Eccelino lost Padua, but on

Sept. 1, 1258, he defeated his enemies at Torricella. At Cassano on Sept. 27, 1259, Eccelino was wounded and taken prisoner. Enraged at his capture, he tore the bandages from his wounds, refused to take food and died at Soncino on Oct. 7, 1259. In the following year his brother Albert was put to death, and the Romano family became extinct. Eccelino, sometimes called the *tyrant*, acquired a reputation for cruelty that gained him a place in Dante's *Inferno*, but his unswerving loyalty to Frederick II contrasts favourably with many of his contemporaries. Eccelino is the subject of a novel by Cesare Cantù and of a drama by J. Eichendorff.

See J. M. Gittermyn, *Eccelino da Romano* (Freiburg, 1890), S. Mitis, *Storia d'Eccelino IV da Romano* (Maddaloni, 1896), and F. Steue, *Eccelino von Romano* (Leipzig, 1909). See also HAMPE, *Mittelalt. Geschichte* (1922).

ECCENTRIC, from two Greek words, meaning literally "out from the centre," and thus used to connote generally any deviation from the normal. In ancient astronomy the word denotes a circle round which a body revolves, but whose centre is displaced from the visible centre of motion. In early times the ellipses in which the planets revolve around the sun as focus could not be distinguished from circles, but the unequal angular motion due to ellipticity was observed. A point, however, can be

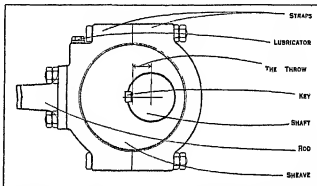


DIAGRAM OF AN ECCENTRIC USED IN STEAM ENGINES SHOWING PARTS. The eccentric converts rotary into reciprocating motion and moves the valve controlling the flow of steam and the exhaust to and from the cylinder.

found on the major axis of the ellipse (namely the empty focus) such that the angular velocity of the planet about it is nearly constant. It was therefore supposed that the deferent of the epicycle of the planet moved uniformly in a circle about this point. For eccentric angle see ELLIPSE.

In engineering, an eccentric is a disc mounted out of centre on a shaft, to give reciprocating movement to a lever, it is an agent much used in steam engines and other mechanisms. It is fixed with a key or screw on to the crankshaft and moves the valve rod to and fro to control the flow of steam and the exhaust. Using two eccentrics with link-motion, the engine can be reversed, and the steam used expansively, e.g., in locomotives, when a good rate of speed has been reached. A reversing eccentric is one with a slotted fitting whereby it can be moved in relation to the shaft, thus reversing the action of the valve to run the engine in the opposite direction. This is but little used, however, the link motion having preference. Eccentrics are also fitted on the popular drop valve steam engines, being located then on a shaft running parallel with the cylinder. An eccentric is often employed to work a pump and operate the slides of certain machines such as the lathe, planer, and puncher. Eccentrics are used to work the valves of powerful rock and stone crushers, and to those quick-return cranks a link mechanism in check shipping.

ECCHELLENSIS (or ECHHELLENSIS) **ABRAHAM** (c. 1600-1664), a learned Maronite was born at Latakia, Syria. Founded at Rome, he became professor of Arabic and Syriac in the college of the Propaganda at Rome and in 1646 professor at the College de France. Invited to take part in the preparation of an Arabic version of the Bible, he declined, returned in 1662 to Rome where he died. Of his Latin translations of Arabic works, the most important was the *Chronicon Orientale* of Ibn al-Rahbi.

(Paris, 1653), a history of the patriarchs of Alexandria. With Giovanni Borelli he wrote a Latin translation of the 5th, 6th and 7th books of the *Comics* of Apollonius of Perga (1661). He also published *Eutychius vindicatus, sive Responso ad Silem Origines* (Rome, 1661). To Le Jay's polyglot Bible he contributed the Arabic and Latin version of Ruth and the Arabic version of the third book of Maccabees.

ECCLES, JOHN (1650–1735), English composer, son of Solomon Eccles, from whom he learned music. Beginning about 1681, he wrote music for the theatre for two decades, contributing music to more than 40 plays during that period. He became a member of the king's band in 1694 and master in 1700. He won second prize in a competition for the best composition to Congreve's "Judgment of Paris," wrote music for Queen Anne's coronation and published a collection of his own widely popular songs. He died on Jan. 12, 1735, at Kingston in Surrey.

ECCLES, SOLOMON (1618–1683), English musician and Quaker, was born in London in 1618. Beginning about 1647 he taught and composed music. He became a Quaker about 1660, and, because music was considered inconsistent with the tenets of Quakerism, publicly burned all his instruments and music books on Tower Hill. Taking up the trade of shoemaking, he began a somewhat spectacular personal crusade against what he considered to be the evils of his time. His extravagant course of action, which included violent protests in "popish" churches and walks through the streets unclothed with a banner of burning brimstone on his head, indicated an unbalanced mind and led to numerous floggings and periods of imprisonment. In 1671 he went to the West Indies with a missionary group of Friends led by George Fox. The following year he travelled to New England and was reportedly banished after his arrest in Boston. In Barbadoes in 1680, he was prosecuted for sedition and blasphemy and later expelled from the colony. He is believed to have returned to his musical interests in later years and is credited with certain contributions to the "Division Violin." He died on Feb. 11, 1683, and was buried at Spitalfields.

ECCLES, a municipal and parliamentary borough of Lancashire, Eng., 4 mi W. of Manchester, of which it forms practically a suburb. Pop. (1951) 43,927. Area 5.3 sq mi. It lies on the north bank of the Manchester Ship canal.

Before the Reformation the monks of Whalley abbey had a grange there at what is still called Monks' hall, and in 1864 many thousands of silver pennies of Henry III and John of England and William I of Scotland were discovered near the spot. From early times "wakes" were held at Eccles, and bullbaiting, bearbaiting and cockfighting were carried on. Under Elizabeth I these festivals were abolished but were revived under James I and maintained until late in the 19th century. The church of St. Mary, believed to date from the 12th century, has been much restored. There are several modern churches and chapels and a town hall. Among a variety of industries the chief are engineering and metalworking. Eccles cakes, made of pastry with currants, have a wide reputation. The town was incorporated in 1892. Eccles and the borough of Swinton and Pendlebury form the borough constituency of Eccles, which returns one member.

ECCLESFIELD, township, Wortley rural district, Penistone parliamentary division, West Riding of Yorkshire, Eng., 5 mi N of Sheffield. Pop. (1954 est.) 30,150. The church of St. Mary is Perpendicular on a Norman foundation, it contains excellent woodwork and formerly bore the familiar title of the "Minster of the Moors." Ecclesfield was the seat of a Benedictine priory in the 12th century which passed to the Carthusians in 1386. There are coal mines, paper mills and iron foundries, file and tool factories and brick and firebrick clay works.

ECCLESHALL, a market town in the Stafford and Stone parliamentary division of Staffordshire, Eng., 3 mi NW of Stafford by road. Pop. (1951) of town 13,000, of parish 14,400. Holy Trinity church is principally Early English and has fine stained glass. Several shops on Lichfield are situated there is Eccleshall castle is the principal residence from the 15th to nearly until 1860. Of the old castle only the walls enclosing the moat remain. The main building being relatively modern. Eccle hall though chiefly

residential and agricultural with a livestock market, has a few light industries including the manufacture of clothing and agricultural implements.

ECCLESIA, the general assembly of freemen in Athens (*ἐκκλησία*). In the primitive state the king was absolute, though his great nobles in council (*see* Boule) were able to influence him considerably. In the earliest times the free people, *i.e.*, the fighting force of the state were called together to ratify the decisions of the king. In Athens, as in Rome, where the Plebs obtained the codification of the laws (the Twelve Tables), it was owing to the growing power of the people meeting in the agora that Dracon was entrusted with the task of publishing a code of law.

The precise powers which Solon gave the people are not known. The executive power (*see* Archon) was still vested in the Eupatrid class (*see* Eupatridae). It seems that, though the officials of the state were still Eupatrid, the Ecclesia elected those of the Eupatrids whom they could trust, and had the right of criticizing their official actions. Solon admitted the Thetes (*see* Solon) to the Ecclesia, thus recognizing them as citizens. Under Cleisthenes (*qv*) the Ecclesia remained the sovereign power. The relation of Boule and Ecclesia in the Cleisthenic democracy was of the greatest importance. The Ecclesia alone, a heterogeneous body of untrained citizens, could not have drawn up intelligible measures, the preliminary drafting was done by the Boule (*qv*). In the 5th century the functions of the Ecclesia and the popular courts of justice were increased by the exigencies of empire. At the beginning of the 4th century *n.c.* the system of payment was introduced (*see* below). Under Roman rule the powers of the Ecclesia and the popular courts were much diminished. They still assembled to elect *strategoi*, and, under Hadrian, had some small judicial duties, but as a governing body the Ecclesia died when Athens became a *civitas libera* under Roman protection.

Constitution and Functions—Throughout the period of Athenian greatness the Ecclesia was the sovereign power. The regular place of meeting was the Pnyx. From the 5th century it met sometimes in the theatre, which in the 3rd century was the regular place. Special meetings were held at times at Paeonia. Certain meetings, however, for voting ostracism (*qv*) and on questions affecting individual state took place in the agora. Meetings were (1) ordinary, (2) extraordinary, and (3) convened by special messengers (*kuriai sunklētoi* and *kataklētoi*), these last being called when it was desirable that the country people should attend. At ordinary meetings the attendance was practically confined to Athenian residents. According to Aristotle there were four meetings in each of the prytanies, probably only the first of these was called *Kuria*. In the *kuria ekklēsia* of each month took place the *Ephekerotomoi* (monthly inquiry) of the state officials, and if it proved unsatisfactory a trial before the Heliaea (supreme court) was arranged, the council reported on the general security and the corn supply. In the sixth prytany of each year at the *kuria ekklēsia* the question whether ostracism should take place that year was put to the vote. On occasions of sudden importance the herald of the council summoned the people with a trumpet, and sometimes special messengers were despatched to "bring in" the country people (*kataklētoi*).

All Athenians over the age of 18 years were eligible to attend the assembly, save those who for some reason had suffered *atimia* (loss of civil rights). The introduction of pay, which belongs to the early years of the 4th century, was a device to secure a larger attendance. The rate rose from one to two obols and then to three obols, while at the time of Aristotle it was one and a half drachmas for the *kuria ekklēsia* and one drachma for other meetings.

Procedure—The proceedings opened with formalities the purification, the curse against all who should deceive the people, the report as to the weather omens. The assembly was always dismissed if there were thunder, rain or an eclipse. These formalities over the *Praxinos* commenced the *probouleuma* of the council, without which the Ecclesia could not debate. This recommendation either submitted definite proposals or merely brought the agenda before the assembly. It *examinē* the business

in hand, which otherwise must often have been beyond the grasp of a miscellaneous assembly. After the reading, a preliminary vote was taken on the question whether the council's report should be accepted *en bloc*. If it was decided to discuss, the herald called upon people to speak. Any person, without distinction of age or position, might obtain leave to speak, any member of the assembly (1) might propose an amendment, (2) might draw up a new resolution founded on the principal motion, (3) might move the rejection of the motion and the substitution of another, (4) might bring in a motion asking the council for a recommendation on a particular matter, (5) might petition the council for leave to speak on a given matter to the assembly. Voting usually was by show of hands and the decision of the assembly had absolute validity. These decisions were deposited in the *Métroon* where state documents were preserved, peculiarly important decrees were inscribed also on a column (*stelai*) erected on the Acropolis. The power of the council was far from sufficient. The real check on the vagaries of amateur legislators was the *graphê paranómōn*. Any man was at liberty to give notice that he would proceed against the mover of a given resolution. A trial in a Helastic court was then arranged, and the plaintiff had to prove that the resolution in question contravened an existing law. If this contention was upheld by the court, the resolution was annulled and the defendant had to appear in a new trial for the assessment of the penalty, which was usually a fine. Three convictions under this law involved a certain loss of rights, the loser could no longer move a resolution in the Ecclesia. After the lapse of a year the mover of a resolution could not be attacked in the 4th century the *graphê paranómōn* took the place of *Ostracism*.

Revision of Laws—In the 4th century the assembly annually took a general vote on the laws, to decide whether revision was necessary. If the decision was in favour of alteration, any private citizen might put up notice of amendments. The *nomothetai*, a panel selected by the *prytanes* from the Heliae, heard arguments for and against the changes proposed and voted accordingly, new laws so passed were liable to the *graphê paranómōn*.

Judicial Functions—The Ecclesia heard cases of *probolê* and *esangelia* (impeachment—see *Greek Law*). The *probolê* was an action against sycophants and persons who had not kept their promises to the people or had disturbed a public festival. The verdict went by show of hands, but no legal consequences ensued, if the plaintiff demanded punishment he had to go to the Heliae, which was not bound by the previous vote in the Ecclesia. Cases of *esangelia* in which the penalty exceeded the legal competence of the council came before the Ecclesia in the form of a *probonêma*. To prevent vexatious accusations, the accuser who failed to obtain one fifth of the votes was fined 1,000 drachmas (£40).

Summary—The Ecclesia had absolute power save for the *graphê paranómōn*, which constituted the *dicasteries* (jurymen) in one sense the sovereign power in the state. It dealt with all matters, home and foreign. It was in practice by no means a representative assembly. The phrase used to describe a special assembly (*kataklitos ekleisia*) shows that ordinarily the country members did not attend. Thucydides says that 5,000 was the maximum attendance, though he is referring to the time when the number of citizens was reduced owing to the plague and the Sicilian expedition. The Ecclesia did not exercise the power of law-making (*nomothesthai*) in the strict sense but passed *psephismata*, which would in many cases be regarded as law in the modern sense. The Ecclesia also was concerned with the supervision of administration.

See articles on *SOLON*, *ARFOPAGUS*, *GRIFA LAW*, *OSTRACISM*, *BIBLIOTHECA*.—J. W. Headlam *Election by Lot at Athens* (Cambridge, 1891), J. E. Sandys' edition of the *Constitution of Athens* (1892), G. Gilbert, *Greek Constitutional Antiquities* (trans. 1895), A. H. J. Greenidge, *Handbook of Greek Constitution at Athens* (1896), L. Whibley, *Companion to Greek Studies* (1923), with useful bibliography.

ECCLESIASTES, one of the Wisdom Books in the Old Testament (see *WISDOM LITERATURE*). The book, as it stands, is a collection of discourses, observations and aphorisms. The

precise meaning of the Hebrew title is not certain. The Greek *ecclesiastes* means one who takes part in the deliberations of an assembly (*ecclesia*), a debater or speaker in an assembly (Plato, *Gorgias*, 452 E), and this is the general sense of the Hebrew word *Kohleth* is employed in the book as the name of a sage. It is intended to represent him as a member of an assembly (*Kahal*)—not the Jewish congregation, but a body of students or inquirers, such as is referred to in vi 9-11, a sort of collegium, of which he was the head, and as instructor of this body he gives his criticism of life. The author begins, indeed, by identifying his sage with King Solomon (i 12, ii 11, 12b), but he soon abandons this literary device, and speaks in his own name. The rendering "preacher" has a misleading connotation.

Contents—In the book as we have it there is no orderly exposition of a theory, it rather has the appearance of a collection of extracts from a sage's notebook. It is, however, characterized throughout (except in some later additions) by a definite thought, and pervaded by a definite tone of feeling. The keynote is given in the classic phrase with which the discussion opens and with which it closes: "Vanity of vanities (i.e., absolute vanity), all is vanity!" Life, says the author, has nothing of permanent value to offer. His attitude is not one of bitterness but of calm hopelessness, with an occasional tinge of disgust or contempt. He fancies that he has tried or observed everything in human experience, and his deliberate conclusion is that nothing is worth doing. He believes in an all-powerful but indifferent God, and is himself an observer of society, standing aloof from its passions and ambitions, and interested only in pointing out their emptiness.

This general view is set forth in a number of particular observations.

1 His fundamental proposition is that there is a fixed, unchangeable order in the world, a reign of inflexible law (i 4-11, iii 1-11, 14, 15, vii 13, viii 5-9), natural phenomena, such as sunrise and sunset, recur regularly, for everything in human experience a time has been set, all its phenomena are to be regarded not as utterances of a living, self-directing world, but as incidents in the work of a vast machine that rolls on for ever, there is an endless repetition—nothing is new, nothing is lost, God, the author of all, seeks out the past in order to make it once more present, it is impossible to add to or take from the contents of the world, impossible to change the nature of things, the result is unspeakable weariness—a depressing series of sights and sounds. No goal or purpose is discoverable in this eternal round. To what end was the world created? It is impossible to say. Such is Kohleth's view of life, and it is obvious that such a conception of an aimless cosmos is thoroughly non-Jewish, if we may judge Jewish thought by the great body of the extant literature.

2 Further, says Kohleth, man is impelled to study the world, but under the condition that he shall never comprehend it (iii 11, vii 23, 24, viii 16, 17). God has made the world an object of man's thought, yet so that man can never find out the work that God has done (iii 11). The reference seems to be not so much to the variety and complexity of phenomena as to the impossibility of construing them rationally or in such a way that man may foresee and provide for his future. Man is in the clutches of fate (ix 11, 12), there is no observable relation between exertion and result in life, the race is not to the swift nor the battle to the strong.

3 Human life, Kohleth declares, is unsatisfying. He inquired, he says, into everything that is done by men under the sun (i 12-11), God has inflicted on men a restless desire for movement and work, yet life is but a catalogue of fruitless struggles. He gives a number of illustrations. In his character of king he tried all the bodily pleasures of life (ii 1-11), all these he set himself to enjoy in a rational way, but, when all was done, he surveyed it only to see that it was weary and unprofitable. Dropping the role of Solomon and speaking as an observer of life, the author declares (iv 4) that the struggle for success is the result of rivalry among men, which has no worthy outcome. The securing of riches is a fallacious achievement—naked man comes into the world, naked he goes out.

If wealth be thus a vain thing, yet a sage might be supposed to find satisfaction in wisdom, that is, practical good sense and sagacity, but this also the author puts aside as bringing no lasting advantage, since a wise man must finally give up the fruit of his wisdom to someone else, who may be a fool, and in any case the final result for both fools and wise men is the same—both are forgotten (i 12-23). The whole constitution of society, in fact, seems to the sage a lamentable thing, the poor are oppressed, the earth is full of their cries, and there is no helper (iv 1), strange social upheavals may be seen, the poor set in high places, the rich cast down, slaves on horseback, princes on foot (x 5-7). He permits himself a sweeping generalization (vii 25-28), human beings as a rule are bad, one may occasionally find a good man, never a good woman—woman is a snare and a curse.

4 The natural outcome of these experiences of the author is that he cannot recognize a moral government of the world. He finds, like Job, that there are good men who die prematurely notwithstanding their goodness, and bad men who live long notwithstanding their badness (vii 15), and in general there is no moral discrimination in the fortunes of men (viii 14, ix 2).

5 There is no sacredness or dignity in man or in human life, man has no pre-eminence over beasts, seeing that he and they have the same final fate, die and pass into the dust, and no one knows what becomes of the spirit, whether in man's case it goes up to heaven, and in the case of beasts goes down into Sheol—death is practically the end all, and so poor a thing is life that the dead are to be considered more fortunate than the living, and more to be envied than either class is he who never came into existence (iv 2, 3). It is a special grievance that the wicked when they die are buried with pomp and ceremony, while men who have acted well are forgotten in the city (vii 10).

6 That the author does not believe in a happy or active future life appears in the passage (iv 2, 3) quoted above. The old Hebrew view of the future excluded from Sheol the common activities of life and also the worship of the national god (Isa xxxviii 18), he goes even beyond this in his conception of the blankness of existence in the underworld. The living, he says, at least know that they shall die, and he the dead know nothing—the memory of them, their love, hate, envy, perishes, they have no reward, no part in earthly life (ix 5, 6), there is absolutely no knowledge and no work in Sheol (ix 10). His conclusion is that men should do now with all their might what they have to do, the future of man's vital part, the spirit, is wholly uncertain.

7 His conception of God is in accord with these views. God for him is the creator and ruler of the world, but hardly more, he is the master of a vast machine that grinds out human destinies without sympathy with man and without visible regard for what man deems justice—a being to be acknowledged as lord, not one to be loved. There can thus be no social contact between man and God, no communion of soul, no enthusiasm of service. Moral conduct is to be regulated not by divine law (of this nothing is said) but by human experience. The author's theism is cold, spiritless, without influence on life.

If now the question be asked what purpose or aim a man can have, seeing that there is nothing of permanent value in human work, an answer is given which recurs, like a refrain, from the beginning to the end of the book, and appears to be from the hand of the original author, after every description of the vanity of things comes the injunction to enjoy such pleasures as may fall to one's lot (i 24, 25, ii 12, 13, 22, v 18, 19, viii 15, ix 7-10, xi 7, xii 7). The opportunity and the power to enjoy are represented as being the gift of God, but this statement is not out of accord with the author's general position, which is distinctly theistic.

There are many sayings in the book that appear to be at variance with its fundamental thought. For example, wisdom is praised in a number of passages (iv 13, vii 5, 11, 12, 19, viii 1, ix 16, 17, x 2, 3), though it is elsewhere denounced as worthless. It may be said that the author, while denying that wisdom (practical sagacity and level headedness) can give permanent satisfaction, yet admits its practical value in the conduct of life. This

may be so, but it would be strange if a writer who could say "in much wisdom is much grief" should deliberately laud wisdom. It may be added that there are in the book a number of aphorisms about fools (v 3 [4], vii 5, 6, x 1-3, 12-15) quite in the style of the book of Proverbs, some of them contrasting the wise man and the fool, these appear to be the insertions of an editor. Further, it may be concluded with reasonable certainty that the passages that affirm a moral government of the world are additions by pious editors who wished to bring the book into harmony with the orthodox thought of the time.

Many practical admonitions and homely aphorisms are scattered through the book. iv 5, quiet is a blessing, iv 9-12, two are better than one, iv 17 (Eng v 1), be reverent in visiting the house of God (the temple and the connected buildings)—to listen (to the service of song or the reading of Scripture) is better than to offer a foolish (thoughtless) sacrifice, v 1 (2), be sparing of words in addressing God, v 1-5 (2-6), pay your vows—do not say to the priest's messenger that you made a mistake, vii 2-4, sorrow is better than mirth, viii 16-18, be not over-righteous (over-attentive to details of ritual and convention) or over-wicked (flagrantly neglectful of established beliefs and customs), here "righteous" and "wicked" appear to be technical terms designating two parties in the Jewish world of the 2nd and 1st centuries B.C., the observers and the non observers of the Jewish ritual law, these parties represent in a general way the Pharisees and the Sadducees, viii 2-4, x 20, it is well to obey kings and to be cautious in speaking about them, for there are talebearers everywhere, viii 20, no man is free from sin, viii 21, do not listen to all that you may overhear, lest you hear yourself ill spoken of, ix 4, a living dog is better than a dead lion, ix 1-6, show prudence, and decision in business, do not sell all your goods on one venture, act promptly and hope for the best.

Composition of the Book.—If the analysis given above is correct, the book is not a unit, it contains passages mutually contradictory and not harmonizable. Various attempts have been made to establish its unity. Other of the biblical Wisdom books (Job, Proverbs) are compilations—why not this? It is not necessary to multiply authors, as is done, for example, by Siegfried, who supposes four principal writers (a pessimistic philosopher, an Epicurean glossator, a sage who upholds the value of wisdom, and an orthodox editor) besides a number of annotators. Nor is it worth while to attempt a logical or symmetrical arrangement of the material.

A simple and adequate view of the growth of the book has been formulated by A. H. McNeale and followed by Barton. Its essence may be briefly stated. The original Kheleth, as has been indicated, was a very heretical work, nevertheless it was so brilliant and so in keeping with the mind of the Greek period that it obtained a firm hold upon the intelligence of the age. Orthodoxy, however, could not allow it to continue unchallenged or unopposed. Two sets of additions, therefore, were attached to it. One of them consists of a series of conventional aphorisms of the sages inserted to give the work a more Hebrew tone and colouring. Examples of this sort are seen in iv 5b, 6, vii 1-14. The second series is more positively and directly orthodox. It is in flat contradiction to the cold lifeless scepticism of Kheleth. It sets forth the traditional, positive and constructive view of life. It may be seen in such passages, for example, as in vii 17, iv 17, xi 9d, ix 10, 13. Had it not been for the mollifying effect of such additions, it is hardly conceivable that Kheleth would ever have entered the Canon, or held its place there long if it had found entry.

Date.—As to the date of the book, there is a gradual approach to a consensus of opinion. The Solomonic authorship has long since been given up, the historical setting of the work and its atmosphere—the silent assumption of monotheism and monogamy, the non national tone, the attitude towards kings and people, the picture of a complicated social life, the strain of philosophic reflection—are wholly at variance with what is known of the 10th century B.C. and with the Hebrew literature down to the 5th or 4th century B.C. The introduction of Solomon, the ideal of wisdom, is a literary device of the later time and probably

deceived nobody. The decisive indications for the determination of the date in the language, the historical background and the thought. The language belongs to the post classical period of Hebrew. More than that there is much resemblance between the dialect of Kabbalah and that of the Mishnah. Not only are new words employed, and old words in new ignifications, but the grammatical structure has a modern stamp—some phrases have the appearance of having been translated out of Aramaic into Hebrew. It is improbable that such Hebrew is that of Kabbalah would have been written earlier than the 2nd century B.C. (for details see Drivers' *Introduction*). The general historical situation, also, presupposed or reflected to, is that of the period from the year 200 B.C. to the beginning of our era, in particular the familiar references to kings is a part of the social system, and to social dislocations (servants and princes changing places, x. 7), suggest the troubled times of the Hittor Greek and Maccabean rulers, of which the history of Josephus gives a good picture.

The conception of the world and of human life as controlled by natural law, a naturalistic cosmos, is alien not only to the prophetic and liturgical Hebrew literature but also to Hebrew thought in general. Whether borrowed or not, it must be late, and its resemblance to Greek ideas suggests Greek influence. The general air of Greek reflection seems unmistakable. The scepticism of Koheleth differs from that of Job in quality and scope, it is deliberate and calm, not wrung out by personal suffering, and it relies to the whole course and constitution of nature, not merely to the injustice of fortune. Such a conception has a Greek tinge, and would be found in Jewish circles, probably, not before the 2nd century B.C.

A precise indication of date has been sought in certain supposed references or allusions to historical facts. The mention of persons who do not sacrifice or take oaths (ix. 2) is held by some to point to the Essenes, if that be so, it is not chronologically precise, since we have not the means of determining the beginning of the movement of thought that issued in Essenism. So also the coincidences of thought with *Ben-Sira* (*Ecclesiasticus*) are not decisive if it be with *BS* xviii 6, 2-6 (3-7) with *BS* xxxiv 1-7, vii 19 with *BS* xxxiv 14, x 8 with *BS* xxxv 26a, xi 13 with *BS* xxxv 21, xi 10, 11 with *BS* xxxix 2 ff., xii 13 with *BS* xii 27, if there be borrowing in these passages it is not clear on which side it lies, and it is not certain that there is borrowing—the thoughts may have been taken independently by the two authors.

Of the author nothing is known save that he was a man of wide observation and philosophic thought of the Suidcean type, in religion, but non Jewish in his attitude toward life. He was, doubtless a man of high standing, but neither a king nor a high priest, certainly not the apostate priest. Alcumus (i Macce vii 1x), nor was he necessarily a physician—there are no details in ch. xi or elsewhere that any man of good intelligence might not know. The book is a mixture of prose and poetry, in about equal proportions.

The fortunes of the book are not known in detail, but it is clear that its merciless criticism of life and its literary charm

made it popular while its scepticism excited the apprehensions of pious conservatives. Possibly the *Wisdom of Solomon* (c. 50 B.C.) was written partly as a reply to it. The claim of sacredness made for it was warmly contested by some Jewish scholars. In spite of the relief afforded by orthodox additions, it was urged that its Epicurean sentiments contradicted the Torah and favoured heresy. Finally, by some process of reasoning not fully recorded, the difficulties were set aside and the book was received into the sacred canon, but not until the synod of Jabneh in A.D. 90 was its right to remain in the canon officially and finally allowed. Jerome (on *Eccles.* vi 13, 14) declares that the decisive fact was the orthodox statement at the end of the book, the one important thing is to fear God and keep His commandments. It is not certain that it is quoted in the New Testament, but it appears to be included in Josephus' list of sacred books.

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ECCLIASTICAL COMMISSIONERS, in England, a body corporate, whose full title is "Ecclesiastical and Church Estates Commissioners for England," invested with very important powers, under the operation of which extensive changes have been made in the distribution of the revenues of the established church.

Their appointment was one of the results of the vigorous movements for the reform of public institutions which followed the Reform act of 1832. In 1835 two commissions were appointed "to consider the state of the several dioceses of England and Wales, with reference to the amount of their revenues and the more equal distribution of episcopal duties, and the prevention of the necessity of attaching by commendam to bishoprics certain benefices with cure of souls, and to consider also the state of the several cathedral and collegiate churches in England and Wales, with a view to the suggestion of such measures as might render them conducive to the efficiency of the established church, and to provide for the best mode of providing for the cure of souls, with special reference to the residence of the clergy on their

constituted a corporation with power to purchase and hold lands for the purposes of the act, notwithstanding the statutes of mortmain.

The first members of the commission were the two archbishops and three bishops, the lord chancellor and the principal officers of state, and three laymen named in the act.

The constitution of the commission was amended by the Ecclesiastical Commissioners acts, 1840-41, and 1868. The commission consists of the two archbishops, all the bishops, the deans of Canterbury, St Paul's and Westminster, the lord chancellor, the lord president of the council, the first lord of the treasury, the chancellor of the exchequer, one of the principal secretaries of state the lord chief justice, the master of the rolls, and certain members of the church of England appointed by the crown and by the bishopric of London. The crown also appoints two laymen to church estates commissioners of the bishopric of Canterbury on.

These three are the joint treasurers of the commission and form, with two members appointed by the commission, the church estates committee.

The substitution of one central corporation for the many local and independent corporations of the church so far at least as the management of property is concerned, was a constitutional

change of great importance, and the effect of it undoubtedly was to correct the anomalous distribution of ecclesiastical revenues by equalizing incomes and abolishing sinecures. At the same time it was regarded as having made a serious breach in the legal theory of ecclesiastical property.

"The important principle," said Clippis in *Law Relating to the Church and Clergy*, "on which the inviolability of the church establishment depends, that the church generally possesses no property as a corporation, or which is applicable to general purposes, but that such particular ecclesiastical corporation, whether aggregate or sole, has its property separate distinct and inalienable, according to the intention of the original endowment, was given up without an effort to defend it."

The commission presents an annual report to parliament in which full information is given as to its activities.

The main function of the commission is the management of the estates of the church in order to augment or endow benefices, etc.

ECCLESIASTICAL JURISDICTION The jurisdiction exercised by ecclesiastics, in taking cognizance of and deciding causes, over other ecclesiastics and over the laity. Before its union with the State, the power of the Church in this direction, as in others, was only spiritual. Coercive authority over their bodies or estates could only be given by concession from the secular power.

The fundamental principle of ecclesiastical jurisdiction with its "sanction" of excommunication will be found in the words attributed to Christ in Matt. xviii. 15-18. These injunctions indicate the customs of the Christian Churches at an early stage in their history. After the time of the Apostles, we find this criminal jurisdiction exercised by bishops individually over their respective "subjects"—doubtless with the advice of their presbyters according to the precept of St. Ignatius (*c. 110*). As neighbouring dioceses coalesced into "provinces" and provinces into larger districts (corresponding to the civil "dioceses" of the later Roman Empire), the provincial synods of bishops and the synods of the larger districts acquired a criminal jurisdiction, still purely spiritual, of their own. The theory, as expressed in legal phrase by Cyprian in the 3rd century, was that the apostolic power of delegated sovereignty from the Lord, alike legislative and judicial, was held in joint-tenancy by the whole body of Catholic bishops.

Even before the edict of Milan, at least as early as the latter half of the 3rd century, the spiritual sentences of deposition from office had sometimes indirect temporal consequences recognized by the secular courts. The classical example is the case of Paul of Samosata, bishop of Antioch. It would seem that, in the intervals of persecution, some rights of property were recognized in the Christian Church and its officers, although the Church was an illegal society. After some previous abortive trials, Paul of Samosata was deposed and excommunicated, in 269, by a great synod of the Antiochene district. Paul, notwithstanding his deposition, kept possession of the episcopal residence. The local church sought recovery of it before the tribunals of the Empire. The judicial authorities requested a rescript from the emperor Aurelian for the decision of the cause. Aurelian referred the matter to the bishop of Rome and the bishops of Italy, who gave their award in favour of the Antiochene Church.

Roman Empire from Constantine—With the "Nicene period" came a great development on the criminal side. A system begins to be formed, and the secular arm supports the decrees of the Church. The first trace of system is in the limited right of appeal given by the first oecumenical council of Nicaea and its provision that episcopal sentences or those of provincial synods on appeal were to be recognized throughout the world. Still examination must be had whether persons have been expelled from the congregation by any episcopal small-mindedness (*μικροψυχία*), or contentious spirit, or such-like harshness (*ἀνδία*). That this may be conveniently inquired into, synods are to be held every year, in each province, and questions of this kind examined. And as regards the secular arm, the practice arose of superadding banishment by the emperor to synodical condemnation. The dogmatic

decrees of Nicaea I. were at once enforced in this manner. On the other hand, the Arian reaction it courted its objects by using the criminal spiritual jurisdiction of synods against the Catholics—often picking the synod for the purpose. The acts of councils of this age are full of the trials of bishops not only for heresy, but for immorality and common law crimes. The accusations are frequently unfounded, but the trials are already conducted in a certain regular forensic form. The secular authorities follow the precedent of Nicaea I. and intervene to supplement the spiritual sentence by administrative penalties. Sometimes an imperial officer of high rank is present at the synod, as an assessor to maintain order and advise upon points of procedure.

The trial of Athanasius shows a further stage in the development of ecclesiastical jurisdiction. Its significance is seen in the council of Sardara (347), a council of practically the whole West save Africa, which acquitted Athanasius after a full judicial inquiry. This council endeavoured to set up a system of appeals in the case of bishops, in which the see of Rome was made to play a great part. "Out of honour to the memory of St. Peter," a condemned bishop may ask the intervention of Rome. If the bishop of Rome thinks the cause should be heard again, he is to appoint judges, if otherwise, the original judgment is to be confirmed. Pending appeal, the appellant's see is not to be filled up.

The tendency to give pre-eminence to Rome appears again in an imperial letter to St. Flavian, who, in the judgment of the East, was bishop of Antioch, but who was rejected by the West and Egypt, summoning him to Rome to be there judged by the bishops of the imperial city—a summons which St. Flavian did not obey.

The story of the administrative development of the Church in the 5th century is mainly the story of the final emergence and constitution of the great "patriarchates," as authorities superior to metropolitans and provincial synods. In consequence of the occupants of the thrones of Constantinople and Alexandria falling successively into opposite heresies, the question arose how "patriarchs" were to be judged. In both cases, as it seems, an attempt was made by the bishop of Rome to depose the erring patriarch by his authority as primate of Christendom, acting in concert with a Western synod. In both cases, apparently, an oecumenical synod ignored the Roman deposition and judged the alleged offences of the respective patriarchs in first and last instance. The third and fourth oecumenical synods (Ephesus, 431, Chalcedon, 451) were primarily tribunals for the trials of Nestorius and Dioscorus, it was secondarily that they became organs of the universal episcopate for the definition of the faith, or legislative assemblies for the enactment of canon. Nothing is more remarkable than their minute care as to observance of rules of procedure. In both cases, imperial assessors were appointed. At Chalcedon, on the other hand, the imperial commissioners decided points of order, kept the synod to the question, took the votes and adjourned the court. The fifth oecumenical council came near to sitting in judgment over the pope. Vigilius, although in Constantinople, refused to attend the sittings of the council. He was cited three times, in the canonical manner, and upon not appearing was threatened in the third session with anathema (*Hefele, Councils*, §§ 263 ff.). After the council, Justinian banished the pope, until he accepted the council, which he ultimately did.

The constitution of the patriarchal system resulted in the recognition of a certain right of appeal to Rome from the larger part of the West. Britain remained outside that jurisdiction, the Celtic churches of the British islands, after those islands were abandoned by the Empire pursuing a course of their own. In the East, Constantinople, from its pre-eminence, acquired special administrative pre-eminence, naturally followed, as in the case of Rome, by judicial pre-eminence. An example of this is found in the ninth canon of Chalcedon which also illustrates the enforcement upon a clerical plaintiff in dispute with a brother cleric of recourse to the arbitration of their ecclesiastical superior. The canon provides that any cleric having a complaint against another cleric must not pass by his own bishop and turn to secular tribunals, but first lay bare his cause before him, so that by the sentence of the bishop himself the dispute may be settled by

arbitrators acceptable to both parties. In the next century Justinian put the other patriarchates on the same footing as Constantinople. But the growth of a special original jurisdiction at Constantinople, which principle developed earlier than the corresponding institution at Rome, may be traced to the fact that bishops from all parts were constantly in Constantinople. The bishop of Constantinople, even before he became properly "patriarch," would often assemble a synod from these visiting bishops which acquired the technical name of *synodus oecumenica*, the synod of sojourners. This synod frequently decided questions belonging to other patriarchates.

Theodosius I began the system of giving secular authority to Church tribunals. But it appears definitely in 475 when a constitution of Theodosius II provides that a recent decree of the usurper John should be disregarded and that clerics whom he had brought before secular judges should be reserved for the episcopal jurisdiction. "since it is not lawful to subject the ministers of the divine office to the arbitrament of temporal powers." Justinian has a clear perception of the demarcation between the spheres of spiritual and temporal law. His system is based on the principle that if the offence be ecclesiastical, needing ecclesiastical correction the bishop shall take cognizance of it, but if a cleric be accused of a secular crime he must be first accused before his bishop, who may depose him from his office and order, and then the competent judge may take him and deal with him according to the laws.

Certain enactments of later Saxon times in England have been sometimes spoken of as though they united together the temporal and spiritual jurisdictions into one mixed tribunal deriving its authority from the State. In the latter part of the 10th century, laws of Edgar provided that the bishop should be at the county court and also the alderman, and that there each of them should put in use both God's laws and the world's law (Johnson's *English Canons*, i. 411). This probably was, as Johnson suggests, that the bishop might enforce secular laws by ecclesiastical censure and the alderman ecclesiastical laws with secular punishment. But the two jurisdictions were kept separate, for by another law of Edgar it was provided that "in the most august assembly the bishop and alderman should be present, and the one should interpret to the people the law of God, the other the laws of men." In the meantime, however, on the Continent Charlemagne under the mistaken belief that he was following the authority of Constantine I and Theodosius I, had taken the serious step of empowering bishops to act as feudal judges, and causes could be taken from lay cognizance and transferred to the bishop's tribunal.

The Mediaeval System—With the latter 9th century we enter upon a new epoch, and by the time of Gregory VII, in the 11th century, the tribunals have fallen into the hands of a regular class of canonists who are in fact professional church lawyers in orders (see CANON LAW). The changes due to the adoption of the false Decretals by Nicholas I and the application of their principles by Hildebrand (afterwards Gregory VII) are discussed elsewhere (see GREGORY VII, INVESTITURE, and kindred articles). The mediaeval system, thus inaugurated, may be considered (1) in its hierarchy, (2) in the subject matter of its jurisdiction, (3) in its penalties.

(1) It is a system of courts. Much that had been done by bishops is now done in the course of regular judicial procedure, the court takes the place of the synod, which ceases to have judicial work. The court of the metropolitan takes the place of the provincial synod, except possibly for the trial of bishops and even this becomes doubtful.

At first the bishop was the only judge in the diocesan court and he always remains a judge. But just as the king appoints judges to hear *placita coram rege ipso*, and the feudal lord appoints his seneschal or steward, so the bishop appoints his official, the "vicar-general" or "chancellor" (see CHANCELLOR). It was gradually established that as a king should not hear causes but commit them to his judges, so a bishop should not hear causes but appoint an official to hear them. In France the parlements were constantly invoking the independence and irremovability of the official.

The ecclesiastical and secular courts are kept distinct. The charter of Wilfrim the Conqueror abrogated the laws of Edgar. No bishop or archbishop "shall any longer hold pleas in the Hundred concerning episcopal law nor draw a cause which concerns the rule of such to the judgment of men of the world" (Stubbs, *Select Charters*, part ii). In France, where the bishop was a temporal baron, his feudal and his spiritual courts were kept by distinct officers. From the bishop, or his official, appeal lay to the metropolitan, who again could hear causes by his official. The Constitutions of Clarendon recognize this appeal (c. viii). An appeal lay from the court of the metropolitan to that of the primate. There were many disputes as to the existence of these primates (see MATLAND, *Canon Law in the Church of England*, p. 121). In England the dispute between Cisterbury and York was settled by making them both primates giving Cisterbury the further honour of being primate of all England. In France the primatial sees and the course of appeals to them were well established.

In England the Constitutions of Clarendon added a provision for appeal to the king, "and if the archbishop shall have failed in doing justice recourse is to be had in the last resort (*postremo*) to our lord the king, that by his writ the controversy may be ended in the court of the archbishop, because there must be no further process without the assent of our lord the king." The last words were an attempt to limit further appeal to Rome. It will be observed that the king does not hear the cause or adjudicate upon it. He merely corrects slackness or lack of doing justice (*Si archiepiscopus defecerit in iustitia evadendo*) and by his writ (*precepto*) directs the controversy to be determined in the metropolitan's court. As Bishop Stubbs says (*Report of Eccl. Comm.* vol. i. *Hist. App.* 1) "The appeal to the king is merely a provision for a rehearing before the archbishop, such failure to do justice being not so much applicable to an unfair decision as to the delays or refusal to proceed common at that time" (cf. Joyce, *The Sword and the Keys*, 2d ed., pp. 19-20). The *recursus ad principem*, in some form or other of appeal or application to the sovereign or his lay judges, was at the end of the middle ages well known over western Europe. This recourse in England sometimes took the form of the appeal to the king given by the Constitutions of Clarendon, just mentioned, and later by the acts of Henry VIII, sometimes that of suing for writs of *prohibition* or *mandamus*, which were granted by the king's judges, either to restrain excess of jurisdiction, or to compel the spiritual judge to exercise jurisdiction in cases where it seemed to the temporal court that he was failing in his duty. The *appellatio inquam ab abusu* (*appel comme d'abus*) in France was an application of a like nature.

Lastly there was the appeal to the patriarchs, &c. in the West to Rome. The distinguishing feature of this appeal was that the rule of the other appeals did not apply to it. In the regular course of those appeals an appellant could not leap the intermediate stages, but he could at any stage go to this final appeal, *omisso medio*, as it was technically called. Van Espen says "The whole right of appeal to the Roman pontiff *omisso medio* had undoubtedly its origin in this principle, that the Roman pontiff is ordinary of ordinaries, or, in other words, has immediate episcopal authority in all particular churches, and this principle had its own beginning from the false Decretals." There was an alleged original jurisdiction of the pope, which he exercised sometimes by permanent legates, whom Gregory VII and his successors established in the chief countries of Europe, and to whom were committed the legislative, executive and judicial powers of the spiritual "prince" in the districts assigned to them. After legates came special delegates appointed by the pope to hear a particular cause. It was the general practice to appoint two or three to sit together (Van Espen, *pars iii tit v c 2, 37*). These might sub delegate the whole cause or any part of it as they pleased (*ibid.* 9-18). These courts were convenient since it was the custom to appoint delegates resident in the neighbourhood, and the power of sub delegation, general or limited, simplified questions of distance. In Belgium causes appealed to Rome had to be committed to local delegates (Van Espen, *pars iii tit v c 3, tit x c 2*).

to the king in chancery. Thence a commission was to issue to persons named therein to determine the appeal definitely. Henry VIII. exercised his jurisdiction as Supreme Head through a vicar-general. Edward VI. exercised original jurisdiction in spiritual causes by delegated commissions (*see* Archdeacon Hile, *Precedents in Criminal Cases*, p. xlviii). Unless the king was to be regarded as an ecclesiastical person, they were not properly ecclesiastical courts, although spiritual persons might sit in them, for they sat only as royal commissioners. The same point has been taken by large bodies of clergy and lay in regard to the court of final appeal created by 25 Hen. VIII. c. 19 and its present successor, the judicial committee of Privy Council. At any rate the "original" jurisdiction claimed for the monarch personally and his delegates, under Henry VIII. and Edward VI., has not permanently remained. In theory, Hooker's contentions have been questioned that "kings cannot in their own proper persons decide questions about matters of faith and Christian religion" and that "they have not ordinary spiritual power" (*Ecc. Pol.* viii. 8, 1, 6, *cf.* xxxix. Articles, Art. 37). In the case of an "established" church, and in particular, of the Church of England as by law established, Hooker's theory meets with important qualifications (*see* article ECCLESIASTICAL LAW).

The legal position of the clergy of the Church of England has been affected by a series of enactments of which the most important are the following: the "Church Discipline Act" (3 and 4 Vict. c. 86) creating the "consistory court", the "Public Worship Regulation Act" (37 and 38 Vict. c. 85), and the "Clergy Discipline Act" (55 and 56 Vict. c. 32). The last remains of the old powers of ecclesiastical jurisdiction in reference to secular causes, have been removed during the 19th century. (1) All matrimonial, testamentary and *de intestate* jurisdiction has been taken away by 20 & 21 Vict. c. 77 (testamentary, etc., England), c. 79 (testamentary etc., Ireland), c. 85 (matrimonial, England), 33 & 34 Vict. c. 110 (matrimonial, Ireland). Matrimonial jurisdiction was taken from the bishop of Sodor and Man in 1884. (2) Since 6 & 7 Will. IV. c. 71, tithes have become, except in a few rare cases, tithes rent charge, and its recovery has been entirely an operation of secular law. Most kinds of offerings are now recoverable in secular courts. (3) Administration of pious gifts has passed to the court of chancery. (4) The enforcement of contractual promises has long been abandoned by the courts. Christian themselves (5) Church rates can no longer be enforced by suit (35 & 36 Vict. c. 109). (6) Disputes were taken away in England by 18 & 19 Vict. c. 41, and in Ireland by 23 & 24 Vict. c. 32. (7) Laymen can no longer be tried in the spiritual courts for offences against clerics. (8) The jurisdiction to "bring" in church etc., is taken away by 23 & 24 Vict. c. 31, in the case of the duty (see A. J. Stephens, *Ecclesiastical Statistics*, i. 356). On the other hand the "Church of England Assembly (Powers) Act, 1919," defined the powers of the Church in reference to internal affairs and facilitated administrative action where this is required (*see* ENGLAND, CHURCH OF).

The position of a disestablished or an unestablished church is comparatively modern, and has given rise to many complications. These Churches are *collegia laici* and come within the liberty of association so freely conceded in modern times. The relations of their bishops, priests or other ministers and lay office-bearers *inter se* and to their lay folk depend upon contract, and these contracts will be enforced by the ordinary courts of law. A consensual ecclesiastical jurisdiction in the Church, which has to this extent temporal sanction (*see* ECCLESIASTICAL LAW).

The case of Scotland presents special features. The Church had the same jurisdiction in Scotland and exercised it through similar courts to those which she had in England and France, till about 1750. As late as 1566 Archbishop Hamilton of Glasgow, upon his appointment, had restitution of his jurisdiction in the province of testaments and other matters (Keith, *History of the Scottish Bishops*, Edinburgh, 1824, p. 38). There was an interval of uncertainty with any real titular bishops till 1790. Then parliament enacted a new system of Church courts which, though to some extent in its turn superseded by the revival of episcopacy under James VI., was revived or ratified by the act of 1690, c. 7

and stands to this day. It is a Presbyterian system, and the Scottish Episcopal Church is a disestablished and voluntary body since 1690.

(*See* PRESBYTERIAN, SCOTLAND, CHURCH OF.)

Protestant Continental European States.—With the Reformation in the 16th century, Church courts properly speaking disappeared from the non-episcopal religious communities which were established in Holland, in the Protestant states of Switzerland and of Germany, and in the then non-episcopal countries of Denmark and Norway.

Discipline over ministers and other office bearers was exercised by administrative methods in the form of trials before consistory or synods. To this extent ecclesiastical jurisdiction is still exercised in these countries. Consistories and synods have exercised discipline of a penitential kind over their lay members, but in later times their censures have generally ceased to carry temporal consequences. Ecclesiastical jurisdiction on the civil side for the trial of causes soon disappeared.

The matter is now determined for all countries which have adopted codes, whether after the pattern of the Code Napoléon or otherwise. These countries have created a hierarchy of temporal courts competent to deal with every matter of which law takes cognizance, and a penal code which embraces and deals with all crimes or delicts which the state recognizes as offences. Hence, even in countries where the Roman Church is established, such as Belgium and Italy, the most of the Latin republics of America, and the province of Quebec, and *a fortiori* where this Church is not established, there is now no discipline over the laity, except penitential, and no jurisdiction exercised in civil suits, except possibly the matrimonial questions of princes (of which there was an example in the case of the late prince of Monaco). In Spain causes of nullity and divorce *a thoro*, in Portugal causes of nullity between Catholics are still for the court Christian (non-secular).

Background.—The subject of ecclesiastical jurisdiction in modern times inevitably links itself into the ecclesiastical and civil history of the countries concerned. On the general subject, *see* ECCLESIASTICAL LAW, and, for further references, articles "Law, Christian" in *Hastings' Encyclopedia of Religion and Ethics*, vol. vii. "Roman Catholic" and "Eastern" by Adrian Fortescue, and "Anglican" by A. J. Maclean. For the history of the principal codes *see* Canon Law. On the development of ecclesiastical jurisdiction in the Church of Rome *see* ROMAN CATHOLIC CHURCH, and (from other points of view) TRENT, COUNCIL OF, VATICAN COUNCIL, and ULTRAMONTANISM. With reference to the Eastern Church, *see* ORTHODOX EASTERN CHURCH, also Landon, *Manual of Councils* (1893), *see* "Constantinople" and "Rome"; Mouravieff, *History of the Russian Church*, Eng. tr. 1882; Hackett, *Orthodox Church in Cyprus* (1901); Milasch, *Das Kirchenrecht der morgenländischen Kirche* (1905). With reference to the Anglican Church, *see* Blunt, Phillimore and Jones, *Book of Church Law*, 1899; W. E. Collins *Nature and Force of the Canon Law* (Church Historical Society, no. xxvii, 1908), and the classical statement of Hooker, *Ecclesiastical Polity*, bk. viii. With reference to the middle ages, *see* the relative parts of the *Cambridge Mediaeval History* and the classical works of van Espen (Louvain, 1720) *Justi ecclesiasticum universum*, *Observationes in Concilio Lateranense vi*, *De recurru ad Principem*. *See* also other works mentioned in the course of the foregoing article (X).

ECCLESIASTICAL LAW, in its broadest sense, the sum of the authoritative rules governing the Christian Church, whether in its internal polity or in its relations with the secular power. Since there are various churches, widely differing both in their principles and practice, it follows that a like difference exists in their ecclesiastical law, which is the outcome of their corporate consciousness as modified by their several relations to the secular authority. In the outcome of this action must be noted between those which are established and those that are "free". The ecclesiastical laws of the latter are, like the rules of a private society or club, the concern of the members of the church only, and come under the purview of the State only in so far as they come in conflict with the secular law (*see* *polygamy* among the Mormons or violation of the trust deeds under which the property of a church is held). In the case of "established" churches, on the other hand, wherever the principle on which the system is based or the difference in its practical application, the essential consideration is that the ecclesiastical law is also the law of the land, the decisions of the church courts being enforced by the

civil power. This holds good both of the Roman Catholic church, wherever this is recognized as the "State religion," of the Oriental churches whether closely identified with the State itself, or endowed with powers over particular nationalities within the State, and of the various Protestant churches established in Great Britain and on the Continent of Europe.

Writers on the theory of ecclesiastical law, moreover, draw a fundamental distinction between that of the church of Rome and that of the Protestant national or territorial churches. This distinction is due to the claim of the Roman Catholic church to be the *only* church, her laws being thus of universal obligation, whereas the laws of the various established Protestant churches are valid—at least so far as legal obligation is concerned—only within the limits of the countries in which they are established. The practical effects of this distinction have been, and still are, of enormous importance. The Roman Catholic church, even when recognized as the State religion, is nowhere "established" in the sense of being identified with the State, but is rather an *imperium in imperio* which negotiates on equal terms with the State, the results being embodied in concordats (*qv*) between the State and the pope as head of the church. The concordats are of the nature of truces in the perennial conflict between the spiritual and secular powers, and imply in principle no surrender of the claims of the one to those of the other.

Protestant ecclesiastical law, then, is distinguished from that of the Roman Catholic church (1) by being more limited in its scope, (2) by having for its authoritative source, not the church only or even mainly, but the church in more or less complete union with or subordination to the State, the latter being considered, equally with the church, as an organ of the will of God. The ecclesiastical law of the church of Rome, on the other hand, what ever its origin, is now valid only in so far as it has the sanction of the authority of the Holy See. And it must be noted that the "canon law" in its old sense is not identical with the "ecclesiastical law" of the Roman Catholic church. By the canon law used to be meant the contents of the *Corpus iuris canonici*, which have been largely superseded or added to by, e.g., the canons of the Council of Trent and the Vatican decrees. The long projected codification of the whole of the ecclesiastical law of the church of Rome, was completed in 1917 in the *Code of Canon Law* (1917).

by parliament in the ordinary course of legislation, and in point of fact a very large portion of the existing ecclesiastical law consists of acts of parliament.

The first principle of the ecclesiastical law in England is the assertion of the supremacy of the Crown, which in the present state of the constitution means the same thing as the supremacy of parliament. This principle has been maintained ever since the Reformation. Before the Reformation the ecclesiastical supremacy of the pope was recognized, with certain limitations, in England, and the church itself had some pretensions to ecclesiastical freedom. The freedom of the church is, in fact, one of the standing provisions of those charters on which the English constitution was based. The first provision of Magna Carta is *quod ecclesia Anglicana libera sit*. By the various enactments of the period of the Reformation the whole constitutional position of the church, not merely with reference to the pope but with reference to the State, was definitely fixed. The legislative power of

convocation was held to extend to the clergy only, and even to that extent required the sanction and assent of the Crown. The common law courts controlled the jurisdiction of the ecclesiastical courts, claiming to have "the execution of such statutes or acts of parliament in concern either the extent of the jurisdiction of these courts or the matters depending before them. And therefore if these courts, either refuse to allow these acts of parliament, or expound them in any other sense than is truly and properly the exposition of them, the king's great courts of common law may prohibit and control them."

The design of constructing a code of ecclesiastical laws was entertained during the period of the Reformation but never carried into effect. It is alluded to in various statutes of the reign of Henry VIII, who obtained power to appoint a commission to examine the old ecclesiastical laws, with a view of deciding which ought to be kept and which ought to be abolished, and in the meantime it was enacted that "such canons, institutions, ordinances, synodal or provincial, or other ecclesiastical laws or jurisdictions spiritual as be yet accustomed and used here in the church of England, which necessarily and conveniently are requisite to be put in use and execution for the time, not being repugnant, contrariant, or derogatory to the laws or statutes of the realm, nor to the prerogatives of the royal crown of the same, or any of them, shall be occupied, exercised, and put in use for the time with this realm" (25 Henry VIII c. 19, 35 c. 16).

The work was actually undertaken and finished in the reign of Edward VI by a subcommittee of eight persons, under the name of the *Reformatio legum ecclesiasticarum*, which, however, never obtained the royal assent. Although the powers of the 25 Henry VIII c. 19, were revived by the 1 Elizabeth c. 1, the scheme was never executed, and the ecclesiastical laws remained on the footing assigned to them in that statute—so much of the old ecclesiastical laws might be used as had been actually in use, and was not repugnant to the laws of the realm.

The statement is, indeed, made by Sir R. Phillimore (*Ecclesiastical Law*, 2nd ed., 1895) that the "Church of England has at all times, before and since the Reformation, claimed the right of an independent church in an independent kingdom, to be governed by the laws which she has deemed it expedient to adopt." This position can only be accepted if it is confined, as the authorities cited for it are confined, to the resistance of interference from abroad. If it mean that the church, as distinguished from the kingdom, has claimed to be governed by laws of her own making, all that can be said is that the claim has been singularly unsuccessful. From the time of the Reformation no change has been made in the law of the church which has not been made by the king and parliament, sometimes indirectly, as by confirming the resolutions of convocation, but for the most part by statute. The list of statutes cited in Sir R. Phillimore's *Ecclesiastical Law* fills 12 pages. It is only by a kind of legal fiction that the church can be said to have deemed it expedient to adopt these laws.

The terms on which the church establishment of Ireland was abolished, by the Irish Church Act of 1869, may be mentioned. By s. 20 the present ecclesiastical law was made binding on the members for the time being of the church, "as if they had mutually contracted and agreed to abide by and observe the same," and by s. 21 it was enacted that the ecclesiastical courts should cease after Jan. 1, 1871, and that the ecclesiastical laws of Ireland, except so far as relates to matrimonial causes and matters, should cease to exist as law. (See also ENGLAND, THE CHURCH OF.)

BIBLIOGRAPHY.—The number of works on ecclesiastical law is very great, and it must suffice here to mention a few of the more conspicuous modern ones. Ferdinand Walter, *Lehrbuch des Kirchenrechts als christlichen Konfessionen* (14th ed., Bonn, 1871); G. Phillips, *Kirchenrecht*, Bde 1-2 (Regensburg, 1845-72) incomplete; the text-book by Cardinal Hergenrother (*qv*), P. Hinschus, *Kirchenrecht der Katholiken und Protestanten in Deutschland*, 6 Bde (1869 sqq.), only the Catholic part; a masterly and detailed survey of the ecclesiastical law, finished, Sir Robert Phillimore, *Eccl. Law of the Church of England* (2nd ed., ed. by Sir Walter Phillimore, 1895). For further references see CANON LAW and the article "Kirchenrecht" in Herzog-Hauck, *Realencyklopädie* (ed. Leipzig, 1901); C. F. S. Zollman, *Amer. Civil Church Law* (1917); P. Gillet, *La personnalité juridique en droit ecclésiastique* (Malines, 1927).

ECCLESIASTICUS (abbreviated to *Ecclesi*), an alterna-
tive title of the apocryphal book otherwise called "The Wisdom
of Jesus the son of Sirach". The Latin word *ecclesiasticus* means
"churchly," and might be used of any book which was read in
church or received ecclesiastical sanction. The name of the
book appears in the authorities in a variety of forms. The writer's
full name is given in l. 27 (Heb. text) as "Simeon the son
of Jeshua (i.e. Jesus) the son of Eleazar the son of Sirā". In
the Greek text this name appears as "Jesus son of Sirach Eleazar
of Jerusalem". The name is shortened sometimes to *Ben
Sira* in Hebrew, *Bar Sira* in Aramaic, and sometimes to *Sirach*.
The work is variously described as the *Words* (Heb. text), the
Book (Talmud), the *Proverbs* (Jerome), or the *Wisdom* of the
son of Sirā (or Sirach).

Of the date of the book we have no certain indication. It was
translated by a person who says that he "came into Egypt in the
38th year of Euergetes the king" (Ptolemy VII, 1, 1, in
132 B.C., and that he executed the work some time later. The
translator believed that the writer of the original was his own
grandfather (or ancestor, *πάτριος*). Arguments for a pre-Mac-
cabean date may be derived (a) from the fact that the book
contains apparently no reference to the Maccabean struggles,
(b) from the eulogy of the priestly house of Zadok which fell
into disrepute during these wars for independence.

In the Jewish Church Ecclesiasticus hovered on the border of
the canon. The book contains much which attracted and also much
which repelled Jewish feeling, and it appears that it was
necessary to pronounce against its canonicity. In the Talmud
(Sanhedrin 100 b) Rabbi Joseph says that it is forbidden to
read (i.e. in the synagogue) the book of Ben Sirā. In the Christian
Church it was largely used by Clement of Alexandria (c. A.D. 200)
and by St Augustine. Jerome (c. A.D. 390-400) writes
"Let the Church read these two volumes (Wisdom of Solomon
and Ecclesiasticus) for the instruction of the people, not for
establishing the authority of the dogmas of the Church" (*Præ-
fatio in libros Salomonis*). In the Vulgate Ecclesiasticus immedi-
ately precedes Isaiah. The council of Trent declared this book
and the rest of the books reckoned in the Thirty-nine Articles as
apocryphal to be canonical.

The text of the book raises intricate problems which are still
far from solution. The original Hebrew (rediscovered in frag-
ments and published between 1896 and 1900) has come down
to us in a mutilated and corrupt form. There are marginal
readings which show that two different recensions existed once
in Hebrew. The Greek version exists in two forms—(a) that
preserved in cod. B and in the other uncial mss., (b) that pre-
served in the cursive codex 248 (Holmes and Parsons). Owing
to the mutilation of the Hebrew the Greek version retains its
place as the chief authority for the text.

The restoration of a satisfactory text is beyond our hopes, for
we cannot doubt that the translator amplified and paraphrased
the text before him. It is probable that at least one considerable
omission must be laid to his charge, for the hymn preserved
in the Hebrew text after ch. li. 12 is almost certainly original.
Ancient translators allowed themselves much liberty in their
work, and Ecclesiasticus had no reputation for canonicity in the
2nd century B.C. to serve as a protection for its text.

The uncertainty of the text has affected both English versions
unfavourably. The A.V., following the corrupt cursives, is often
wrong. The R.V., on the other hand, in following the uncial
mss. sometimes departs from the Hebrew, while the A.V. with
the cursives agrees with it. Thus the R.V. omits the whole of
ul. 19, which the A.V. retains, but for the clause, "Mysteries
are revealed unto the meek," the A.V. has the support of the
Hebrew. Sometimes both versions go astray in places in which
the Hebrew text recommends itself as original by its vigour,
e.g. in vi. 26, where the Hebrew is—

Hast thou a wife? abominate her not
Hast thou a hated wife? trust not in her

Again in ch. xxxviii the Hebrew text shows its superiority over
both English versions

| | Hebrew | RV (similarly AV) |
|--------|--|--|
| Ver 1 | Account thyself with a physician before thou have need of him | Honour a physician according to thy need of him with the honours due unto him |
| Ver 15 | He that sinneth against his Maker will behave himself proud- ly against a physician | He that sinneth before his Maker, let him fall into the hands of the physician |

In the second instance, while the Hebrew says that the man who
rebels against his Heavenly Benefactor will *a fortiori* rebel
against a human benefactor, the Greek text gives a cynical turn
to the verse, "Let the man who rebels against his true benefactor
be punished through the tender mercies of a quack." The He-
brew text is superior also in xlv. 1 "Let me now praise favoured
men," i.e. men in whom God's grace was shown. The Greek text
of v. 1 "famous men" is nothing but a loose paraphrase.

In character Ecclesiasticus resembles the book of Proverbs.
It consists mainly of maxims, moral, utilitarian and secular.
Occasionally the author attacks prevalent religious doctrines,
e.g. the denial of free will (xv. 11-20), or the assertion of God's
indifference towards men's actions (xxxv. 12-19). Occasionally
he touches the highest themes, and speaks of the nature of God
"He is All" (xlii. 27), "He is One from everlasting" (xlii. 21,
Heb. text), "The mercy of the Lord is upon all flesh" (xviii. 13).
The book contains several passages of force and beauty, e.g. ch.
ii. (how to fear the Lord), xv. 11-20 (on free-will), xxiv. 1-22
(the song of wisdom), xli. 15-25 (praise of the works of the
Lord), xlv. 1-15 (the well known praise of famous men). Many
sayings scattered throughout the book show depth of insight or
practical shrewdness. A few examples may be cited. "Call no
man blessed before his death" (xi. 28), "He that toucheth pitch
shall be defiled" (xii. 1), "God hath not given any man license
to sin" (xv. 20), "Man cherisheth anger against man, and doth
he seek healing from the Lord?" (xxviii. 3), "All things are
double one against another and He hath made nothing imperfect"
(xli. 24, the motto of Butler's *analogy*), "Work your work be-
fore the time cometh, and in His time He will give you your re-
ward" (li. 30). It cannot be said, however, that Ben Sirā preaches
a hopeful religion. Though he prays, "Renew Thy signs, and re-
peat Thy wonders. Fill Zion with Thy majesty and Thy
Temple with Thy glory" (xxvii. 6, 14 [19], Heb. text), he does
not look for a Messiah. Of the resurrection of the dead or of
the immortality of the soul there is no word. In his maxims of
life he shows a frigid and narrow mind. He is a pessimist as
regards women. "From a woman was the beginning of sin, and
because of her we all die" (xxv. 24). He does not believe in
home spun wisdom. "How shall he become wise that holdeth the
plough?" (xxxvii. 25). Artificers are not expected to pray like
the wise man. "In the handwork of their craft is their prayer"
(v. 34). Merchants are expected to cheat. "Sin will thrust itself
in between buying and selling" (xxvii. 2).

BIBLIOGRAPHY—A useful summary of the literature of Ecclesiasticus
is found at the end of Israel Levi's article, "Sirach," in the *Jewish
Encyclopaedia*. The most important edition in English is that of
G. H. Box and W. O. E. Oesterley in R. H. Charles, *Apocrypha
and Pseudepigrapha of the O.T.* (1913). (W. E. B. A.)

ECGBERT or **ECGBERTH** (d. 766), archbishop of York,
was made bishop of that see in 733 by his cousin Ceolwulf, king
of Northumbria, succeeding Wilfrid II. on the latter's resignation.
The pall was sent him in 735 and he became the first northern
archbishop after Paulinus, none of his predecessors having re-
ceived the vestment. He was the brother of Eadbert, who ruled
Northumbria 737-758. He was the recipient of the famous letter
of Bede, dealing with the evils arising from the corrupt state of the
monasteries. Ecgbert himself wrote a *Dialogus Ecclesiasticæ
Institutionis*, a *Penitential* and a *Pontifical*. He was a corres-
pondent of St Boniface. His brother Eadbert succeeded to the
throne of Northumbria in 758, and Ecgbert, whose power
was certainly increased by this relationship, used his authority
wisely for the welfare of his see. He gave generously to the
churches of his diocese, and, in particular, founded the Cathedral
School of York. He died on Nov. 19, 766.

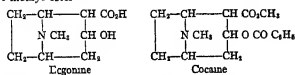
See Bede, *Continuatio*, suly. ann. 733, 735, 756, and *Epistola ad Eg-*

berctum (ed. Plummer, 1896), *Chronicle*, sub ann. 734, 735, 738, 766 (ed. Earle and Plummer, 1899), Hadden and Stubbs, *Councils and Ecclesiastical Documents* (1869-78), in 403-431, *Proceedings of Surtees Society* (Dulham, 1883).

ECGBERT or ECGBERHT (d. 839), king of the West Saxons, son of Ealhmund, succeeded to the throne in 802 on the death of Beorhtic. It is said that at an earlier period in his life he had been driven out for three years by Offa and Beorhtic. In 815 Egbert ravaged the whole of the territories of the West Welsh, which probably at this time did not include much more than Cornwall. In 825 he joined the men of Devon against the West Welsh, who were again defeated at Camelford. The next important occurrence in the reign was the defeat of Beornwulf of Mercia at Ellendun, probably near Winchester, in 825. Egbert sent his son Aethelwulf against Kent, he drove Baldred, king of Kent, across the Thames, and Kent, Surrey, Sussex and Essex submitted to Wessex, while the East Angles, who slew Beornwulf shortly afterwards, acknowledged Egbert as overlord. In 829 the king finally conquered Mercia, and Northumbria, which accepted him as overlord. Egbert was the first king to hold the whole of England under his overlordship. He also increased his power by reversing the Mercian policy of resting the authority of the archbishops, and by making an agreement of perpetual alliance with the church of Canterbury. In 830 he led a successful expedition against the Welsh. In 836 he was defeated by the Danes, but in 838 he entirely routed them and their allies the West Welsh at Hingston Down (Hengist dune) in Cornwall. Egbert died in 839, after a reign of 37 years, and was succeeded by his son Aethelwulf.

See *Anglo-Saxon Chronicle* (ed. Earle and Plummer, 1899), W. de G. Birch, *Carularium Saxonum* (1885-93). Also a paper by Sir H. H. Howarth in *Nimrod's Chronicle*, 3rd series, vol. x, pp. 66-87 (reprinted separately, 1900), where attention is called to the peculiar dating of several of Egbert's charters, and the view is put forward that he remained abroad considerably later than the date given by the *Chronicle* for his accession. On the other hand a charter in Birch, *Cart Sax.*, purporting to date from 799, contains the curious statement that peace was made between Coenwulf and Egbert in that year.

ECGONINE, a white crystalline alkaloid of the tropane group, is chiefly of interest because of its relation to cocaine. Ecgonine is a tropine carboxylic acid $C_8H_{13}NO_3$, and cocaine is its benzoyl methyl ester.



l-Ecgonine results from the alkaline hydrolysis of *l*-cocaine (the naturally occurring form), it melts at 205° C. when anhydrous α -Ecgonine is an isomeride, having its CO_2H group attached to the same carbon atom as the OH group.

ECHEGARAY Y EIZAGUIRRE, JOSÉ (1832-1916), Spanish mathematician, statesman and dramatist, passed out at the head of the list of engineers in the Escuela de Caminos at Madrid, and, after a brief practical experience at Almería and Granada, was appointed professor of pure and applied mathematics in the school where he had lately been a pupil. Between 1867 and 1874 he acted as minister of education and of finance, upon the restoration of the Bourbon dynasty he withdrew from politics and under the pseudonym of Jorge Hayaseca won a new reputation as a dramatist with *El Libro del avaroso*, which was played at the Teatro de Apolo on Feb. 18, 1874. Later in the same year Echeagaray achieved a popular triumph with *La Esposa del vengador*, in which the good and bad qualities—the clever stagecraft and unbridled extravagance—of his later work are clearly noticeable. From 1874 onwards he wrote, with varying success, a prodigious number of plays. Among the most favourable specimens of his talent may be mentioned *En el puño de la espada* (1875), *O locura o santidad* (1877) and *En el seno de la muerte* (1879). *El gran Galeoto* (1881), perhaps the best of Echeagaray's plays in conception and execution, has been translated into several languages. The humorous proverb, *¿Presu-*

mal y acertaras? exemplifies the author's limitations, but the attempt is interesting as an instance of ambitious versatility. His susceptibility to new ideas is illustrated in such pieces as *Mariana* (1892), *Mancha que limp* (1895), *El Hijo de Don Juan* (1892), and *El Loco Dios* (1900), these indicate a close study of Ibsen, and *El Loco Dios* more especially might be taken for an unintentional parody of Ibsen's symbolism.

Echeagaray enjoyed exceptional popularity for over 30 years, but his vogue is now over. He had valuable gifts in artistic construction, in the arrangement of dramatic scenes, in mere theatrical technique, in the focusing of attention on his chief personages, few writers excel him. He had, moreover, a powerful, gloomy imagination, which is momentarily impressive. But in the drawing of character, in the invention of felicitous phrase, in the contrivance of verbal music, he is deficient. He alternates between the use of verse and prose, and his hesitancy in choosing a medium of expression is amply justified, for the writer's prose is not more distinguished than his verse.

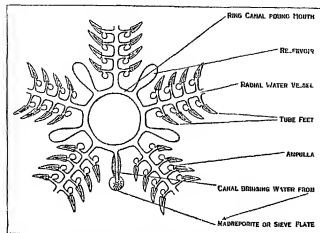
See L. Anton del Olmet and A. García Canalla, *Echeagaray* (1912). **ECHELON**, in military tactics and drill, a formation of troops composed of successive and parallel units facing in the same direction, each on a flank, and to the rear of, the unit in front of it (Fr. from échelle, ladder). The disposition of the whole thus resembles the steps of a staircase. To form echelon from line, the units forming the line move off, each direct to its front, in succession, so that when the formation is completed the rightmost body, for example, is farthest advanced, the one originally next on its left is to the left rear, a third is to the left rear of the second, and so on. The word is also used more loosely in tactics and strategy to express the successive parts of a unit or force, e.g., forward, reserve or rear echelon, irrespective of distances and relative positions, and in military organization to indicate parts of the headquarters organization which are left in rear of the fighting zone.

ECHIDNA or SPINY ANTEATER (*Tachyglossus*), one of the Monotremata (*q.v.*) the lowest subclass of Mammalia. It is a native of Australia, burrowing in sand, or hiding in rock crevices. In size and appearance it resembles a hedgehog, its upper surface being covered over with strong spines directed backwards and upwards, so as to cross each other on the middle line. The tail is very small. It has a long tubular snout with a small mouth, its tongue is long and slender, lubricated with a viscous secretion, by means of which it seizes the insects on which it feeds. It has no teeth. Its legs are short and strong and form powerful burrowing organs. The male echidna has its heel provided with a sharp hollow spur, connected with a gland. It is a nocturnal animal. When attacked it seeks to escape either by rolling itself into a ball or by burrowing rapidly into the sand. Two eggs are laid and these are carried, as are the young at an early stage, in an abdominal pouch, into which open the mammary glands. The echidnas are restless in confinement and constantly endeavour to effect their escape by burrowing. There are two varieties: the Port Moresby echidna of southeastern New Guinea with longer beak and shorter spines, and the hairy echidna of Tasmania. In all, the spines are mixed with hair, in the Tasmanian race they are nearly hidden by the long harsh fur. Of the curved-beaked echidnas (*Zaglossus*) confined to New Guinea there are several species, about 30 in all, in length.

ECHINODERMA (Echinoderms), a group of animals that live in the sea and constitute one of the great branches (phyla) of the animal kingdom. Familiar examples are the sea-urchin (Echinoid), the sea-star or starfish (Asteroid) and the brittle-star (Ophiuroid). Less familiar are the feather star and sea lily (unstalked and stalked Crinoid), and the sea-cucumber (Holothurian) (figs. 1-5). These forms represent the five classes into which the Echinoderms now living are usually divided. In the older periods of the world's history there were other classes, none of which have survived.

The living forms are of such diverse appearance, and for the most part so unfamiliar, that there is no vernacular English name for the group. "Echinoderma" is a Greek word and means "prickle-skinned" ("animals" being understood). The Greeks gave

mouth of five grooves lined with minute lashes (cilia), which by constant whipping drive a stream of water with food particles towards the mouth. The food collecting area was increased by the elongation or branching of the grooves, as in crinoids and sea stars, and the water-vessels followed the food grooves. In crinoids and sea stars the food grooves are open and in use, but in brittle stars, sea-urchins, and holothurians they have become



FROM MONTGOMERY: PISCIBUS DAINWAS & FAUNA (O. E. C. 545)

FIG 6—HYDRAULIC APPARATUS OF SEA STAR

closed over, while the ambulacral system continues to send out its podia (fig 7).

Spicular Structure of Skin—The name Echinodermata expresses one of the chief characters of the branch. Prickles, it is true, are not so extensively developed in the other classes as they are in sea-urchins, though they are present in considerable numbers in most of them. The essential feature is the presence in the deeper layers of the skin of minute spicules of crystalline carbonate of lime (calcite), which usually grow together into plates, or small bones, or prickles, all so interpenetrated with the connecting fibres of the body wall that they constitute a beam and rafter work (fig 8). Under the microscope a thin section of such bones like a net. Wherever the mid layer or mesoderm occurs in the body, and not only in the body-wall, its cells have this power of depositing lime, they can also absorb it and redeposit it, so that the shape and structure of the skeleton change as the animal grows. In all these respects the skeletal tissue of Echinodermata is paralleled only by the bone of Vertebrata, but it differs from

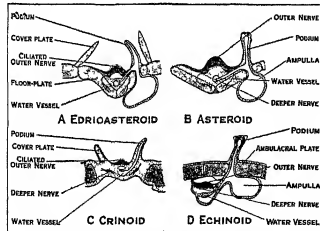
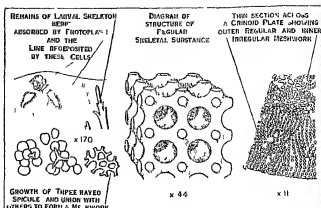


FIG 7—CROSS SECTIONS OF RADIAL GROOVE

bone in chemical composition, in the formation of the spicules within the cells and not outside them, and in the retention of a crystalline character so that each plate acts as an individual crystal. By the cleaved surface characteristic of calcite and the netlike appearance, even minute fragments of echinoderm skeleton embedded in the rocks can be distinguished from the

remains of molluscs, corals, arthropods and other animals.

Other Common Characters—The following characters of less obvious nature are also common to all living echinoderms—The egg develops first into an elongate, two sided larva (figs 9 and 21), with an unciliated gut, and with the body cavity essentially arising as three pairs of pouches (coeloms), all or part

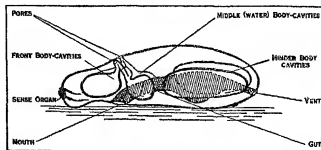


FROM LANKFESTER: TREATISE ON ZOOLOGY (A & C BLACK)

FIG 8—SKELETAL SUBSTANCE OF ECHINODERMA

of this is somewhat abruptly changed into a radial creature with ciliated gut. This characteristic metamorphosis is described later. The nervous systems are three: (1) the outer oral sensory system, chiefly composed of a ring round the mouth, and radial nerves lying outside the water vessels, and derived from the superficial epithelium, (2) the deeper oral motor system, lying just below the former, applying the muscles in the oral side of the body wall, (3) the apical motor system, most highly developed in crinoids, its centre is where the stem originates, and its cords pass down the stem and the rays to work their muscles, it is in all classes except holothurians. The blood system consists of a number of spaces rather than definite vessels, without heart or regular circulation, its contents differ from the general fluid of the body-cavity only in containing more albumen. In all the internal fluids float various bodies some are red with haemoglobin (like human blood corpuscles) and aid respiration, others are white, wandering, amoebalike cells, which serve many purposes, some eating the various waste products and then squeezing their way to the exterior, for there is no definite excretory system.

Relationships—The Echinodermata as we have seen, differ from other radial animals, but agree with many other branches, in the separation of a body cavity (coelom) from the primitive hollow, which persists as the gut. The various branches of the



FROM LANKFESTER: TREATISE ON ZOOLOGY (A & C BLACK)

FIG 9—SIMPLIFIED DIAGRAM OF THE DIPLEURALA

Coelomata may have sprung independently from the Coelentera, and if there was any connection between them it must have been through forms whose existence we can only infer from a study of the oldest fossils and of the earliest stages in the life history of their living descendants. Thus we find the mode of origin of the coelom and its early division into three pairs of sacs paralleled only in that great branch of the Coelomata which includes all animals with a backbone or with its cartilaginous precursor termed "notochord." The lower Chordata (as the branch is named) comprise the lancelet (*Amphioxus*), the sea-squirts or

ascidians, and some less known, often worm shaped creatures named Enteropneusta. All Chordata, except sea squirts, show traces of this triple division of the coelom, and the growth of its middle division into lobes and tentacles is seen also in some Enteropneusta. The larva of one of the Enteropneusta (*Balanus glossus*) was originally described as an independent animal (*Tornaria*) and supposed to be related to the Echinoderm larval forms—the presence of a water pore accentuates the outer similarity. The mouth of the developing Echinoderm, when it shifts from the original median position, invariably moves to the left not to the right, in the hunchet the mouth opens first on the left side. The central nervous system of Chordata, like the outer oral nervous system of Echinoderm, is derived from the outer epidermis and sinks below the surface in the same manner, this indicates that the ancestral forms responded to certain outer stimuli by a similar mechanism. The resemblances and differences between echinodermal and vertebrate skeletal tissue have already been emphasized. All these facts suggest that the Echinoderm and the Chordata were derived from a common ancestor, differing from the ancestors of other Coelomata, but itself not yet either an echinoderm or a chordate.

CLASSIFICATION

The five classes into which, as said at the outset, Echinoderm now living are usually divided, are not of equal value, for the Asteroidea and Ophiuroidea diverged in a comparatively late geological period, so that the differences between them are not so profound as those that distinguish the other classes, the difficulty is met by merging them in a super class, Stelliformia. In early Paleozoic times there existed other classes, all of which became extinct before the Mesozoic era began. Most of these creatures resembled most crinoids in being attached to the sea floor and in feeding on minute organisms, which they swept along chitid grooves into their usually upturned mouths. They have therefore been grouped with the crinoids as Palmariazoa (stalk animals), while the remaining classes, which are free moving and generally feed with down turned mouth on larger organisms have been opposed to them under the name Eleutherozoa (free animals). These names conveniently connote definite facts of structure and habit, but do not imply any closer relationship between the classes included under them. The classification here adopted embodies a few recent advances. Certain Palmariazoa that, in editions of the *Encyclopaedia Britannica* after 1900, have been placed under Cystoidea as an order Carpoidea are now distinguished as a class. On the other hand the Blastoidea, though numerous and rather sharply defined, are a relatively late offshoot from the Cystoidea, and it they are retained here as a class, it is only because authorities disagree upon their point of origin. W. J. Sollas has proposed a class Ophiocystis for a few rare Silurian fossils, of which the structure was long misunderstood though correctly given in the *Encyclopaedia Britannica* (1911), they may be modified Stelliformia or Echinoderm, but cannot be maintained as a separate class. Recently some Paleozoic fossils, usually regarded as Cirripedia, have been identified by T. H. Withers (1926) to the Echinoderm, and F. A. Bather has accepted this view, while keeping them apart as a sub branch, Machaeridia. The larger divisions of the Echinoderm here accepted may be tabulated, without implication as to their mutual affinity, thus—

- With more or less Radial structure
 - † Carpoidea
 - † Cystoidea
 - † Blastoidea
 - † Cystoidea
 - † Echinosteroidea
- Palmariazoa
 - † Machaeridia

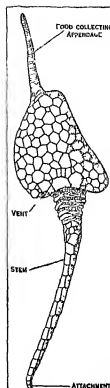
Asteroidea } Stelliformia
 Ophiuroidea }
 Echinoderm } Eleutherozoa
 Holothuroidea }

The † denotes that the group became extinct before the Mesozoic.

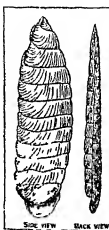
COMPARATIVE ANATOMY AND PHYSIOLOGY

Machaeridia—Of the Machaeridia only one skeleton is known, and it is mainly because its plates have shown the crystalline cleavage characteristic of echinoderms that they have been placed in this branch. In the simpler forms the plates are in two rows, hinged down the back, and opening on the other side (fig 10), scars on their inner face indicate the presence of muscles that would pull the two sides together. One infers that the animal was elongate, flexible, symmetrically two sided, with a mouth and some sensory organ at the fore end, and a vent at or near the hind end, it may have been such a creature as study of recent larvae has led several authors to imagine as a probable ancestor under the name *Dipleuralia* (little two-sided) (fig 9). In that the two front pores of coeloms would have opened to the exterior by a pore apiece, but no trace of such a pore has yet been seen in machaeridian plates. More advanced forms had four rows of plates, two on each side. At one end a plate was often modified in a way that suggests temporary fixation.

Carpoidea—All Carpoidea bear traces of a stem by which the body was attached to some object on or near the sea-floor (fig 11). In most the skeleton shows some two sided symmetry, if only in a part of the stem, this may have originated in the symmetry of the *Dipleuralia*, but its gradual increase in various series of the class is due to adaptation. Nearly all Carpoidea are flattened in a plane parallel to the sea-floor, and either the whole body-wall is flexible or one side remains flexible, so that it could expand and contract as the animal drew in or expelled water for food or aeration. The positions of intake and vent relative to the stem and to each other vary according to the particular habitat and mode of life of each genus, originally, perhaps, they were at



BY COURTESY OF THE ROYAL SOCIETY OF ECHINODERM FROM BATHER CARPOIDEAN CYTHERA FIG 10—A CARPOID DIPLEURALIA



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY FIG 11—A CARPOID DIPLEURALIA

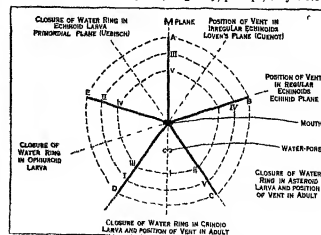
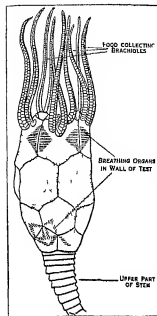


FIG 12—THE SYMMETRIES OF THE CHIEF CLASSES

opposite ends of the body and the stem arose between them, in any case the arrangement differed from that of all other Palmariazoa. In the apparent absence of water-pore, genital pore and any trace of radial symmetry, the Carpoidea and Machaeridia differ from all other classes.

Cystoidea—The Cystoidea, like all other echinoderms, have a

two sided symmetry, but in them we see the rise of radial symmetry. Study of this enables one to draw a plan by which the symmetries in other classes can be compared (fig 12). Normally the cystoids are attached to the sea floor by one pole of the body and take in food through a mouth at the opposite, upper pole. Near the mouth is a water pore, and close to it, but further from the mouth, is a genital pore, the vent is usually in the same line,



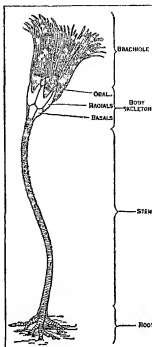
AFTER JAECKEL IN SYMMETRISCHESCHEN DER
FELMATOZOEN (JULIUS REINER BERLIN)
FIG 13—A RHOMBIFEROUS CY-
STOID CHIROCRINUS NAT SIZE

at the side of the body. Thus the body can be divided into similar halves by a plane passing through the mouth or oral pole, the apical hole, and the water pore. This plane is termed the *M* plane (because in other classes the water pore is broken up into many, and the perforated plate is called a *madreporite*) and it can always be identified. The rays originate by the extension of the ciliated lining of the gullet over the body-surface, it stretches out in the form of grooves, the first, naturally, away from the vent, towards the front or anterior part of the body, the second and third towards the free space on each side, later, these three grooves become five by the forking of the right and left grooves. The food-collecting surface was usually increased by the extension of the grooves on little jointed appendages (brachioles), which did not contain prolongations of the body cavity or of the generative system (fig 13). The water system may have sent branches through the mouth opening along the food grooves, but did not subserve locomotion. Aeration of the body-fluids was effected through thinner portions of the test, and according to the structure of these the Cystoidea may be grouped in two subclasses—(1) Rhombifera or Dychopora, in which the breathing organs are folds of the test-wall, crossing the sutures of the plates (fig 13), (2) Diploporita, in which the breathing organs are canals of *U*-shape within the test wall and not crossing the sutures (fig 14). There are other differences between these subclasses.

Blastoidea.—The Blastoidea proper (fig 15) have a body-skeleton of 13 main plates arranged in three circlets, according to a marked five rayed symmetry, viz, five radials, which support the five main food-grooves, five orals, which surround the mouth and lie between the food-grooves, the basals, which lie beneath the radials and form a facet for the stem. The vent lies in one of the interradia, either adjoining, or enclosed by, an oral, the water pore and genital pore are probably associated with it. Respiration was effected through thin portions of the test wall, strongly folded so as to increase the surface, these *hydrospires* cross the sutures between the radial and oral plates. Each food-groove, after passing between the orals, lies not on the radial plate, but on a special plate in the radial line called, from its shape, the lancet-plate, this is bordered by small side-plates, to which brachioles are attached.

Crinoida.—The body of the Crinoida (fig 16) is normally borne on a stem, has the food-collecting system upwards, and the vent in the *M* plane at the side or raised away from the intake on a sort of chimney (anal tube). The food-grooves are extended on five arms or brachia, which are not, like brachioles, mere ap-

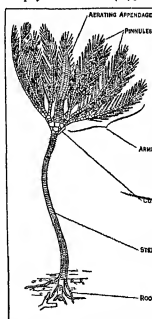
pendages to the test, but actual outgrowths of the body (fig 7) containing throughout extensions of the body cavities, the generative organs, and the apical nervous system, as well as bearing the usual water vessels with their side branches and podia, and nerves from the two oral systems. The arms, which are built of successive plates (brachials), may fork or branch repeatedly, and the smaller branches may become arranged along the sides of the larger, forming pinnules. Pinnules are commonly of some what different structure from the arms and may lack ambulacral grooves and associated structures. O Jaekel and A H Clark hold that the pinnules of certain forms, including the living feather stars, represent the brachioles of cystoids. The body with its arms is termed the crown, that portion of it below the free part of the arms is the dorsal cup, the covering or lid of the cup, above the free part of the arms, is the tegmen. In the simpler crinoids the cup consists of only two or three circlets of plates, the five radials, from which spring the arms, the (primitively) five basals, beneath the radials and alternating with them, and often the (primitively) five infrabasals, beneath and alternating with the basals. Infrabasals are wanting in some groups (monocyclic), present in others (dicyclic), but may be overgrown by the basals or may atrophy in the adult (cryptocyclic). The cup may be enlarged



BY COURTESY OF THE BRITISH MUSEUM (NATURAL HISTORY)

FIG 15—A BLASTOID OROPHO-
CRINUS FUSIFORMIS

by the incorporation of the lower parts of the arms, between which other plates (interbrachials) often arise, to make room for the vent, or to support it, special anal plates may be added, or it may be reduced to a small platform as in most feather-stars. The gut, as viewed from the oral surface, is coiled in a clockwise direction (solar).



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM (NATURAL HISTORY)

FIG 16—BOTRYOCRINUS DECADACTYLUS OF SILURIAN AGE

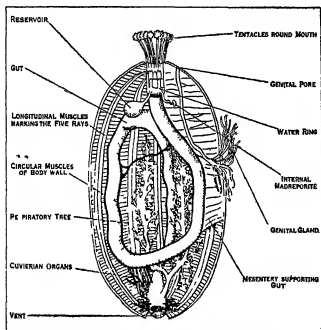
floor plates, and that it gave off branches, each of which ended in a podium stretching outwards and a swelling (ampulla) stretching inwards between the floor-plates to form a reservoir, no other Palaeozoan show such a structure. There were no brachioles. The gut seems to have had a solar coil, its vent and madreporite lay

Edrioasteroidea.—The Edrioasteroidea (fig 17) had a circular test composed of an indefinite number of irregular plates. They were either permanently attached to the sea-floor, or adhered like a limpet with some power of movement. From the upturned mouth five food-grooves stretched over the upper face, these were usually borne on a series of alternating floor-plates and protected by hinged cover plates. From the structure of the fossils (fig 7) it is inferred that a water-canal passed from a ring canal round the mouth, beneath each groove but outside the floor plates, and that it gave off branches, each of which ended in a podium stretching outwards and a swelling (ampulla) stretching inwards between the floor-plates to form a reservoir, no other Palaeozoan show such a structure. There were no brachioles. The gut seems to have had a solar coil, its vent and madreporite lay

are always present and are of five different types

Holothuroidea—The Holothuroidea (holothurians, sea cucumbers) resemble the Echinoidea in that the outer skin covers the grooves, podia may or may not be present. But, whereas a sea urchin moves sideways in any direction, a normal holothurian (fig. 5) moves only in the direction of its mouth, with the body stretched along the sea-floor, and the vent at the other end. The surface turned to the sea floor is always the same, and is usually flattened down its middle line is one of the radii (A), with radius B to its right and E to its left (fig. 12), the podia of these radii serve as sucking feet, but those of radii C and D, on the upper surface, are used only for feeling and aeration. Near the front or mouth end of the middle upper interradius C/D opens the duct from the usually single genital gland, while the water pore opens just in front of it in the larva and in the adult too in some species, in others the pore closes and the water system obtains its fluid from the body cavity through openings in the stone canal. There is no apical system of plates, and no terminal plate or special tentacle at the end of each ray. In these respects and in the symmetry of the rays the holothurians depart from other Eleutherozoa and approach such early Pelmatozoa as *Echinoaster*.

The following special features are found in most holothurians (fig. 20). The mouth is surrounded by the 8-30 (usually 10-20) front podia, which have become prominent tentacles. Outside these is a rim, which can close over both mouth and tentacles. The body wall has two sets of muscles, a transverse, circular layer, which, on contraction, compresses the contained fluids and thus elongates the body, five pairs of longitudinal muscles, along side the radii, which on contraction shorten the body (it is hard to hold a holothurian). The gut passes from the mouth, below interradius C/D to the hinder end of the body, then forward along interradius D/E, then downward along A/B to the vent, thus it has a solar coil as in ctenoids and echnoids. Most holothurians suck in water through the vent for aeration, to accommodate this the rectum is enlarged and, in numerous species, gives

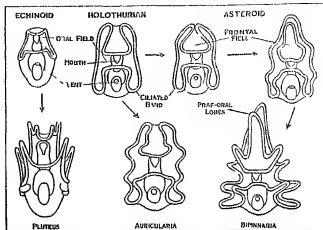


FROM REDWICK, STUDENT'S TEXT BOOK OF ZOOLOGY (ALLER & HARVEY, LTD.)
FIG. 20—A HOLOTHURIAN OPENED ALONG THE BACK

off two many-branched tubes with blind ends, termed the respiratory trees. In most holothurians the skeleton is greatly reduced. Round the gullet is usually a ring of five radial and five interradial pieces, which may correspond to the mouth frame of echnoids. There are no regular plates in the body-wall, but throughout the skin and the connective tissue are scattered minute spicules, which have different shapes characteristic of the various genera and species; in one or two genera some of these are enlarged to form irregular plates, and in one or two they are absent altogether




REPRODUCTION AND DEVELOPMENT

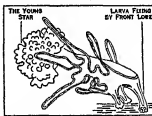
In most echnoderms the sexes are separate, but not distinguished by any external character. The gametic products are discharged into the water, where the eggs are fertilized by the sperm. The egg then divides into a number of cells, which form a hollow ball. One end of this grows inward, and the result is an open mouthed larva with a double cell. This stage corresponds to the



FROM WORTENBERG, NORDDEUTSCHES PLANKTON (PREUSSISCHE AKADEMIE DER WISSENSCHAFTEN)
FIG. 21—THE EARLY STAGES OF LARVAE OF VARIOUS ECHINODERMS

structure of the jelly fish, etc. (Coelentera). From the walls cells migrate into the space between, forming a middle layer. The body cavity arises from the hollow of the sac as a single pouch growing out into the loose middle layer. By repeated division of this pouch arise the three pairs of coeloms shown in the diagram of the dipleurula (fig. 9). Meanwhile the sac lengthens and is flattened on one side, toward which the original cavity bends down and breaks through to form the larval mouth, leaving the original opening as the larval vent.

The larvae are free swimming, and are modified from this ground plan in five directions according to the class to which each belongs. They used to be regarded as distinct animals, and so received special names. Of the four types of pelagic larvae of Eleutherozoa the simplest is the holothurian, of which an early stage is shown in fig. 21. The primitive mouth is surrounded at a little distance by a band of cilia, which by their vibration move the larva. A smaller ciliated band immediately round the mouth sweeps in food. The oral field, within the main band, is shaped like a broad , in later stages the two side portions are folded on their borders and look like a pair of human ears, whence this larva has been called *Auricularia*. The vent lies in the middle below the crosspiece of the H, and the gut runs through the curved body to it, swelling on its way into a stomach but showing no twist. This larva has no skeleton, only some wheel-shaped spicules scattered through its substance. The larvae of brittle-stars and sea urchins have a skeleton, in which long rods push out the side folds and so increase the length of the ciliated band, early stages are shown in fig. 21. A fancied resemblance of later stages to a painter's easel led J. Muller to call the larva *Pulveus* (easel). In the arrangement of the rods the *Ophiopluteus* differs somewhat from the *Echinopluteus*. The asterooid larva has no skeleton. It differs from the *auricularia* in the meeting of the two upper limbs of the , so that the oral field is like an , and there are two complete ciliated bands (fig. 21), their apices are drawn out into long prae oral lobes, and their margins are folded into narrower lobes or pinnas, whence the larva was called *Bipinnaria*. In the recent unstalked ctenoids and some other echnoderms with large yolky eggs, the larva grows within the egg till it emerges as



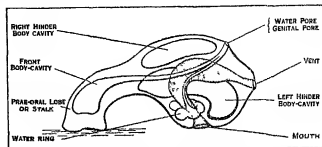
FROM WORTENBERG, NORDDEUTSCHES PLANKTON (PREUSSISCHE AKADEMIE DER WISSENSCHAFTEN)
FIG. 22—LARVA FIXED TO SEA FLOOR AND YOUNG STAR

a barrel shaped form with five bands of cilia like the hoops of the barrel, the primitive mouth, being unused, closes

Between the larva and the adult is a series of complicated changes, during which the larval skeleton is absorbed and re-disposed as the permanent skeleton, while portions of the creature are often cast aside as worn out trappings. Such a marked change is called metamorphosis (*q.v.*) It is best known in some of the sea stars, where it takes about 10 days. The larva sinks and attaches itself to the sea floor by a portion of the pre-oral lobe (fig. 22) this is pulled out to a stalk, and the future star developed within the body of the larva. The essential change is the curving of the left hind coel and the left hinder coelom round the gut, till each becomes a ring. In the asteroid the oral face of the star bends downwards towards the stalk and the floor, and the water ring closes round the stalk which then disappears (fig. 24). In the crinoid the oral face is bent upwards, so that the water ring does not enclose the stalk (fig. 23). As shown in fig. 12 the water ring closes in a different interval with reference to the M plane in each class, this is connected with the torsions that occur during metamorphosis. The later stages of growth are often of interest to the evolutionist as suggesting the ancestry of the present form and the origin of its special structures. The classical instance is the rosy feather star (*Antedon bifida*). This was thought to be an asteroid, but in 1823 J. V. Thompson, a Cork surgeon, discovered that when quite young it was fixed by a stalk like a crinoid, the growing animal breaks away from the root, and the upper part of the stalk is condensed into a knob bearing numerous stem tendrils or cirri. This process recapitulates the race history traced in Jurassic fossils.

Protection of the Brood.—Although most echinoderms have free swimming larvae, about 60 keep their young with them until they are large enough to shift for themselves. These brood protecting species are found in all the groups, but are most numerous in the holothurians, starfishes and brittle-stars. Especially characteristic of sub antarctic regions, there are less than a third as many in the arctic, and only a few in tropical and temperate seas. The young may be carried on the outside of the body, generally distributed, or segregated in special areas, as in the deeply sunken

brittle-stars snap the arms when seized and disintegrate before the distressed naturalist, some holothurians, when attacked, eject portions of their viscera and to this habit the cotton-spinner owes its name. The discarded portions can be grown again, it has even been claimed that in some cases they can themselves grow fresh bodies and become complete individuals. A sea star (*Luchka*)



FROM LANKESTER 'TREATISE ON ZOOLOGY' (A. H. C. BLACK)

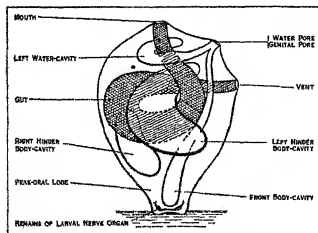
FIG 22—DIAGRAM SHOWING CHANGE FROM FIXED ECHINODERM TO FREE

commonly avails itself of this faculty, and one may find small arms with a small body at one end, and four little buds growing out of it, these are known as comet-forms. The power of regeneration is probably due to the extension of all the systems of the body into the arms, but it seems that in general a portion of the central disc must also be present. A development of this power is reproduction by spontaneous division, as practised by many sea-stars, brittle stars and holothurians, it is indeed the usual method in a number of small six armed tropical brittle stars which when young commonly have three larger and three smaller arms

GEOGRAPHICAL DISTRIBUTION

Echinoderms are confined to the sea and differ in this from all but one or two branches of the animal kingdom. The limitation is probably connected with the density of the water, since echinoderms depend largely on their hydraulic system, and there is besides a constant interchange between the internal fluids and the outer water through the thin membranes. Any sudden change would be particularly fatal to the larval stages, which transport the species to other localities. Some species tolerate a change better than others, but few are found even in brackish water. Within the sea, however, echinoderms may occur from anywhere between tidemarks down to 6,000 metres (33 miles). Those between tidemarks are often buried in moist sand, some urchins bore holes in rock, and these retain a little water, few can stand being left high and dry. In littoral waters examples of all classes are numerous, but the greatest abundance and variety occur between 1,000 and 2,000 metres, in the greater depths both species and individuals are fewer. Most species have a limited range of depth, but a few have considerable extension, thus, the brittle-star *Ophiacantha bidentata* ranges from 5 to 4,450 metres. No order and few families are exclusively either littoral or abyssal, but two highly modified kinds of holothurians occur only floating in the open sea.

Success the depths of the sea are connected and their conditions more or less uniform, abyssal species are much alike in all the oceans. The conditions of coastal waters are varied, and so, consequently, are the species, few having a really wide distribution, the chief exceptions are circumpolar species, which may stretch



FROM LANKESTER 'TREATISE ON ZOOLOGY' (A. H. C. BLACK)

FIG 23—DIAGRAM SHOWING THE INTERNAL STRUCTURE OF THE PRIMITIVE PELMATOZOON, PRODUCED WHEN THE DIPLEURULA FIRED ITSELF BY THE HEAD CAUSING THE MOUTH TO MOVE UPWARDS AND SO THROW THE GUT INTO A COIL AND BEND THE BODY CAVITIES

ambulacra of certain irregular echinoids, or clustered about the mouth, as in certain starfishes, or in the feather stars attached to the cirri or pinules. Often they develop in special pouches which may be on the upper surface as in some holothurians and starfishes, in the interradial areas as in some brittle stars, or on the pinules in some feather-stars. In some cases they are developed internally, escaping through rents in the body-wall of the adult.

Self-division and Regeneration.—Many echinoderms can break off portions of themselves, generally under the stimulus of danger or to get out of a difficult situation. The stem and arms of some of the later crinoids have special breaking-planes, some

GEOLOGICAL HISTORY AND EVOLUTION

Geology gives only a succession of fossil forms, the relation of these to one another is interpreted through facts of anatomy and development, and seen to be an evolution. In its main lines the race-history is now thought to have been as follows. We start with a dipleurula larva (fig. 9), still free floating and with none of the peculiarities of the modern adult echinoderm. The event that originated the branch was the discovery of the sea floor, on which followed the adoption of a stationary life and the deposition of lime spicules in the skin. The three rayed spicules grew into star shaped plates loosely joined, such as are scattered in Lower and Middle Cambrian rocks. As the plates grew, they were more firmly united, and complete skeletons were preserved. These, at the outset, show a divergence. The *Machaeridia* (fig. 10) may represent the elongate stage before fixation. If the elongate form became fixed by the middle of its body, the mouth and the vent would be on the two sides of the base of attachment, and from such a creature all the nonradiate *Carpodaea* (fig. 11) may have descended. They are found only from Middle Cambrian to Devonian.

Origin of Radiate Forms—Radiate forms had a different origin. The dipleurula, apprehending the floor by its sensory front end, fixed itself, not by the ciliated pole, but a little to one side, the right side being chosen for a reason we cannot yet fathom. The result was the passage of the mouth to the upper surface (fig. 23). As it passed up along the left side, the gut caught hold of the left water-sac and pulled it upwards, curving it in the process. Since this was attached to the left duct from the front body cavity, that structure was also pulled up and its pore came to lie between mouth and vent, while the stretched part of the front cavity formed a canal lying along the outer wall. The gut, as it coiled, drew the left hinder coelom also upwards in a curve, while the stomach pressed the right hinder coelom down to the fixed end, where it was involved in the elongation of that region. Not only can these changes be traced in the developing *Antedon* today, but several of the older cystoids had the structure of such a primitive pelmatozoan. Notably they retain the pore by which the genital products, formed from the canal alongside the body-wall, were extruded. At this stage no radiate structure was visible, but, unlike *Carpodaea* and *Machaeridia*, these forms had the fundamental plan on which the radiate types were built.

Radiation arose from the mode of feeding combined with the effect of gravity. Fixed to the sea-floor, with its mouth upturned to the food-bearing waters, which it swept inwards by the cilia of the gullet, the primitive pelmatozoan extended its food collecting surface by the outgrowth of ciliated channels from its mouth

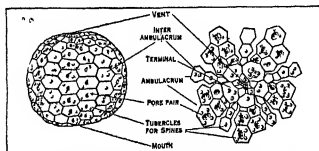


FIG. 23.—SUPPOSED ANCIENT ECHINODERM BOTHRIOCIDARIS SHOWING (RIGHT) ARRANGEMENT OF PLATES AROUND THE VENT.

as already described under *Cystodera*. A limit was set to this increase by the size of the body itself.

Crinoids and Feather stars—Another class, based on a better plan, appeared first at the close of Cambrian time, and by the close of Devonian time had taken the place of the cystoids, this class was the Crinoids. Here the length of the food grooves was increased by the actual outgrowth of the body wall in the direction of the five rays, but upward, the outgrowths became jointed, and repetition of the process led eventually to the long and many-branched arms of the crinoids, in which the grooves sometimes reach the combined length of a quarter of a mile. The

Crinoids early blossomed into some half dozen orders and became adapted to every habitat which the sea provides. A single instance may be taken from certain shore dwellers which in Jurassic times found safety by shortening their stem while retaining the whorls of crin, with these, when torn away by the waves, they could grasp the nearest object. Eventually the stem was fused with the lower part of the cup into a hemisphere covered with crin. Acquiring some power of free locomotion, this type expanded into the group of Comatulida (feather stars), which today comprises about 600 species, divided among 140 genera (fig. 4).

Sea stars and Brittle stars—Among the oldest known echinoderms is a genus of Echinoasteroidea, a class in which radiation had affected not only the food-grooves but the hydraulic system. Though clearly Pelmatostoma, they provide a starting point for all classes of Eleutherozoa. Most adhered by a sucking action of the flexible under side to smooth surfaces. Through the thin skin of that side, the genital products, it is suggested, were extruded. At that time, if at no other, the creatures were able to be overturned, and those that could use their podia for locomotion would have an advantage. A sea star is little more than an overturned *Echinoaster*, and some even now retain the power of feeding in the pelmatozoan way. The anatomical changes in adaptation to the new mode of life have been explained under Stelliforma (fig. 24). Fossils of the crawling asteroid type are known from the top of the Cambrian, but are rare until the Upper Silurian and Lower Devonian, when some adopted a wriggling habit and a structure tending towards the ophiroid type. Genera with arm grooves completely closed and with all their floor-plates turned into "vertebrae" are of doubtful occurrence earlier than the Carboniferous. Ophiroids with elaborate vertebrae of modern type appear first in the Trias.

Sea urchins—The first echinoids may also have been derived from overturned *Echinoasteroids*, the vent, as it passed up, was dragged a little farther back, leaving room for the madreporite, with which it became closely associated at the apical pole. The earliest known are from the top of the Ordovician. For half-a-century *Bothriocidaris* (fig. 25), a small fossil from Estonia, has been regarded as an ancestral echinoid, but T. Mortensen, after fresh examination, refuses to accept it. This leaves in the Ordovician and Silurian only many-plated forms with flexible stem, they cannot be derived immediately from *Echinoaster* since they already have well developed jaws. The family *Lepidodactylidae*, to which they belong, continues to the Carboniferous. Nearly all Palaeozoic echinoids have more than the 20 columns of plates found in later genera, among them the *Archaeocidaridae*, apparently existing in the Devonian, are nearest the simple cidarid type, which has a solitary representative in the Carboniferous and another in the Permian. The early cidarids retained some flexibility in the union between ambulacral and interambulacral areas, in the Triassic period this gradually gave place to a rigid union, and at the same time appeared the diademoid type, with external gills, close set podia, and more numerous radioles. *Cidaroida* and *Diademoida* have persisted to our own day, the former relatively unchanged, the latter giving rise to successive suborders. Among these, some Jurassic genera show the beginning of that movement of the vent towards the margin which characterizes the irregular urchins. A side-branch originating in Cretaceous times was the *Clypeastroidea* (shield-urchins) as an adaptation to life just below the sand of the shore. Another modification led to elongate urchins in which the jaws were gradually lost as the animal took to extracting nutriment from ooze. The extreme of this line is reached in the modern *Spatangidae* (heart-urchins).

Sea Cucumbers—The coiled gut and radiate hydraulic system of the Holothuroidea suggest that this class also was derived from a primitive pelmatozoan. At an early stage the creature took to locomotion in the direction of the mouth, with consequent worm-like lengthening of the body, possibly facilitated by the less calcified integument. Already in Middle Cambrian shales are found the compressed imprints of soft-bodied animals with apparent holothurian structure. The closure of the food-grooves, the elaboration of mouth-tentacles, the suppression of the unused podia on the back, and the retention of the single genital gland with its

poore were all natural consequences of this mode of life. Spicules ascribed to holothurians have been found fossil from the Carboniferous onwards, but the general absence of other skeletal structures prevents one from tracing the history of the class.

NATURAL HISTORY

Echinoderms are sluggish and frequently immobile for considerable periods. The brittle-stars are the most rapid movers. Free forms shun the light and hide or bear a cloak of seaweed by day. Their often brilliant colouring can rarely have protective value. Some sea stars light the depths with glorious phosphorescence, and many littoral brittle stars phosphoresce when stimulated. This also may be a useless by-product of some activity. The general mode of life and nutrition have been mentioned under the various classes, and further details are given under STAR-FISH and SEA URCHIN. Holothurians feed by sweeping minute creatures into the mouth with large shield-shaped tentacles, or by catching them with the slimy surface of buccal tentacles which they push into the mouth and withdraw cleansed. Asexual holothurians live and feed on the ooze breathing by the pedia of the back, which are often monstrously developed. In some holothurians portions of the respiratory trees consist of slime-secreting cells, when irritated, the animal compresses its body and forces the tubes out of the vent, the slime absorbs water and swells enormously finally splitting into sticky threads in which an enemy can be hopelessly entangled. Many animals live in or on echinoderms as mesomates among them are protozoans, sponges, annelids, crustaceans, molluscs, and, most notably, a fish, *Furcifer*, which enters the respiratory trees of holothurians. Parasites are even more numerous. Besides the groups mentioned, they include nematodes, trematodes, a myxomycete, and the myxosomes of uncertain affinity, found chiefly on ctenoids. Many of these unwelcome guests assume the livery of their host, and frequently compel structural changes. A number of brittle stars are symbiotic or parasitic on coelenterates, feather-stars and sea urchins.

Economic Aspects.—In the economy of nature, echinoderms play a larger part than in that of man. The ctenoids and other Pelmatozoa seem useless, yet they have extracted from the sea millions of tons of lime and built up huge masses of rock. Derbyshire marble, Belgian *petit granit*, the *Trochiten-kalk* of Germany and many of the Oolitic freestones are largely formed of their remains. Holothurians in the sea, like earthworms on land, pass the loose detritus perpetually through their bodies, extracting the organic nutrient, and thus acting as cleaners. The same task is performed by many heart urchins, while most of the other free-moving forms, especially the sea-stars, are scavengers on a larger scale. Unfortunately sea stars do not confine themselves to carrion, but attack living molluscs, among them oysters and mussels, doing terrible damage (see STAR-FISH). On the other hand some of the smaller kinds are eaten by bottom-fishes, and thus help to turn nature's waste into marketable food. For the immediate food of man most echinoderms are unsuitable, but some holothurians are used in the east (see BICHE DE MER), and in various parts of the world the ovaries of the larger regular sea urchins are much appreciated. The ease with which the eggs of echinoderms can be fertilized and the early stages of development reared in the laboratory has led to their extensive use as material for research into fundamental problems of life and growth.

History.—During the 18th and first half of the 19th centuries, echinoderms were described by many eminent naturalists. Echinoida by J. T. Klein, C. Linnaeus, N. G. Leske, E. Desor and I. Agassiz, Stelliforma by J. H. Linck, Crinoidea by J. S. Müller, Cystoida by L. v. Buch, but it was the researches of Johannes Müller (1840-50) that laid the foundation for a scientific treatment of the branch. For the host of later writers on this large and varied group, reference must be made to the works cited in the bibliography.

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ECHINOIDEA, a class of the Echinodermata (q.v.), comprising the sea urchins (q.v.), heart-urchins and sand dollars.

ECHINUS, in architecture, a convex moulding, under the ribcuss of a column capital so called from its resemblance, in form, to a sea urchin (Greek *echinos*, echinus). It is universal in both Greek and Roman Doric orders, in which it has a profile of circular or elliptical curvature. Roman examples have a *cyma recta*, double curved (see CYMA) profile. The convex moulding between the volutes of the Ionic order is termed an echinus, as is any similar form in a capital of any style (see ORDER).

ECHIURIDA, a group of marine worms comprising a phylum of the animal kingdom which, in spite of an apparent lack of segmentation, must be considered nearly related to the Annelida (q.v.). Although formerly placed in the obsolete phylum Gephyrea, together with Sipunculida (q.v.) and Priapulida (q.v.), they have little in common with the former while it is probable that supposed relationships with the latter can be altogether discarded.

THE SPOON WORM, A TYPICAL REPRESENTATIVE

Spoon worms (figs 1 and 2) are moderately large, sac-shaped creatures that inhabit U-shaped tubes on sandy mud bottoms. The northern cold water species, *Echinurus echinurus*, is described below as an example.

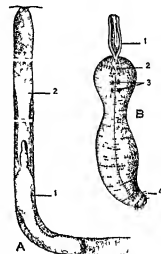


FIG 1—SPOON WORMS

(LATER STAGES AND MACHINERY)
A—*Echinurus echinurus* (1) in its burrow, showing the slime tube (2)

(LATER STAGES)
B—*Echinurus echinurus* (1) Prostomium (2) central setae (3) genital opening (4) anal setae

Setae.—At the anterior end behind the mouth there is a pair of powerful ventral setae which are used in burrowing. At the posterior end there are two incomplete rings of smaller setae, interrupted ventrally, which are used in cleansing the burrow. The setae are exactly similar to those of annelids, each is formed by the secretion of a single basal cell, and when an old worn seta is discarded its place is taken by a new one derived from a reserve follicle. Muscles corresponding to the protractors of an oligochaete move the seta forwards, backwards and sideways, other muscles, including an interbasal, move the two ventral setae apart.

Body Wall.—The skin consists of a simple columnar epithelium which, except on the alined regions of the prostomium, secretes a thin cuticle. The subepidermal connective tissue layer contains yellow

External Characters.—The body consists of a cylindrical trunk which reaches a length of 12 cm or more, and a preoral lobe or prostomium, shaped like a hemispherical fan when fully extended, which is about half as long as the trunk. The prostomium is ciliated on its ventral surface and its margins are fused at the base, forming a funnel around the mouth. During feeding the prostomium is extended over the surface of the surrounding mud, and particles of detritus are swept along ciliary tracks towards the mouth.

The trunk is encased by rings of mucus-secreting papillae, the slime belms used to line the walls of the burrow. The anus is terminal.

Autotomy.—The prostomium is so readily autotomized that few people have ever captured an intact specimen. The musculature of the body wall is thinned in a special autotomization ring behind the mouth and in front of this there is a powerful sphincter muscle which upon sudden contraction, discards the anterior end. The trunk regenerates the missing parts within a few weeks and feeding is then resumed.

and red pigment cells. The muscular coat consists of three layers, circular, longitudinal and oblique, of which the longitudinal are most strongly developed. A peritoneum separates the body wall from the spacious coelom.

Body Cavities.—The cavity of the prostomium is a system of canals and lacunae which are separated from the true body cavity by an incomplete partition, the diaphragm. They are provided with an endothelial lining, and coelomic fluid moves freely between the two compartments, yet it can be shown that the prostomial cavity is derived from the embryonic blastocoel which develops a secondary connection with the coelom (fig. 3). On this account F. Baltzer has likened the body of an echiurus to a chimaera in which the anterior part is larval and the posterior part adult.

Coelomic Fluid.—The coelomic fluid contains two types of cells, spherical erythrocytes which, in the Californian species *Urechis caupo*, are known to contain a respiratory pigment similar to haemoglobin, and amoeboid leucocytes often laden with red-brown pigment granules. In addition, in all but the youngest individuals, there are maturing sex cells. The coelomic fluid thus performs respiratory as well as nutritive and excretory functions. Respiratory exchanges take place in part through the skin, since the worm keeps up a constant flow of water through the burrow by peristaltic contractions of the body. Water is also taken into the anal vesicles and expelled periodically. According to the investigations of A. C. Redfield and M. Florin, the properties of *Urechis* haemoglobin are such that it serves as a reservoir, giving up its oxygen to the tissues only during periods of deficiency when the worm is confined to its burrow by exposure at low tide.

The coelomic fluid of *Echiurus* is isotonic with the sea water in which it lives and, as is commonly the case among invertebrates, contains no plasma proteins in solution.

Digestive System.—The mouth communicates with the pharynx, which makes a double loop in the region of the diaphragm, a thick-walled oesophagus is dilated posteriorly to form a crop in which the food bolus is moulded. These parts, constituting the fore-gut, are of ectodermal origin. The endodermal mid-gut is separated from the fore-gut by a sphincter, it is divided into three regions, the pre-mid- and post-intestine. The mid-intestine is accompanied by an accessory tube of smaller diameter which is continuous before and behind with an open ciliated groove. This accessory tube or apophysis is of unknown function and, although similar structures occur in many related groups, as for example among polychaetes (Capitellidae) and sea-urchins, its presence is considered to be one of the more distinctive features of the Echiurida. The post-intestine opens into a short anal tube, also of endodermal origin. Both mid- and post-intestine are strongly coiled and convoluted. The intestinal juice is alkaline and contains a powerful proteolytic enzyme. A lipase is also present but evidence for an amylase is inconclusive.

Excretory Organs.—The anal tube receives a pair of endodermal sacs, in the newly metamorphosed larva these sacs communicate with the coelom, each by a single nephro-stome, in the adult the number of nephro-stomes is great increased and the anal vesicles are highly characteristic of the phylum. They absorb bacteria, toxins, and respiratory functions, and since they are provided with typical nephro-stomes, they probably represent a posterior pair of metanephridia.

Vascular System.—The vascular system is closed, a ventral vessel runs the whole length of the trunk above the nerve cord and bifurcates anteriorly to form a ring around the margin of the prostomium. A short dorsal vessel, confined to the anterior part of the body, receives blood from the ventral vessel by way of a suture surrounding the mid-gut. It pumps the blood forward into a median prostomial vessel which communicates anteriorly via the marginal loop with the ventral vessel. The blood is colourless and contains only phagocytic amoebocytes.

Nervous System.—There is a ventral nerve cord in which, in the adult, no separate ganglia can be recognized. It divides anteriorly, and the circum-pharyngeal connective joins a long drawn-out loop

which follows the margin of the prostomium. There are no special enlargements of cerebral ganglia. The ventral nerve cord arises embryonically by the union of two ectodermal thickenings and, in *Echiurus*, exhibits 16 transitory ganglionic masses. In *Urechis* the number of these supposedly primary trunk ganglia is only 13 (fig. 3).

Sense Organs.—Groups of sensory cells which may be either tactile organs or chemoreceptors underlie the epidermis and are especially abundant along the margins of the prostomium. Special sense organs are lacking in the adult, but eye spots are present in the larva.

Reproductive System.—In *Echiurus* the sexes are separate but superficially alike. The gonad is suspended from the ventral vessel and the sex products are shed into the coelom during the early stages of their formation. The fertilized eggs grow from 0.01 to 0.2 mm in diam nourished by the coelomic fluid, and are then taken up by the ciliated funnels of the storage organs. In some genera like *Bonellia*, the developing ovum is enclosed in a follicle and nutrition is mediated by a special cap of nurse cells. In males the sperm clusters also develop in the body cavity and the liberated spermatozoa are collected as they become mature and free swimming.

There are two pairs of gonoducts, or storage organs, in *Echiurus*, opening to the exterior behind the ventral setae. They are regarded as modified metanephridia and each is provided with a bilobed ciliated funnel which gathers up the mature sex cells and a large thin-walled sac which serves as a storage chamber. In this genus as in the majority of echiurids, the funnel opens into the storage chamber close to its ectal end, in a Japanese species, *Ikeda taenoides*, the funnel is at the ental (internal) end of the sac, presumably a more primitive condition. In some genera (*Urechis*, *Ockelostoma*) the lips are drawn out into spirally twisted, whip-like processes.

Development.—The most complete study is that of W. W. Newby on *Urechis*. Fertilization is external and the early stages show a spiral cleavage similar to that of Platyhelminthes, Mollusca and Annelida. A typical "Annelidan Cross" is formed from cells of the first quartet, but the later stages show a predominance of supposedly molluscan features. Thus the blastopore, pushed forward ventrally by the expansion of the somatic plate, forms only the mouth. In typical annelids the somatic plate, as it grows downward on each side, unites ventrally to divide the blastopore into a mouth forming and an anus-forming region. Although mesoblastic teloblasts are absent in the better known European and North American species, C. N. Dawydoff

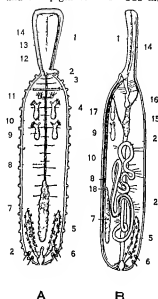


FIG. 2.—ANATOMY OF ECHIURUS. (A) VENTRAL VIEW. (B) SIDE VIEW. (1) Prostomium. (2) Alimentary tract (cut off in fig. A). (3) Diaphragm. (4) Paillia. (5) Anal setae. (6) Gonad. (7) Ventral nerve cord. (8) Storage organs. (9) Lateral blood vessel. (10) Dorsal blood vessel. (11) Dorsal alimentary tract. (12) Dorsal mesenteric vessel. (13) Ventral mesenteric vessel. (14) Acoustic gut.

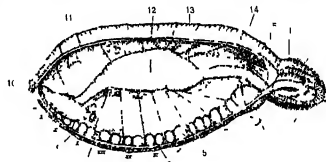


FIG. 3.—URECHIS CAUPO. STEREOGRAM OF A 50 DAY LARVA. (1) Prostomium. (2) Cerebral ganglion and portion of connectives. (3) Blastopore (prostomial cavity). (4) Anterior seta. (5) Ventral nerve cord. (6) Mesenteric filaments. (7) Anus. (8) Coelomic funnel. (9) Anal seta. (10) Anus. (11) Intestine. (12) Larval stomach (postoral portion). (13) Larval stomach (preoral portion). (14) Oesophagus. (15) Diaphragm.

has described the appearance of two teloblasts and a transient metamorphosis of the mesoderm in the giant larva of an unidentified echiurus from the coast of Annam. In the better known species growth in length is achieved by intercalary expansion of the trunk region and not by the teloblastic addition of segments at the posterior end.

The embryo develops into a free swimming trochophore of the annelidan type, provided with a pair of larval protonephridia.

OTHER ECHIURIDA

The group is a small one comprising about 17 genera with 60 or 70 species described in the literature. The classification adopted below is that proposed by S. Bock (1942) who recognizes three families.

(1) **Echiuridae.**—This family is typically represented by the circum-arctic species *Echiurus echiurus*, described above. The sexes are alike and there are one (*Urechis*) or two rings of anal setae. *Urechis* presents some interesting and rather aberrant features. The prostomium is relatively small and is not used as a feeding organ, food is captured by means of a slime tube (fig. 1A) secreted periodically by a glandular girdle, which filters the water as it is swept through the burrow by peristaltic contractions of the body. The slime tube, together with its catch, is then eaten. It has been estimated that the net must have a mesh with pores of 36 to 40 Angstrom units, since molecules of ovalbumin can pass through while those of serum albumin are partly, and those of haemocyanin completely re-

tained *Urechis* has sometimes been placed in a separate family or subfamily on account of the complete absence of a vascular system. Another peculiar feature is the absence of a definitive gonad; the sex cells are found free in the coelomic fluid from their earliest identifiable stages.

(2) *Thalassematidae*.—Members of this predominantly tropical and subtropical family are distinguished from the Echiuridae primarily by an absence of anal setae. Some thalassematids inhabit the shells of sea-urchins or sand dollars and there are estuarine species from India and Burma which have gill-like processes on the margins of the prostomium. *Arhychile* is a Japanese genus in which the prostomium is completely lacking and Ikeda claims to have shown that this is not, as one might suppose, the result of autotomy. In other genera the prostomium is usually very long and the apical portion, the prostoma of Ikeda's term, were at one time mistaken for nemertean worms. The most primitive arrangement of the storage organs is found in the genus *Ochetostoma* in which there is a metameric repetition of several, usually three pairs in sequence, strongly suggestive of ventral segmentation. In *Thalassoma* (s.s.) the number has become restricted to one or two pairs, as in the Echiuridae. A culmination of this evolutionary trend is found in some of the Bonelliidae, in which only a single organ remains. On the other hand *Ikedaella* has as many as seven or eight pairs, and several of them are represented by groups of organs; it is evident that some of the embryological rudiments have undergone a local, nonmetameric multiplication. This process has advanced so far in *Ikeda*, which has 200 to 400 organs, that all trace of metameric pairing is obliterated.

(3) *Bonelliidae*.—Members of this family are characterized by a pronounced sexual dimorphism. The males are minute and live as parasites upon or within the body of the female. They may be found developing in the pharynx, on the prostomium or attached to the skin and, when mature, they migrate into an antechamber of the storage organ (*Bonellia*) or are otherwise accommodated. In *Pseudobonellia* there is a special invagination or male tube, between the genital pores, the relatively large male of *Acanthohammingia* is found in the body cavity, in *Maxmulleria* the males have not yet been discovered. Except in the possession of functional reproductive organs, the dwarf males present a combination of degenerate and persistent larval features. There is no prostomium and the mid-gut is closed at both ends. A single collecting funnel opens in the male *Bonellia*, into the blind fore gut which functions as a sperm reservoir while the spermatozoa are discharged through the mouth. The excretory organs are a pair of larval metanephridia which do not disappear as they do in the females of nearly all genera.

Females of the Bonelliidae are typical echiurids; anal setae are always lacking and an important character is that the nephrostomes are not sessile but communicate with the anal vesicles by tubules. The majority of species are of an intense green colour, the pigment, known as bonellin, is a mesoporphyrin, chemically a degradation product of chlorophyll. It has been suggested that it is a warning colour, or that it may be distasteful since the green tissues are usually rejected by predators and are poisonous to various invertebrates when eaten. The long, ribbonlike prostomium is frequently deeply cleft or bifurcated but there are, three or four genera in which it is simply truncate, as for example in *Protobonellia* and *Maxmulleria*. Ventral setae are lacking in a few forms, like *Hammingia* and *Ikedaella*, so that these species are completely sessile and are completely sessile.

On the other hand *Acanthohammingia* has numerous very minute ventral setae. *Archibonellia* retains a pair of larval metanephridia and *Sclaterina* is said to be without accessory gut.

Sex-determination in Bonelliidae—*oolinids* have long been interested in this problem and many outstanding contributions have been made, especially by F. Baltzer and C. Herbst. In *tracheophora*, becomes transformed into an indifferent larva (fig. 5). It is in the prostomium of a female larva becomes attached and remains for several days (*B. turgida*) during which period a gradual metamorphosis towards the male condition takes place. It can migrate to the fore gut and from there to the antechamber of the female storage organ, where it remains for at least one breeding season. On the other hand, larvae that develop in sea water usually become females. However, the presence of female extracts, from the fore gut or prostomium,

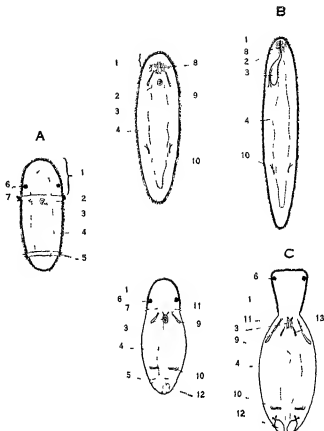


FIG. 5.—*BONELLIA VIRIDIS* LARVAL DEVELOPMENT OF MALE AND OF FEMALE.

A Indifferent larva B Metamorphosed male C Young female (1) Prostomium (2) Glands (3) Fore gut rudiment (4) Mid gut (5) Anal ciliated ring (6) Eye spot (7) Prostom ciliated ring (8) Male gonoduct homologous with mouth invagination of female (C 12) (9) Protonephridia (10) Metanephridia (11) Epidermal muscle invagination (12) Anal setae, (13) Ventral setae.

will stimulate male transformation. The active principle, which resists boiling and is probably not a protein, has not been identified. Moreover, a diversity of foreign agents such as acids, potassium, heavy metals, glycerine and even shaking or transference from Mediterranean to North sea water, have been shown to induce masculinization.

The simple facts, outlined above, appear to justify the view that all larvae are potentially bisexual and that the male response is elicited by a variety of different stimuli and is therefore, fundamentally, an irritability. The investigations of Baltzer have shown that when larvae are removed prematurely from the female prostomium they exhibit various stages of male transformation. The degree of intersexuality is approximately correlated with the duration of the attachment period but, since extracts also elicit a graded series of transitional types, it appears probable that organs in the mouth region have a lower threshold towards the male inducing substance than have those situated more posteriorly. Baltzer advanced the view that male transformation is essentially an inhibition. The stimulatory action of potassium led Herbst to suggest, in view of the known effect of these ions in increasing cellular permeability, that an increased water uptake might be the masculinizing agent, and this hypothesis received support from the antagony of action of calcium. Later Herbst suggested that glycerine derived from the metacolibolus fat in the larval gut must play some role. R. Goldschmidt attempted to bring the facts in line with his famous theory of sex determination while M. Hartman has pointed out similarities with the phenomenon of sex-reversal in the polychaet *Ophryotrocha*.

DOUBTFUL GENERA AND RELATIONSHIPS

Two genera which were formerly placed among the Echiuridae are now definitely excluded. *Sternaspis* is a polychaet, and "*Epithetovum*" a nemertean of the genus *Micrura*.

Saccosomatidae.—*Saccosoma* has been removed by S. Back to a separate order, the Saccosomatinae, of doubtful echiuran status. The species has not been seen since its original discovery. It is said to possess one pair of storage organs but to lack proboscis, setae, anal setae and blood vessels. The body musculature is in reverse order to that found in true echiurids.

Pocobidae.—*Porosus* is a laterally compressed, bathypelagic species regarded by its discoverer, H. Heath, as a connecting link be-

tween Echiurida and Annelida. Interpretation of its anatomy is complicated by the fact that no known echiurids are adapted for a pelagic mode of life. There are no setae. The prostomium may be represented by a pair of grooved tentacles but, in addition, there are five pairs of cirri. Structures resembling anal vesicles are present, but without nephrostomes, and there is a single pair of metanephridia not known to function as storage organs. The ventral nerve cord is strangely annelidan, with 11 metameric pairs of ganglia. Septa are lacking.

Relationships.—The Echiurida have many features in common with the Annelida. Distinctive features of the group are the apparent lack of segmentation and the persistent "larval" anterior end which forms the proboscis-like prostomium. It is by no means certain that the lack of segmentation is primary, although W. W. Newby favoured this view. Evidence of suppressed segmentation may be derived from the appearance of triramous ganglia in the ventral nerve cord, from the varying number of setal groups, and from a metameric interpretation of the storage and excretory organs. Molluscan features are evident in early development and for this reason it is difficult to regard the Echiurida as a degenerate class of the Annelida. Molluscan affinities have also been suggested for the Sipunculida, another unsegmented phylum unrelated to the Annelida but widely different from the Echiurida. Echiurids are clearly more primitive, as shown by the half larval character of their body, and more annelidan than the sipunculids, as shown by the possession of setae and by the terminal position of the anus. Relationships with the Prapulida are extremely doubtful since the body cavity of the latter is probably a pseudocoel.

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ECHMIADZIN, (1) a monastery in the Armenian SSR, in 40° 12' N, 44° 19' E, the seat of the *Catholicos* or primate of the Armenian church. It is situated close to the village of Vagharshapat, in the plain of the Aras, 2,840 ft above the sea, 12 mi west of Erivan and 40 north of Mount Ararat. The monastery comprises a complex of buildings, surrounded

by brick walls 30 ft high, which with their loopholes and towers present the appearance of a fortress. Its architectural character has been considerably impaired by additions and alterations in modern Russian style. On the western side of the quadrangle is the residence of the primate, on the south the refectory (1730-35), on the east the lodgings for the monks and on the north the cells. The cathedral is a small but fine cruciform building with a Byzantine cupola at the intersection. Its foundation is ascribed to St. Gregory the Illuminator in 302. Of special interest is the porch, built of red porphyry and profusely adorned with sculptured designs somewhat of a Gothic character. The interior is decorated with Persian frescoes of flowers, birds and scrollwork. It is here that the primate confers episcopal consecration by the sacred hand (relic) of St. Gregory, and here every seven years he prepares the holy oil which is to be used throughout the churches of the Armenian communion. Outside the main entrance are the alabaster tombs of the primates Alexander I (1714), Alexander II (1755), Daniel (1806) and Narses (1857) and a white marble monument erected by the English East India company to mark the resting place of Sir John Macdonald Kinner, who died at Tiflis in 1830 while on an embassy to the Persian court. The library of the monastery is a rich storehouse of Armenian literature (see Brossel's *Catalogue de la bibliothèque d'Echmiadzin* [St. Petersburg, 1840]). Among the more remarkable manuscripts are a copy of the gospels dating from the 10th or 11th century and three Bibles of the 13th century. A type foundry, a printing press and a bookbinding establishment are maintained by the monks, who supply religious and educational works for their coreligionists.

To the east of the monastery is a modern college and seminary. Half a mile to the east stand the churches of St. Ripsime and St. Gaiana, two of the early martyrs of Armenian Christianity, the latter is the burial place of those primates who are not deemed worthy of interment beside the cathedral. From a distance the three churches form a fairly striking group, and accordingly the Turkish name for Echmiadzin is Uch-Kilissi, or 'The Three Churches'. The town of Vagharshapat dates from the 6th century A.D., it takes its name from King Vagarsh (Vologases), who in the 2nd century A.D. chose it as his residence and surrounded it with walls. There the apostle of Armenia, St. Gregory the Illuminator, erected a church in 309, and with it the primacy was associated. In 344 Vagharshapat ceased to be the Armenian capital, and in the 5th century the patriarchal seat was removed to Dvin and then to Ani. The monastery was founded by Narses II, who ruled 524-533, and a restoration was effected in 618. The present name of the monastery was adopted instead of Vagharshapat in the 10th century. At length in 1441 the primate George brought back the see to the original site.

(2) An administrative district of the Armenian SSR, with an area of 3,500 sq km and a population of 113,935, mainly rural Vagharshapat (see above) is the centre, population 8,035. The district suffers severely from drought, but a scheme of irrigation is now being inaugurated which should greatly increase the cotton production of the region.

ECHO, a sound reflected from an obstacle, personified in later Greek mythology as a mountain nymph or oread (not before Euripides). In Ovid (*Metam.* II, 356 ff.) she defied Hera by keeping her talking and thus preventing her spying on an amour of Zeus, in punishment, she was deprived of speech, save the power to repeat the last words of another. A hopeless love for Narcissus (*q.v.*) made her fade away to a voice only. In Longus (II, 23), she rejected Pan's advances, he thereupon drove the shepherds mad, and they tore her in pieces, Earth buried her limbs and allowed them still her power of sound.

See Roscher's *Lexikon*, article "Echo."

ECHTERNACH, a town in northeast Luxembourg on the Sire 18 mi NE of the city of Luxembourg. Pop. (1947) 3,141. Echternach was the centre from which the English St. Willibrord converted the people to Christianity in the 7th century. A Benedictine abbey is represented mainly by an old Romano-Gothic church. The hospital-alms-house is said to be the oldest in Europe save the Hôtel Dieu in Paris. The Benedictine abbey has been greatly shorn of its original dimensions. The basilica was destroyed in 1944 but a new one was begun in 1949 and dedicated in 1953.

The Church of SS Peter and Paul contains the remains of St. Willibrord and stands on an isolated mound, it is reached by 60

steps which are the scene of a remarkable ceremony on Whit-Tuesday. The religious procession (300 singers) under the bishop of Luxembourg, chants St. Willibrord's hymn, it is followed by a miscellaneous band which plays the old German air "Adam Had Seven Sons." Next come the dancers, who take three steps forward and two steps back up the 60 steps. The procession is thus a considerable strain on those who partake but, as the saint is reputed to cure epilepsy, St. Vitus' dance and other illnesses many sick persons try to reach the church. It is said that the ceremony dates from a cholera epidemic of the 13th century. King William I of the Netherlands tried to change the day from a Tuesday to a Sunday, so as to avoid loss of a full working day, but the old order re-established itself.

ECIJA, a town of Andalusia, southern Spain, 48 mi. ENE of Seville. Pop. (1940) 25,165 (mun. 34,944). Ecija lies on the left bank of the river Genil, which is navigable to this point, and is the centre of a fertile district producing mainly olives and cereals. The heat in summer is so great that the spot is known as El Sarten, or the "frying pan" of Andalusia. Long famous for its shoemakers, Ecija also manufactures olive oil, soap, flour and preserves.

The city, once enclosed by walls, now in ruins, is chiefly remarkable for its Moorish gateways, its church towers studded with glazed tiles, its many fine balconied and decorated mansions and its chief square surrounded by colonnades and planted with acacias. It also possesses 20 convents, now mostly secularized. Ecija, called Estadja by the Arabs, is the ancient Astigi, which was raised to the rank of a Roman colony with the title of Augusti Firma and became so flourishing a centre that Pliny and Pomponius Mela, writing in the 1st century A.D., described it as the rival of Córdoba and Seville. Local tradition maintains that it was visited by the apostle Paul, who converted his hostess, St. Xantippe, according to one version of his life, it was the see of St. Crispin in the 3rd century.

ECK, JOHANN MAIER (1486–1543), German theologian, the most indefatigable and important opponent of Martin Luther, was born on Nov. 13, 1486, at Eck, Swabia. His father, Michael Maier, was a peasant and bailiff (*Amtmann*) of the village, his uncle Martin Maier, parish priest at Rothenburg on the Neckar, sent him at the age of 12 to the university of Heidelberg, later on to Tübingen, Cologne and Freiburg-im-Breisgau. At the age of 24 he was already doctor and professor of theology. During this period he was known as an opponent of the scholastic philosophy, and, though he did not go to all lengths with the "modernists" (*moderni*) of his day, his first work—*Logices exercitationes* (1507)—was on their side, an attitude which brought him into conflict with the university senate. His position in Freiburg becoming intolerable he accepted in 1510 an invitation from the duke of Bavaria to fill the theological chair at Ingolstadt, where he was destined for 30 years to exercise a profound influence as teacher and vice-chancellor (*Prokanzler*).

A dual commission, appointed to find a means for ending the interminable strife between the rival academic parties, entrusted Eck with the preparation of fresh commentaries on Aristotle and Petrus Hispanus, and between 1516 and 1520, in addition to his other duties, he published commentaries on the *Summulae* of Hispanus, and on the *Dialectics*, *Physics* and lesser scientific works of Aristotle, which became the textbooks of the university. These commentaries are inspired with much of the scientific spirit of the new learning, but he had not sympathy with the revolutionary attitude of the reformers. He had won laurels in a public disputation at Augsburg in 1514, when he had defended the lawfulness of putting out capital at interest against the Bolognese thesis on the same subject and on the question of usury, and these triumphs had been renewed at Vienna in 1516. These successes gained him the patronage of the Emperor and he found himself fairly launched as the recognized protagonist of the established order in church and state. The first fruits of this new position being a quite gratuitous attack on his old friend the distinguished humanist and jurist Ulrich Zasius (1461–1536), for a doctrine proclaimed ten years before and a simultaneous assault on Erasmus's *Annotationes in Novum Testamentum*.

Luther sent to Eck in 1517 copies of his celebrated 95 theses. Eck made no public reply, but, in 1518 he circulated, privately at first, his *Obelisci*, in which Luther was branded as a Hussite. Luther entrusted his defense to Carlstadt, who answered Eck in 400 distinct theses, and declared his readiness to meet him in a public disputation, which took place at Leipzig in 1519. On June 27 and 28 and on July 1 and 3 Eck disputed with Carlstadt on the subjects of grace, free will and good works, ably defending the Roman standpoint, from July 4 to 14 he engaged with Luther on the absolute supremacy of the papacy, purgatory, penance, etc., showing a brilliant display of patristic and conciliar learning against the reformer's appeals to Scripture. The arbitrator, declined to give a verdict, but the general impression was that victory rested with Eck. He made Luther admit that there was some truth in the Hussite opinions and declare himself against the pope. He induced the universities of Cologne and Louvain to condemn the reformer's writings, but failed to enlist the German princes, and in Jan. 1520 went to Rome to obtain strict regulations against those whom he called "Lutherans." He was created a protonotary apostolic, and in July returned to Germany, as papal nuncio, with the bull *Exsurge Domine* directed against Luther's writings. He now thought that he could crush not only the Lutheran heretics but also his humanist critics. The effect of the publication of the bull, however, soon deceived him, and he was glad to escape from Saxony with a whole skin. In his wrath he appealed to force, and his *Epistola ad Carolum V* (Feb. 18, 1521) called on the emperor to take measures against Luther, a demand soon to be responded to in the edict of Worms. In 1521 and 1522 Eck was again in Rome, reporting on the results of his nunciature. On his return from his second visit he was the prime mover in the promulgation of the Bavarian religious edict of 1522, which led to years of persecution. In return for this action of the duke, Eck obtained for him, during a third visit to Rome in 1523, valuable ecclesiastical concessions. Meanwhile he published eight considerable polemics between 1522 and 1526.

Luther declined to answer his arguments, and Eck turned his attention to Switzerland and the Zwinglians. At Baden in Aargau in May and June 1526 a public disputation on the doctrine of transubstantiation was held, in which Eck and Thomas Murner were pitted against Johann Oecolampadius. Though Eck claimed the victory in argument, the only result was to strengthen the Swiss in their memorial view of the Holy communion, and so to diverge them further from Luther. At the Augsburg diet in 1530 Eck was charged by Charles V to draw up, in concert with 20 other theologians, the refutation of the Protestant confession. He was at the colloquy of Worms in 1540 and at the diet of Regensburg (Ratisbon) in 1541. At Worms he showed some signs of a willingness to compromise, but at Regensburg he persuaded the Catholic princes to reject the Interim.

Eck died at Ingolstadt on Feb. 10, 1543. He was a powerful debater, but his victories were those of a dialectician rather than a convincing reasoner, and in him depth of insight and conviction were ill replaced by the controversial violence characteristic of the age. His chief work was *De primatu Petri* (1519), his *Enchiridion locorum communium adversus Lutherum* ran through 46 editions between 1525 and 1576. In 1530–35 he published a collection of his writings against Luther, *Opera contra Luderum*, in 4 vols. See also LUTHER, MARTIN.

See T. Wiedemann, *Dr. Johann Eck* (Regensburg, 1865).

ECKERMANN, JOHANN PETER (1792–1854), German

jurist and statesman. He was born at Göttingen on Oct. 1, 1792. He studied law at Göttingen and Berlin, and was called to the bar in 1815. He was a member of the Prussian House of Representatives from 1821 to 1825. He was a member of the grand ducal council and appointed librarian to the grand duchess. Eckermann is chiefly remembered for his

contributions to the knowledge of Goethe contained in his *Conversations with Goethe* (1836-48) To Eckermann Goethe entrusted the publication of his *Nachgelassene Schriften* (posthumous works) (1833-33) He was also joint editor with Friedrich Wilhelm Riemer (1774-1845) of the complete edition of Goethe's works in 40 vols (1839-40) He died at Weimar on Dec 3, 1854

Eckermann's *Gespräche mit Goethe* (vols 1 and 2, 1836, vol 1, 1848, 7th ed, 1899, edit by L Geiger, 1902) have been translated into almost all the European languages, not excepting Turkish (Eng trans by Margaret Fuller, Boston, 1839, and John Oxford, London, 1850) His "remains" were edited by F Tewes in vol 1 of *Aus Goethes Lebenskreise* (1905) See Petersen, *Die Entstehung der Eckermannschen Gespräche* (1924), Houder, *J P Eckermann, Sein Leben für Goethe* (1925), based on recently discovered letters and diaries

ECKERNFORDE, a town of Germany, in the *Land* of Schleswig Holstein, on a fiord of the Baltic sea 20 mi by rail NW from Kiel Pop (1949) 23,996 It has a good harbour, fishing, trade in agricultural products and manufactures of tobacco, salt and iron goods There is a technical school Eckernforde was taken by Christian IV of Denmark in 1628 from the imperial troops In 1833 the Danes were defeated there The place lost most of its trade after the union with Germany in 1864 and suffered severely from a sea flood in 1872 In the immediate neighbourhood is Borby, popular for sea bathing

ECKERSBERG, KRISTOFFER (1783-1853), Danish painter, was born at Warnitz on Jan 2, 1783 He studied in Paris under J L David, and then went to Rome, where he worked until 1826 in close fellowship with Thorvaldsen His paintings from this period—"The Spartan Boy," "Bacchus and Anadine" and "Ulysses"—testify to the influence of the great sculptor After his return to Denmark his chief work was done in landscape and sea painting It is claimed for Eckersberg by the native critics that "he created a Danish colour," that is to say, he was the first painter who threw off conventional tones and the pseudo classical landscape, in exchange for the clear atmosphere and natural outlines of Danish scenery Eckersberg died on July 22, 1853, at Copenhagen, where he was professor at the academy

ECKHART, JOHANNES ["MEISTER ECKHART"] (1260?-1327), German philosopher, the first of the great speculative mystics of the West, was born at Hochheim, near Gotha He entered the Dominican order and in 1302 became a master of theology at Paris Two years later he was made provincial of his order for Saxony, and in 1307 vicar general for Bohemia In both provinces he was distinguished for his practical reforms and for his power in preaching

Released from his offices in 1311, Eckhart taught in Paris until 1324, when he was sent to Strasbourg Later he was transferred to Cologne, where, in 1326, the archbishop took proceedings against his doctrines In the following year, that of his death, Eckhart publicly declared his orthodoxy and appealed to Pope John XXII In 1329, 28 of his propositions were condemned by the Holy See

Eckhart has been termed a scholastic mystic, rather than a mystical scholastic, because he colours the Aristotelian elements in Aquinas with the mysticism of the pseudo-Dionysius The two most important doctrines in his, as in all mystical systems, are those of the Divine nature and of the relation between God and creatures, especially the human soul

For Eckhart, God is the absolute and infinite Being best characterized as nothing on the ground that His simplicity is irreconcilable with a plurality of predicates If any attribute could be ascribed to Him, it would be the *esse* implied in the scriptural *Ego sum qui sum*, though strictly speaking, God is, rather than *has, esse* In spite of this assertion that the Divine essence and existence are identical, Eckhart goes on to declare that apart from the Divine existence there is nothing *Ens tantum unum est et Deus est* Every creature has its own essence, but its existence is that of God, and God and the creature are more closely related than matter or form or the parts and the whole In addition to this pantheistic leaning, the statement that at the

same time that God engendered His Son, co eternal and equal to Himself, He created the world, brought Eckhart's orthodoxy under suspicion The statement may not apply to the exterior effect of the eternal act of God, but Eckhart's interpretation of the *in principio* of Genesis as the *nunc aeternitatis* suggests that it does

Although the Divine existence permeates all being, it is regarded by Eckhart as especially manifested in the human soul, whose end is union with God This union is to be accomplished through knowledge The soul must first understand that creatures in themselves are nothing, and then, having perceived the continuity of its being with the Divine being, it can dispense with the external means of salvation and abandon itself to God, Who finds in it His own existence

Eckhart's style is unsystematic and abounding in symbolical expression, but his successful exposition of scholastic doctrines in an undeveloped tongue has made him the father of German philosophical language

For the German writings of Eckhart see F Pfeiffer, *Deutsche Mystiker*, vol II (Lübeck, 1857, Eng. trans by C B Evans 1904), for the Latin works, H Denifle in *Archiv f. Litt. u. Kirchengeschichte d. Mittelalters*, n (1886), German translations by G Landauer (Berlin, 1903), and Buttner (Leipzig, 2 vols, 1917), M Grabmann, "Neuaugefundene Pariser Quaestiones Eckharts," in *Abhandl. d. Bayer. Akademie der Wiss.* (1917), E Longpre, "Quaestiones inédites de maître Eckhart," in *Rev. Neoschol.* (1921), A Daniels, *Eine lateinische Rechtfertigungsschrift des Meisters Eckhart* (Münster, 1921) and G Thery, "Edition critique des pièces relatives au procès d'Eckhart," in *Arch. d'hist. doctrinale et litt. du moyen âge* 1 (1926) See further A Læssle, *Meister Eckhart der Mystiker* (1868), W Preger, *Geschichte d. deutschen Mystik*, 3 vols (1874-92), H Delacroix, *Le Mysticisme spéculatif en Allemagne au XIV^e siècle* (Paris, 1900), A Spamer, "Zur Überlieferung der Pfeifferschen Eckharttexte," in *Beitr. z. Gesch. d. deutschen Sprache* (1908) and in the same periodical for 1909, M Pahnke, "Untersuchungen zu den deutschen Predigten M. Eckharts," F Strauch, *Meister Eckhart Probleme* (Halle, 1912), X de Hornstein, *Les grands Mystiques allemands du XIV^e siècle* (Lucerne, 1922), O Karras, *Meister Eckhart* (Munich, 1926), Uebowies, *Grundriss der Gesch. der Phil.*, bd II, containing a full bibliography (1928) (See MYSTICISM)

ECKHELL, JOSEPH HILARIUS (1737-1798), Austrian numismatist, born at Enzersfeld lower Austria, was for over 20 years professor of antiquities and numismatics at the university of Vienna, and keeper of the imperial cabinet of coins Eckhell's great work is the *Doctrina numorum veterum* (8 vols., 1792-98) Out of the mass of previously loose and confused facts Eckhell constituted a true science A volume of *Addenda*, prepared by Steinhuebel from Eckhell's papers after his death, was published in 1826 He died at Vienna on May 16, 1798

ECKMUHL or EGGMUHL, a village of Germany, in Bavaria, on the Grosse Laaber, 13 km SE of Regensburg by the rail way to Munich It is famous as the scene of a battle fought here on April 22, 1809, between the French, Bavarians and Wurtembergers under Napoleon, and the Austrians under the archduke Charles, which resulted in the defeat of the latter Napoleon, in recognition of Marshal Davout's great share in the victory, conferred on him the title of prince of Eckmühl For an account of this action and those of Abensberg and Landshut see NAPOLEONIC CAMPAIGNS

ECLLECTICISM, a term used specially in philosophy and theology for a composite system of thought made up of views chosen from various other systems (from Gr *ἐκλέγω*, I select) Where the characteristic doctrines of a philosophy are not thus merely adopted, but are the modified products of a blending of the systems from which it takes its rise, the philosophy is not properly eclectic Eclecticism always tends to spring up after a period of vigorous constructive speculation, especially in the later stages of a controversy between thinkers of pre-eminent ability Their respective followers, and more especially cultured laymen, lacking the capacity for original work, seeking for a solution in some kind of compromise, and possibly failing to grasp the essentials of the controversy, take refuge in a combination of those elements in the opposing systems which seem to afford a sound practical theory Since these combinations have often been as illogical as facile, "eclecticism" has generally acquired a somewhat con-

temptuous significance. At the same time, the essence of eclecticism is the refusal to follow blindly one set of formulae and conventions, coupled with a determination to recognize and select from all sources those elements which are good or true in the abstract, or in practical affairs most useful *ad hoc*. Theoretically, therefore, eclecticism is a perfectly sound method, and the contemptuous significance which the word has acquired is due partly to the fact that many eclectics have been intellectual trimmers, sceptics or dilettanti, and partly to mere partisanship. On the other hand, eclecticism in the sphere of abstract thought is open to this main objection that, in so far as every philosophic system is, at least in theory, an integral whole, the combination of principles from hostile theories must result in an incoherent patchwork. Thus it might be argued that there can be no logical combination of elements from Christian ethics with its divine sanction and purely intuitional or evolutionary ethical theories, where the sanction is essentially different in quality. It is in practical affairs that the eclectic or undogmatic spirit is most valuable, and also least dangerous.

In the 2nd century B.C. a remarkable tendency toward eclecticism began to manifest itself. The longing to arrive at the one explanation of all things, which had inspired the older philosophers, became less earnest, the belief indeed, that any such explanation was attainable began to fail. Thus men came to adopt from all systems the doctrines which best pleased them. In Panaetius we find one of the earliest examples of the modification of Stoicism by the eclectic spirit, about the same time the same spirit displayed itself among the Peripatetics. In Rome philosophy never became more than a secondary pursuit, naturally, therefore, the Roman thinkers were for the most part eclectic. Of this tendency Cicero is the most striking illustration—his philosophical works consisting of an aggregation, with little or no blending, of doctrines borrowed from Stoicism, Peripateticism, and the Scepticism of the Middle Academy.

In the last stage of Greek philosophy the eclectic spirit produced remarkable results outside the philosophies of those properly called eclectics. Thinkers chose their doctrines from many sources—from the venerated teaching of Aristotle and Plato, from that of the Pythagoreans and of the Stoics, from the old Greek mythology, and from the Jewish and other Oriental systems. Yet it must be observed that Neoplatonism, Gnosticism, and the other systems which are grouped under the name Alexandrian, were not truly eclectic, consisting, as they did, not of a mere syncretism of Greek and Oriental thought, but of a mutual modification of the two. It is true that several of the Neoplatonists professed to accept all the teaching both of Plato and of Aristotle, whereas, in fact, they arbitrarily interpreted Aristotle so as to make him agree with Plato, and Plato so as to make his teachings consistent with the oriental doctrines which they had adopted, in the same manner as the schoolmen attempted to reconcile Aristotle with the doctrines of the church. Among the early Christians, Clement of Alexandria, Origen and Synesius were eclectics in philosophy.

The eclectics of modern philosophy are too numerous to name. Of Italian philosophers the eclectics form a large proportion. Among the Germans we may mention Wolf and his followers, as well as Mendelssohn, J. A. Eberhard, Ernst Platner, and to some extent Schelling, whom, however, it would be incorrect to describe as merely an eclectic. In the first place, his speculations were largely original, and in the second place, it is not so much that his views of any time were borrowed from a number of philosophers, as that his thinking was influenced first by one philosopher, then by another.

In the 19th century the term "eclectic" came to be applied specially to a number of French philosophers who differed considerably from one another. Of these the earliest were Pierre Paul Royer-Collard, who was mainly a follower of Thomas Reid, and Maine de Biran, but the name is still more appropriately given to the school of which the most distinguished members are Victor Cousin, Théodore Jouffroy, J. P. Damiron, Barthélemy St. Hilaire, C. F. M. de Rémusat, Adolphe Garnier and Ravasson-Mollien. (See COUSIN, VICTOR.)

ECLIPSE When the visibility of a celestial body is prevented or reduced by the passage of a second body, the occurrence is called an eclipse (from Gr. *ελεειναι*, failing to appear). The many eclipse phenomena known to astronomers are of two distinctly different types. In the first of these the eclipsing body comes between the observer and the eclipsed object, and the latter appears to the observer partly or completely covered by the eclipsing body. Eclipses of the sun, occultations of stars by the moon, transits of Venus or Mercury across the sun's disk, and eclipses of binary stars are of this kind. Eclipses of the second type affect only planets or satellites which are not self-luminous, here the eclipsing body intervenes between the sun and the eclipsed object. The latter remains in view of the observer, but its illumination by the sun is interrupted, and it becomes darkened by entering into the shadow of the eclipsing body. Examples of this case are eclipses of the moon and eclipses of the satellites of Jupiter.

To the general public, eclipses of the sun and of the moon are of considerable interest as they are readily observable without a telescope and offer an impressive spectacle. Primitive people are struck with fear by the filling darkness during a total solar eclipse or by the weird sight of the eclipsed moon, even animals are disturbed or frightened. Accounts of such eclipses are found among the oldest records of history, battles have been decided by their unexpected advent and the successful prediction of eclipses constitutes one of the earliest triumphs of the scientific investigation of nature.

- We shall divide the consideration of eclipses as follows:
- I Eclipses of the sun
 - II Eclipses of the moon
 - III Eclipses of the satellites of Jupiter
 - IV Other eclipse phenomena
 - V Prediction and calculation of solar and lunar eclipses
 - VI Phenomena and information yielded by observation of solar eclipses
 - VII Total solar eclipses during the 20th century
- I Eclipses of the sun**—An eclipse of the sun takes place when the moon revolving in its orbit around the earth comes between the earth and the sun so that the moon's shadow sweeps over the

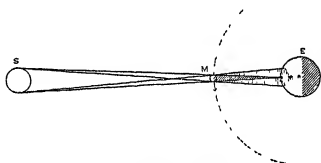


FIG. 1.—ECLIPSE OF THE SUN

The shadow of the moon M sweeps over the surface of the earth E in the darkly shaded region (umbra) the eclipse is total, in the lightly shaded region (penumbra) the eclipse is partial.

face of the earth (see fig. 1). This shadow consists of two parts the umbra or total shadow, a cone into which no direct sunlight penetrates, and the penumbra or half shadow which is reached by light from only a part of the sun's disk.

To an observer who is within the umbra the disk of the sun will appear completely covered by the disk of the moon. Such an eclipse is called *total*. If the observer is within the penumbra, the moon's disk will appear projected onto the sun's disk so as to overlap on it partly, the eclipse is then called *partial*.

As the umbra cone is quite narrow at its intersection with the earth, a total eclipse is observable only within a narrow strip of land or sea over which the umbra passes. A partial eclipse, on the other hand, is visible over the large area covered by the penumbra. Sometimes the earth intercepts the penumbra of the moon but is

missed by its umbra, only a partial eclipse of the sun is then observed anywhere on the earth

By a remarkable coincidence, the sizes and distances of the sun and moon are such that they subtend very nearly the same angle (about $\frac{1}{2}^\circ$) at the earth, but their apparent sizes are not constant. Since the earth revolves around the sun in an elliptical orbit, the distance of the sun varies slightly during the year, and this involves a small change in the angular diameter of the solar disk. In a similar way the apparent size of the moon's disk changes somewhat during the month on account of the elliptical shape of the moon's orbit. Thus when the sun is nearest to the earth and the moon is at its greatest distance the apparent disk of the moon is smaller than that of the sun. If an eclipse occurs at this time the moon's disk passing over the sun's disk may enter completely inside of the latter, leaving the rim of the sun visible all around it. Such an eclipse is called *annular*.

The various phases observable at a total solar eclipse are illustrated in fig 2(A). *First contact* designates the moment when the invisible disk of the moon just touches the disk of the sun. The partial phase of the eclipse then begins as a small indentation in the western rim of the sun becomes noticeable. The dark disk of the moon now gradually moves into the sun's disk and the

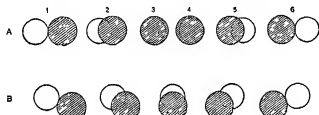


FIG 2—SUCCESSIVE PHASES OF SOLAR ECLIPSE

The dark disk of the moon gradually moves across the disk of the sun from west (right) to east (left). (A) Total eclipse (1) First contact (2) Partial phase (3) Second contact beginning of totality (4) Third contact, end of totality (5) Partial phase (6) Fourth contact (B) Partial eclipse (1) First contact (2) Maximum phase (3) Last contact

sun appears in the shape of a crescent. After about $\frac{1}{2}$ hours the crescent grows very thin and daylight appears somewhat dusky. At the *second contact* the last trace of the sun's crescent disappears and the total phase begins. Within a few seconds all direct sunlight vanishes; it suddenly grows dark, the brightest stars become visible in the sky, and the dark disk of the moon is seen projected onto the pale mysterious halo of the sun's corona—an unforgettable spectacle. The general landscape illumination during totality is considerably brighter than on a night of full moon, but the sudden transition from daylight is most impressive.

Totally never lasts very long, $\frac{7}{8}$ minutes at the utmost. It ends at the *third contact* when the following limb of the moon begins to uncover the western rim of the sun. Daylight returns as suddenly as it vanished, the thin crescent of the sun gradually widens, and about $\frac{1}{2}$ hours later the second partial phase of the eclipse ends at the *fourth contact*, when the last encroachment made by the moon on the sun's rim disappears.

In a partial eclipse, see fig 2(B), the motion of the moon's disk is such that its centre does not pass across the centre of the sun. After the first contact the visible crescent of the sun decreases in width until the centres of the two disks reach their closest approach. This is the moment of maximum phase, and the latter is measured by the ratio between the smallest width of the crescent and the diameter of the sun. After maximum phase the crescent of the sun widens again until the moon passes out of the sun's disk at the last contact.

When observing a partial or annular eclipse it is necessary to protect the eyes against injury by the intense brilliance of the sun. The sun should be viewed only through a dark smoked glass (much darker than those of ordinary goggles) or a darkened photographic plate or film.

II. Eclipses of the Moon.—When the moon moves through the shadow of the earth (see fig 3), it loses its bright direct

illumination by the sun, although its disk still remains faintly visible. This phenomenon is called an eclipse of the moon. As the shadow of the earth is directed away from the sun, a lunar eclipse can occur only at the time of full moon, that is, when the position of the moon is opposite to that of the sun.



FIG 3—ECLIPSE OF THE MOON

The moon revolving in its orbit around the earth passes through the shadow of the earth U (umbra) is the total shadow P (penumbra) the partial shadow

To describe the progress of a *total eclipse of the moon* we draw a crosscut of the earth's shadow cone, both umbra and penumbra, at the distance of the moon as shown in fig 4. The moon's path relative to the shadow is indicated by the dotted line, and successive positions of the moon are marked by M_1 , M_2 , to M_6 . At M_1 the full moon enters the penumbra, and while it moves from M_1 to M_2 we have a penumbra eclipse. But the dimming of the moon's illumination by the penumbra is so slight as to be scarcely noticeable and penumbra eclipses are rarely watched.

After the moon has reached the position M_2 , a part of its surface is immersed in the umbra and is darkened, the moon is in partial eclipse. About an hour later the eclipse becomes total when (at M_3) the whole disk of the moon is within the umbra.

However, the moon's surface is never completely darkened by an eclipse, even at the middle of totality it is visible with a peculiar dull ruddy hue. This illumination is caused by sunlight refracted in the earth's atmosphere and reddened by its passage through the air.

If the moon's path leads through the centre of the umbra the total eclipse lasts about $\frac{1}{2}$ hours. At M_4 the moon emerges from the umbra, we have again a partial eclipse ending at M_5 followed by a penumbra eclipse ending at M_6 .

An eclipse of the moon is visible and presents the same features at all places on the earth where the moon is above the horizon. On account of the earth's atmosphere the edge of the umbra is rather diffuse, and the times of contact between the moon and the umbra cannot be observed accurately. The progress of a lunar eclipse can be adequately followed with the naked eye, with field glasses or a small telescope. It is an interesting experience for the layman but of little value for astronomical research.

III Eclipses of the Satellites of Jupiter.—Eclipses of the four large satellites of Jupiter provide a frequent and fascinating spectacle to the telescopic observer. The orbits of these satellites lie nearly in the same plane as Jupiter's orbit around the sun, and at practically every revolution of each satellite the following four eclipse phenomena take place:

- (1) Eclipse of the satellite when it passes through Jupiter's shadow.
- (2) Occultation of the satellite, when it disappears behind the planet as seen from the earth.
- (3) Transit of the satellite across the disk of Jupiter.
- (4) Transit of the shadow of the satellite across the planet's disk.

Fig 5 illustrates the occurrence of these phenomena, it shows Jupiter and the orbit of one of its satellites, the direction of the sunlight illuminating the system, and the direction toward the earth from where the observation is made.

When the satellite in its revolution arrives at S_1 , it enters into Jupiter's shadow (eclipse) and vanishes from view of illumination. At S_2 it comes out of the shadow, but to the terrestrial observer it is now hidden behind the planet (occultation) until at S_3 it reappears at the limb. When the satellite reaches the position S_4 , its shadow falls on Jupiter causing a small dark spot on its surface. Seen from the earth the satellite is to the left of

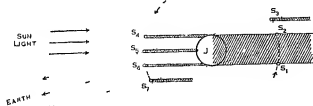


FIG 5—ECLIPSES OF THE SATELLITES OF JUPITER

J represents the planet Jupiter. S_1 to S_7 mark successive positions of one of its satellites as it revolves in its orbit around Jupiter. The system is illuminated by sunlight from the left but is observed from the direction of the earth.

Jupiter approaching its limb, while at the same time its shadow spot passes across the planet's disk (transit of shadow). At S_5 the satellite starts to pass in front of the planet (transit of satellite) following its shadow spot. Since both Jupiter and the satellite turn their illuminated sides toward the earth, they differ little in surface brightness. Near the limb the satellite is somewhat brighter than the planet's surface on which it appears projected, but near the middle of the disk it is hardly distinguishable. At S_6 the shadow leaves the planet, and at S_7 the satellite emerges at the limb.

Historically the eclipses of Jupiter's satellites are important for they provided one of the earliest proofs of the finite velocity of light. It is possible to calculate with considerable precision the times of disappearance and reappearance of a satellite undergoing eclipse. Ole Roemer (1674) noticed discrepancies between the observed and calculated times which he explained as being the result of changes in the travel time of light when the earth is nearest to Jupiter or farther away from it.

IV Other Eclipse Phenomena—Occultations of Stars or Planets by the Moon—From the earth we see the moon projected onto a background of distant stars. As the moon moves eastward across the constellations it will occasionally pass in front of one of the brighter stars, or of a planet, causing an occultation. At the moment when the eastern limb of the moon reaches a star, the latter suddenly disappears (immersion). In about an hour or less the moon will have passed over the star and the latter will reappear at the western limb (emersion). Between new moon and full moon the immersion takes place at the invisible (or faintly visible) dark limb, the emersion at the bright limb.

The surprising suddenness with which a star disappears or reappears without fading or flickering is conclusive proof that the moon has no appreciable atmosphere. Observations of occultations accurately timed are used to study the orbital motion of the moon.

Transits of Mercury and Venus—The two planets Mercury and Venus, which are nearer to the sun than the earth, do some times pass between the earth and the sun. With a telescope properly equipped to reduce the overpowering light of the sun either of these planets is then seen as a small dark circular disk projected on the brilliant disk of the sun, crossing it slowly. The four contacts of the planet's disk with that of the sun are observed similarly as for a solar eclipse.

Transits of Mercury take place at irregular intervals of 3 to 20 years on an average 14 times per century. Transits of Venus are rarer, they have been of great astronomical importance for the accurate determination of the solar parallax. Many expeditions were organized to observe the transits of Venus of 1761, 1769, 1874, 1882, from distant places on the earth. The next transits of Venus will occur on June 8, 2004, and June 6, 2012.

Eclipsing binaries are stars which vary in brightness periodically. The most famous of these is Algol, or β Persei, the explanation of the light change is that there are two stars, not resolvable with the telescope, revolving round one another in an orbit whose plane nearly passes through the solar system. Thus one star passes periodically in front of or behind the other as seen from the earth, and two eclipses take place during each revolution. From the way in which the light from the double system varies it is possible to calculate the orbit and relative sizes of the two components, and to obtain certain other information (see STAR).

V Prediction and Calculation of Solar and Lunar Eclipses—Our problem may be divided into two parts. The first seeks to find out when an eclipse will occur the other to determine its circumstances whether or not it is visible at a given place on the earth, its type (total or partial), etc.

It is convenient for our purpose to consider the earth as fixed and to suppose the observer situated at the centre of the earth. To this observer, O (fig 6), the sun and moon appear projected on the celestial sphere, a large sphere which he imagines surrounding him. While this sphere appears to him to rotate daily around the line PP' (the earth's axis of rotation), the sun's disk S appears to travel slowly along the great circle EE' (the ecliptic), making a complete revolution in one year. At the same time the moon's disk M revolves along the circle LL' once during a lunar month.

The angular diameters of the two disks S and M are about $\frac{1}{2}^\circ$, but vary slightly as explained in section I.

Every month the moon's disk M revolving along LL' will once overtake the more slowly moving sun S, this moment of overtaking is called the new moon. In general the moon's disk will pass above or below the sun's disk. Overlapping of the two disks results in an eclipse of the sun, it will occur only when the new moon happens at a moment when the sun is near the points Ω or Ω' , where the circle LL' intersects EE'. These points are called the ascending and descending nodes of the moon's orbit.

The moon will suffer an eclipse when it enters into the shadow cone of the earth. The crosscut of the umbra at the distance of the moon (as shown in fig 4) may be projected like a disk U onto the celestial sphere. It subtends an angle of about 1.4° , its centre will always be opposite to the sun's disk and travel along EE'. An eclipse of the moon takes place whenever the moon's disk M overlaps the shadow disk U, this happens only when the shadow disk U is near one of the nodes, or the sun is near the opposite node. The passage of the sun through the lunar nodes is therefore the critical time for both solar and lunar eclipses. The moon's orbit plane, represented by the circle LL', is not fixed, and its nodes move slowly along the ecliptic in the direction indicated by the arrow, making a complete revolution in about 19 years. The interval between two successive passages of the sun through one of the nodes is termed an "eclipse year," and since the moon's node moves so as to meet the advancing sun, this interval is about 18.6 days less than a tropical (or ordinary) year.

In fig 7(a) the region of the ascending node as seen from the centre of the sphere is much enlarged. Here the node is kept fixed and the apparent motions of the sun and the moon are taken relative to the node. To our imaginary observer at the centre of the earth the sun's disk S will travel along the circle EE', the moon's disk M along LL'. The sun is so distant compared with the size of the earth that from all places on the earth's surface the sun is seen nearly in the same position as from the centre

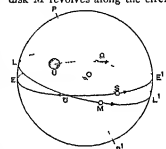


FIG 6—APPARENT MOTIONS OF SUN AND MOON ON THE CELESTIAL SPHERE

The observer O imagines himself at the centre of a large sphere. The sun S appears to move around the circle EE' (the ecliptic) once a year, the moon M around the circle LL', its orbit once a month. The crosscut U of the earth's shadow is always opposite to the sun S. The intersections (nodes) Ω and Ω' of the moon's orbit and the ecliptic revolve along the ecliptic once in 19 years.

But the moon is relatively near and its projected position on the celestial sphere is different for various observing stations on the earth, it may be displaced as much as 1° from the position in which it is seen from the centre of the earth. If we enlarge the radius of the moon's disk by 1° we obtain a circle C which encloses all possible positions of the moon's disk seen from anywhere on the earth. Conversely, if we draw any circle of the moon's

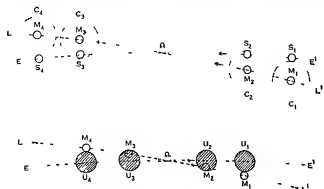


FIG. 7—ASCENDING NODE OF THE MOON'S ORBIT AS SEEN FROM THE CENTRE OF THE SPHERE

- (a) A solar eclipse occurs somewhere on the earth whenever the circle C overlaps the sun's disk S. The circle C encloses all positions of the moon seen from anywhere on the earth at a given moment.
(b) A lunar eclipse occurs when the crosscut U of the earth's shadow overlaps the moon's disk M.

size inside this "moon circle" C, there is a place on the earth where the moon is seen in that position.

Accordingly, there will be an eclipse of the sun somewhere on the earth whenever the moon overtakes the sun in such a position that the moon circle passes over the sun's disk, when the latter is entirely covered by the moon circle, the eclipse will be central (total or annular). From fig 7(a) it is evident that a solar eclipse will take place if a new moon occurs while the sun moves from S_1 to S_2 . This period is called the eclipse season, it starts 19 days before the sun passes a node and ends 19 days after. Since there is a new moon every month, at least one solar eclipse, and sometimes two, occur during every eclipse season. When the new moon falls within 11 days of the node passage (between S_1 and S_2), the eclipse will be central.

Fig 7(b) illustrates the condition for a lunar eclipse. If a full moon occurs within 13 days of a node passage of the sun (when the shadow disk passes the other node) the moon will be eclipsed. Most eclipse seasons, but not all, will thus also contain a lunar eclipse. Eclipses of the sun are evidently more frequent than those of the moon, but the former are only visible from a very limited region of the earth, the latter from a whole hemisphere. Any particular town or city would on the average experience about 40 lunar eclipses and 20 partial solar eclipses in 50 years, but only one total solar eclipse in 400 years.

The sun returns to the same node after each year, new moons (or full moons) recur at intervals of an ordinary month. Nineteen eclipse years (6585.7866 days) are nearly equal to 223 months (6585.3211 days). After this interval of 18 years 11 days, which is called the *saros*, the moon and the sun come nearly to the same relative positions again and eclipses will repeat themselves. Thus the solar eclipse of Sept. 10, 1933, was a repetition of that of Aug. 30, 1905. Already in ancient times the saros was used for the prediction of eclipses (see *Ancient Eclipses*, below).

Since the coincidence of the two periods is not exact, the repetition of an eclipse after a saros will be of different circumstances. Suppose an eclipse of the sun takes place while the sun is at S_1 (fig 7a) and the moon at M_1 , it will be visible on the earth in high northern latitudes from where the moon's disk is projected into the lower part of the moon circle. After 223 months there will be another new moon with eclipse. As this period is shorter by 0.4595 days than 19 eclipse years, the moon will now overtake the sun before the latter has quite returned to S_1 , while it is $28'$ farther to the right, nearer to the node. The sun will be closer to

the centre of the moon circle, and on the earth the eclipse will be visible nearer to the equator or farther south than the previous eclipse. After every saros the meeting of the moon and the sun will be a little farther to the right, until it takes place near S_1 , after which the eclipse returns no more. Solar eclipses may thus be ordered into series, each of which contains 68 to 75 eclipses (about 18 total), at intervals of a saros extending over 13 to 14 centuries.

The fraction of 0.3211 days in the period of the saros has the effect of making each successive eclipse of a series visible about 110° of longitude farther west on the earth, and after three saros it returns nearly to the same longitude, but farther south if at the ascending node or farther north if at the descending node. Eclipses of the moon, of course, also occur in similar saros cycles.

During a solar eclipse the shadow cones (umbra and penumbra) of the moon sweep across the face of the earth (fig 1), while at the same time the earth is rotating around its axis. The circumstances of a solar eclipse are best illustrated by a map which shows the intersections of the shadow cones with the earth's surface and their track across continents and oceans resulting from the combined effects of both motions. Fig 8 illustrates the circumstances of the total solar eclipse of Nov. 1, 1948. The narrow double line marks the path along which the umbra travels in 3½ hours from central Africa across the Indian Ocean toward New Zealand. Within the area of this lane, 50 mi wide, the eclipse is total. The wide surrounding region bounded by the full line is that covered by the penumbra, where the eclipse is partial. Within the lune at its extreme left the sun is already in partial eclipse when it rises, within the lune at the right the sun sets during the partial eclipse. In the intermediate region the whole progress of the partial eclipse can be observed, and from the dotted lines the time of its beginning and end at any particular place can be read.

The astronomical Ephemerides published for each year give such maps for the more important eclipses as well as data for accurate calculation of the times of contact at any observing station.

It is possible with the aid of modern tables to predict solar eclipses several years ahead with an accuracy of a few seconds. For predictions of longer range the main uncertainty is that of the moon's motion. Eclipses can, of course, be "predicted backwards" as well as forwards, and the calculation of ancient eclipses has been of value in historical research (see *Ancient Eclipses*).

(R. J. Ta.)

VI Phenomena and Information Yielded by Observation of Solar Eclipses—Partial solar eclipses give little information of astrophysical interest. Total eclipses, however, contribute much knowledge concerning the nature of the sun's external layers, regions that are usually lost in the brilliant sky glare from the sun's shining surface. Until fairly recently, these faint solar features were observable only at time of a total solar eclipse. A new instrument known as the coronagraph now facilitates the study of them outside of eclipse.

At total eclipse, the disk of the moon acts as a screen outside the earth's atmosphere, cutting off the direct rays from the "photosphere," as the bright solar surface is known. The brilliance of the sky is thus enormously decreased and the fainter appendages of the sun become visible.

The chromosphere (*qv*), the sun's atmosphere, extends upward from the photospheric surface, growing more and more rarefied with increasing height. The chromosphere has no well defined upper boundary, but it has been traced to a height of about 10,000 mi above the surface. It is filamentary in structure, being composed of myriads of streamers of luminous gas projected from the solar surface. An individual spall streamer, or spicule, is very short lived, from its beginning as a bright eruption on the surface until its fading out as a thin, faint, ribbonlike spurt, is a period of only 10 or 15 minutes.

The sun's atmosphere thus in no way resembles that of the earth. Not only is the structure of the chromosphere nonuniform, but the temperature is extremely high. Elements like iron, cal-

cium, or aluminum, which are solids on the earth, are completely vaporized on the sun and appear as important constituents of its gaseous envelope. The determination of the chemical composition of the atmosphere, and of the temperatures and pressures obtaining there, depends upon observations made at the time of total eclipse.

A spectroscope, consisting of a special arrangement of a narrow slit through which the light passes lenses to collimate and focus the radiation, and a prism or diffraction grating to disperse the light into its rainbow colours, is one of the most important tools that the astronomer possesses. At the time of eclipse the narrow solar crescent is often used in place of the customary spectrograph slit.

Each individual chemical substance—element or compound—when vaporized and heated to incandescence, sends out its own characteristic radiations. The exact colours emitted by iron differ completely from those sent out by hydrogen or calcium. Thus, when we watch the rainbow band of colours, or spectrum, of some unknown substance with the radiations from known substances, we can determine the chemical composition of the sample.

This procedure is the basis of modern spectroscopic analysis in the chemical laboratory. The astronomer applies it directly to the sun and stars. The relative intensities of the lines of a given element give further information concerning temperatures and pressures in the luminous material.

The ordinary spectrum of the sun contains a brilliant background of all colours—a so called continuous spectrum. This radiation emanates from the lower levels of the solar atmosphere where the pressure of atoms and electrons is high enough to inhibit the previously mentioned characteristic radiations. The atoms in the upper levels, however, absorb these radiations, so that the solar spectrum consists of the bright rainbow background, with many fine gaps where the light has been absorbed. These gaps appear as dark lines—absorption lines—on the bright background.

At the moment of totality, when the moon obliterates the last trace of the bright photosphere, with its dark line spectrum, the

upper, rarer layers of the atmosphere flash into view with the characteristic bright line spectrum of a luminous gas. This spectrum disappears within four or five seconds, as the moon moves over the sun and a second flash occurs at the end of totality. Because of its evanescent character, astronomers have called the phenomenon the "flash spectrum."

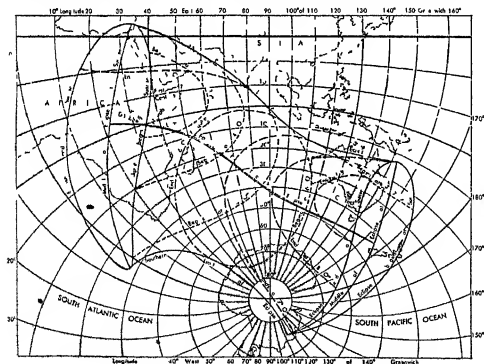
During totality there appears one of the most beautiful of nature's phenomena, the so called solar corona which shines like finely etched white frost against the deep blue of the eclipse darkened sky. The form of the corona presented at different eclipses is almost infinitely variable. On occasion, usually near sun spot minimum, long streamers extend four or five solar diameters away from the sun. At other appearances, especially close to maximum, the corona is more nearly circumbular, but with jagged, flowerlike petals. The corona is faint, 500,000 times or so less brilliant than the sun itself. Consequently the ordinary sky glare surrounding the sun swamps the faint coronal glare. Until recently, astronomers considered it impossible to record the corona outside of eclipse.

Analysis of flash spectra has led to some surprising results. The spectrum matches only roughly with the dark line spectrum. The lines of the neutral metals are of comparable strength in the two spectra, but those of the ionized metals ($i.e.$, atoms that have lost one electron) are markedly enhanced in the flash spectrum. The difference is attributed, in part, to lower pressures in the upper layers, but elevated temperature appears to contribute to the increased excitation. Especially is this true for the flash lines of ionized helium, which do not appear at all in the ordinary dark-line spectrum. These require excitation temperatures of at least 25,000° K. for their production, where the temperature required to produce the observed quality and quantity of bright emission from the surface is only 6,000° K.

Extending upward from the chromosphere, and probably closely related to it, are the so called "prominences," which project outward into space occasionally as far as several hundred thousand miles. These objects are one of the striking features of a total eclipse. They appear as rose coloured patches of flame, projecting well beyond the limb of the moon. Despite the resemblance

to fire, prominences cannot be referred to as flames. They consist of long interlacing filaments of incandescent gas. Their rose colour arises from the predominant gaseous radiations, the red of hydrogen and the violet of ionized calcium. Prominences appear to have a temperature slightly in excess of that associated with the chromosphere.

The spectrohelograph ($q.v.$), invented independently by G. E. Hale and H. Deslandres, enabled astronomers to record the prominences outside of eclipse. Indeed, something of their form and structure is disclosed by an ordinary spectrograph, with the slit wide open. A special spectrohelograph, built at the McMath-Hulbert observatory, with motion-picture recording, was the first instrument to depict graphically the spectacular motions exhibited by some of the prominences. The objects often hang for days, suspended like clouds above the solar surface. Their internal motions are extremely complicated, a characteristic effect is the downward streaming of the filaments, which descend to the surface in long graceful arcs. Occasionally



NOTE: The hours of beginning and ending are expressed in Universal Time or Greenwich Civil Time.

FIG. 8.—MAP SHOWING THE SOLAR ECLIPSE OF NOV. 1, 1940.

Within the narrow double line a total eclipse is observed. In the large area outlined the eclipse is partial. Reproduced from the American Ephemeris and Nautical Almanac by permission of the Nautical Almanac Office, U.S. Naval Observatory.

the great clouds will erupt with violent explosions and rapid motions. Velocities in excess of 100 mi. a second are not uncommon.

These motions, however, are not observable during the short duration of a total eclipse. The spectroheliograph or the instrument known as the coronagraph is required. The latter device, invented by B. Lyot, French astronomer, produces in effect an artificial eclipse of the sun inside the instrument. Under conditions of very clear sky, usually attainable only at high altitudes, astronomers can record the corona with some degree of regularity. The coronagraph was the solution of the problem of recording the corona outside the eclipse.

The corona presents many interesting problems, but the greatest mystery of all—the nature of its composition—has been solved by B. Edlen, Swedish physicist. The spectroscope had revealed numerous lines, radiations that could not be matched with those from any known terrestrial element. For years astronomers theorized about "coronium"—a supposedly new element existing on the sun. There was precedent for such a hypothesis. At the eclipse of 1868, helium had been discovered in such a manner and was not isolated on earth until 27 years later, when Ramsay isolated it from gases extracted from radioactive ore. But as chemists filled in gap after gap in the periodic table of the elements, the hope faded of finding coronium as a new substance.

A somewhat similar mystery, that of the bright emissions from gaseous nebulae, was meanwhile solved by I. S. Bowen, who showed that the lines were due to "forbidden" atomic transitions. In other words, they arose from changes within the atom that were contrary to rules for normal lines. Under laboratory conditions these forbidden lines are extremely faint. Under conditions of low density, however, and special excitation, the normal radiations can be almost completely suppressed and the forbidden lines will then appear. Indeed, both nebular lines and coronal lines have been observed in the spectra of two variable stars of the recurrent nova class.

The coronal lines have also proved to result from forbidden transitions. But where the nebular atoms have lost but from two to four electrons, those responsible for the coronal radiations have had as many as 13 torn away. The substances identified are iron *X* (i.e., iron with nine electrons missing), iron *XI*, *XIII*, and *XIV*. Similar emissions from calcium and nickel also appear.

The import of this discovery is staggering—and almost unbelievable. Reference has already been made to the high excitation of the chromosphere and prominences, which led to estimates of temperature as great as 25,000° K. This figure is in itself enormous compared with the 6,000° K. value usually ascribed to the solar surface. But 25,000°, in turn, is insignificant compared with the minimum figure of 500,000° required for the observed ionization of the coronal atoms. Iron, with half its electrons removed, requires temperatures of at least this order of magnitude. Some estimates have been higher than 1,000,000°.

High temperatures of this character are difficult indeed to explain. They could not be induced by ordinary 6,000° radiation. No simple or reasonable solution to this new enigma of the corona had by 1946 been presented. But it seems that the answer is to be found deep in the solar interior, where even higher temperatures are known to exist. Somehow or other the highly excited matter must escape into space. The details of the process are still unknown.

There is a further implication from this new knowledge of the solar atmosphere. We can no longer assume that the solar radiation has a quality similar to that of a black body heated to 6000° K. We must have in addition quantities of radiation in the far ultra-violet and even in the region of soft X rays, far in excess of that from an incandescent globe at 6000°. These short wave radiations must enter the earth's upper atmosphere, where they cause the aurora borealis and produce the ionosphere, a high layer of electricity that is responsible for long-distance radio transmissions. But the atmosphere so completely absorbs these wave-lengths that none of the energy reaches the surface. We can learn of the existence of the radiation only from study of flash and coronal spectra and from evaluation of the effects in the earth's atmosphere. Variability of the earth's magnetic field is an

associated phenomenon.

The astrophysical value of eclipse observation is, perhaps decreasing. There are still some problems that can be solved only at a true eclipse—but the coronagraph and the artificial eclipse have many advantages. The superiority of the coronagraph lies in the fact that observations can be secured every clear day—whereas eclipses are relatively rare phenomena, usually occurring in distant and inaccessible locations. They last for only a few minutes—7½ minutes at maximum. The continuity thus provided shows that the corona is relatively stable in form, that it is not uniform in brilliance around the sun, and that it rotates with the solar surface.

Eclipse observations, in giving the astronomer answers to certain questions of the sun have nevertheless presented the scientist with newer and more puzzling problems. What relationship is there between the prominences and the corona? What is the source of their excitation? How are they related to sun spots and other solar features? Where does solar variability come into the picture? The questions can be multiplied *ad infinitum*. We must look to the future for the answers.

The Deflection of Light by a Gravitational Field—One of the most famous, and the first, of the tests of Einstein's theory of relativity was that of observing the bending of a ray of light passing close to the sun. During a total eclipse the brighter stars are visible to the naked eye and many more can be photographed near the sun.

Einstein's theory predicts that the stars near the sun should be found not in their true places but displaced away from the sun by a small, but measurable, amount varying inversely as the distance from the centre of the sun. This test was first carried out in 1919 and has been repeated since with results on the whole in favour of the theory (see RELATIVITY).

Other Phenomena—Baily's Beads—It is found that totality does not begin or end quite suddenly, as it should if the sun and moon were of perfectly smooth outline, but that there exists for a moment or two a crescent of minute gleaming points of light, called Baily's Beads. These are due to the irregular outline of the moon (i.e., its mountains and valleys), because of which the sun is left uncovered here and there for a moment after the disk representing the size of the moon, if smoothed out, would have covered it.

Shadow Bands—When totality is nearly due and there remains but a small crescent of the sun left there can often be seen on the ground or on the walls of buildings striations of light and shade, not very definite in outline but something like a sheet of corrugated iron, moving moderately rapidly perpendicular to their length. These are termed the shadow bands and are due to corrugations introduced into the nearly plane waves of light reaching us from the sun through irregularities in the refraction of the earth's atmosphere. They are of no great scientific import.

(D H M)

VII. Total Solar Eclipses During The 20th Century—We omit those eclipses which are visible only in polar regions or are of excessively short duration. The first column gives the date of the eclipse, the next the duration of totality, the third the node near which the eclipse occurs and the number of the saros series to which it belongs, repeated eclipses having the same number. The last column states where the eclipse was or will be visible.

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(J A C, X)

| Date, at noon point | Duration of totality minutes | Node and series | Regions swept by shadow | Date at noon point | Duration of totality minutes | Node and series | Regions swept by shadow |
|---------------------|------------------------------|-----------------|---|--------------------|------------------------------|-----------------|---|
| 1900 May 28 | 1 | D 5 | United States, Spain, N Africa | 1955 Jun 20 | 7.2 | D 6 | Ceylon, Siam, Philippines |
| 1901 May 18 | 6.5 | D 6 | Sumatra, Borneo | 1958 Oct 12 | 5.2 | A 7 | Chile, Argentina |
| 1904 Sep 9 | 6.4 | A 7 | Pacific Ocean | 1959 Oct 2 | 3.0 | A 8 | Canaries, Central Africa |
| 1905 Aug 30 | 3.8 | A 8 | Canada, Spain, N Africa | 1961 Feb 15 | 2.6 | D 9 | France, Italy, Austria, Siberia |
| 1907 Jan 14 | 2.3 | D 9 | Russia, Central Asia | 1962 Feb 5 | 4.1 | D 10 | New Guinea |
| 1908 Jan 3 | 4.2 | D 10 | Pacific Ocean | 1963 Jul 20 | 1.5 | A 11 | Alaska, Canada, Maine |
| 1911 Apr '88 | 5.0 | A 1 | Australia, Polynesia | 1965 May 30 | 5.3 | A 1 | Pacific Ocean |
| 1912 Oct 10 | 1.5 | D 2 | Columbia, Ecuador, Brazil | 1966 Nov 12 | 1.0 | D 2 | Bolivia, Argentina, Brazil |
| 1914 Aug 21 | 2.1 | D 3 | Scandinavia, Russia, Asia Minor | 1970 Mar 7 | 3.3 | A 4 | Mexico, Georgia, Florida |
| 1916 Feb 3 | 2.5 | A 4 | Pacific Ocean, Venezuela, West Indies | 1972 Jul 10 | 2.7 | D 5 | N. L. Asia, N. E. America, and Atlantic Ocean |
| 1918 Jun 8 | 2.4 | D 5 | British Columbia, United States | 1973 Jun 30 | 7.2 | D 6 | S. America, Africa and Atlantic Ocean |
| 1919 May 29 | 6.9 | D 6 | Peru, Brazil, Central Africa | 1974 Jun 20 | 5.3 | D 12 | S. W. Australia and Indian Ocean |
| 1921 Sep 1 | 6.1 | A 7 | E. Africa, Australia, California, Mexico, Central America | 1976 Oct 23 | 4.9 | A 7 | Africa, Australia, Indian and Pacific Oceans |
| 1923 Sep 10 | 3.0 | A 8 | United States, E. Africa, Sumatra, Philippines | 1977 Oct 12 | 2.8 | A 8 | Venezuela, Pacific Ocean |
| 1925 Jan 24 | 2.1 | D 9 | England, Scotland, Scandinavia | 1979 Feb 26 | 2.7 | D 9 | United States, British America, N. Polar Sea |
| 1926 Jan 14 | 4.2 | D 10 | Sumatra, Malacca, Philippines | 1980 Feb 16 | 4.3 | D 10 | Africa, Atlantic and Indian Oceans, India |
| 1927 Jun 29 | 0.7 | A 11 | Pacific Ocean, Pitagoria | 1981 Jul 31 | 7.2 | A 11 | Pacific Ocean, Asia |
| 1929 May 9 | 5.1 | A 1 | Canada, Borneo, Celebes | 1983 Jun 11 | 5.4 | A 1 | Java, Atlantic Ocean |
| 1930 Oct 21 | 1.9 | D 2 | Greece to Central Asia and Japan | 1984 Nov 22 | 2.1 | D 2 | Pacific Ocean, Pitagoria |
| 1933 Aug 31 | 1.5 | D 3 | Pacific Ocean, Peru | 1987 Mar 29 | 0.3 | A 13 | Atlantic, Equatorial Africa |
| 1934 Feb 14 | 7.7 | A 4 | Colombia, Brazil, S. Africa | 1988 Mar 15 | 4.0 | A 4 | Indian and Pacific Oceans, Sumatra |
| 1936 Jun 19 | 2.5 | D 5 | Central Asia, China, Pacific Ocean | 1990 Jul 12 | 6 | D 5 | Ireland, N. Atlantic |
| 1937 Jun 8 | 7.1 | D 6 | China, Alaska, Idaho, Canada, Greenland, Norway, Sweden, Russia | 1991 Jul 21 | 1.1 | D 6 | Pacific Ocean, Hawaii |
| 1940 Oct 1 | 5.7 | A 7 | Argentina, Central Africa, Paraguay | 1992 Jun 30 | 3.1 | D 12 | Central America |
| 1941 Sep 21 | 3.3 | A 8 | Central Africa, Congo | 1994 Nov 3 | 4.1 | A 7 | S. Atlantic |
| 1943 Feb 4 | 2.5 | D 9 | Nubia, Persia, Siberia | 1995 Oct 24 | 1 | A 8 | Pacific and Indian Oceans |
| 1945 July 9 | 1.1 | A 11 | United States Great Lakes Region, Canada, Scandinavia, Russia, Persia | 1997 Mar 9 | 2.5 | D 9 | N. E. Asia, Arctic Sea |
| 1947 May 20 | 5.2 | A 1 | | 1998 Feb 26 | 1.4 | D 10 | Pacific and Atlantic Oceans, Central America |
| 1948 Nov 1 | 1.0 | D 2 | | 1999 Aug 11 | 2.0 | A 11 | Central and Southern Europe, touching England |
| 1953 Feb 25 | 3.0 | A 4 | | | | | |
| 1954 Jun 30 | 2.5 | D 5 | | | | | |

ANCIENT ECLIPSES

It is not surprising that, in ancient times when eclipses were regarded as portents, a large number of eclipses should have been mentioned in history or in literature, in addition to those which are recorded in astronomical treatises or on astronomical tablets.

The value of these records may be classified as follows: (1) *Literary and historical*, depending on the interest which they aroused, the notice taken of them, and their connection with events; (2) *Chronological*, in so far as they enable us, by computing their dates, to verify chronological systems resting on other evidence and to supply dates for events connected with the eclipses; (3) *Astronomical*, including the determination by ancient astronomers of the periods and motions of the sun and moon, and by modern astronomers of the mean rate of change of those motions, which, in astronomical terminology, is called secular acceleration.

Literary and Historical References.—(1) *Chinese*. In the *Shu King* or *Book of Historical Documents* it is stated that Hsi and Ho (the hereditary astronomers) had neglected the duties of their office and were abandoned to drink in their private cities. The king, Chung K'ang, placed the marquis of Yin in command of an army with instructions to punish them. The marquis issued a flimsy address to his troops in which he referred to Hsi and Ho having neither heard nor known anything on a recent occa-

sion when "the sun and moon did not meet harmoniously in Fang." The phrase is taken by all Chinese scholars, ancient and modern, to mean an eclipse. It would therefore appear that a military expedition was sent to punish the two astronomers for failing to observe an eclipse. There are good reasons for believing that this part of the *Shu King* is a literary restoration, made to take the place of books that were burned by imperial order in 213 B.C., but sufficient is found in a quotation made by Tso before that disaster and in the statements in the *Bamboo Annals* also made before that date, to prove that the reference to the eclipse is authentic, though its relation to the supposed offence of Hsi and Ho is doubtful. Attempts have been made to identify this eclipse, but the necessary data are wanting. It may easily have been a small eclipse, and the number of the month is given differently in different texts. The received Chinese chronology places the accession of Chung K'ang in 2159 B.C. The *Bamboo Books*, where chronology is probably nearer to the truth, place that event in 1952 B.C. The *Shih King*, or *Book of Poetry*, contains a lamentation caused by an eclipse of the moon, followed by an eclipse of the sun. The dates are clearly defined and are found to agree with the lunar eclipse of Aug. 21 and the solar eclipse of Sept. 6 in 776 B.C.

The eclipses recorded in the *Spring and Autumn Annals* possess a chronological and astronomical rather than a literary interest.

(2) *Assyrian*—The Assyrian eponym canon, which preserves the names of the annual magistrates who gave their names to the years, records under the year which corresponds to our 763-762 B.C. "Insurrection in the city of Assur. In the month Sivan the sun was eclipsed." The reference must be to the eclipse of the sun on June 15 in 763 B.C. A reference to the same eclipse has been found in Amos viii, 9, "And it shall come to pass in that day, saith the Lord God, that I will cause the sun to go down at noon, and I will darken the earth in the clear day."

(3) *Greek*—In the *Odyssey* Homer twice makes the unrecognized Odysseus predict that Odysseus will return "as the old moon wanes, and the new appears," that is, at new moon, when alone an eclipse of the sun is possible. In one of these passages he predicts vengeance on his wife's suitors. On the day when Odysseus was to become known and slay the suitors, the seer Theoclymenus notes among other portents of gloom that "the sun has perished out of heaven, and an evil mist has spread over all." This was interpreted by Plutarch and Eustathius as a total eclipse of the sun. Some modern scholars have regarded it as merely a vision of the seer. Schöch (*the Observatory*, xlix [1926] pp. 19-21) has suggested an identification with the solar eclipse of April 16 in 1178 B.C., which was total in or near Ithaca. But it is not improbable that the story of the eclipse belongs to legend rather than to history.

In a fragment of a lost poem by Archilochus occur the words "Nothing there is beyond hope, nothing that can be sworn impossible, nothing wonderful, since Zeus, father of the Olympians, made night from mid-day, hiding the light of the shining sun, and sore fear came upon men." According to Aristotle the words come from a passage, abusing a lady, probably Archilochus's former fiancée Neobule, who is supposed to have belonged to Paros. The life of Archilochus was divided between Paros and Thasos. The phenomenon described has been identified as the total eclipse of the sun on April 6 in 648 B.C.

Small fragments survive of other poetic descriptions of eclipses, and the ninth paean of Pindar, addressed to the Thebans, takes an eclipse of the sun as its theme. Sancyo translates the opening lines as follows:

"Beam of the sun! O thou that seest afar, what wilt thou be devising? O mother of mine eyes! O star supreme, reft from us in the daytime! Why hast thou perverted the power of man and the way of wisdom, by rushing forth on a darksome track?"

Pindar then proceeds to speculate on the meaning of the eclipse as a portent. The poem probably refers to the solar eclipse of 463 B.C., April 30, which was nearly total at Thebes.

The most famous of ancient eclipses was a total eclipse of the sun which happened according to Herodotus during a battle between the Lydians and Medes. The portent induced them to cease from fighting and conclude peace. Herodotus further informs us that Thales of Miletus predicted this eclipse to the Ionians for the very year in which it happened. Babylonians were certainly predicting eclipses about this time by means of the 18 years' cycle known as the Saros. But, as that cycle gives eclipses for every year, the statement about Thales must if true mean that he predicted that an eclipse of the particular year would attain a great magnitude. Such a prediction can be made by the 18 years' cycle without any mathematical computation. The eclipse was certainly that of 585 B.C., May 28, and must have been predicted by means of the eclipse of 603 B.C., May 18. Several ancient writers have preserved 585 B.C. or some neighbouring year as the date of the eclipse.

Thucydides comments on the frequency of eclipses during the Peloponnesian war. The most interesting of these were the solar eclipse of 431 B.C., Aug. 3, when, we are told, "the sun assumed the shape of a crescent and became full again, and during the eclipse some stars became visible," a statement that agrees well with modern computation, and the lunar eclipse of 413 B.C., Aug. 27. That date had been selected by the Athenian commanders, Nicias and Demosthenes, for the departure of their armament from Syracuse. All preparations were ready, but the signal had not been given, when the moon was eclipsed. The soldiers and sailors clamoured against departure and Nicias in obedience to

the soothsayers resolved to remain thrice nine days. This delay enabled the Syrians to capture or destroy the whole of the Athenian fleet and army.

The year 310 B.C., Aug. 15, is the date of a total eclipse of the sun, which, as we are informed by Diodorus and Justin, was seen by Agathocles and his men the day after he had sailed from Syracuse on his way to Africa. Modern computations of the eclipse track render it probable that he sailed to the north of Sicily.

In Plutarch's *Dialogue on the Face which appears in the Orb of the Moon*, one of the characters, called Lucius, deduces from the phases of the moon and the phenomena of eclipses a similarity between the earth and the moon and illustrates his argument by means of a recent eclipse of the sun, "which, beginning just after noon, showed us plainly many stars in all parts of the heavens, and produced a chill in the temperature like that of twilight." A little further on Lucius refers to a certain brightness which appears round the moon's rim in total eclipses of the sun. Nicolaus Struyck identified this eclipse with that of A.D. 71, March 20, and the identification has been confirmed by Ginzel after a very exhaustive discussion. There are numerous other references to eclipses in Greek literature.

(4) *Roman*—There is a very large number of eclipses recorded in Roman history. One which has attracted the attention of students alike of astronomy and of the Roman calendar is stated by Cicero to have occurred in the 350th year from the foundation of Rome and to have been described by the poet Ennius as follows: "On the Nones of June the sun was covered by the moon and night." This would appear to have been the solar eclipse of 400 B.C., June 21, which reached a total or almost total phase at Rome a few minutes after sunset. It seems to show that in that year the calendar month of June began 16 days later than in the calendar as reformed by Julius Caesar.

The eclipse of the moon in 168 B.C., June 27, has attracted much attention. The Romans were at that time at war with Macedonia, and Polybius informs us that the eclipse of the moon was interpreted as an omen of the eclipse of a king and thus encouraged the Romans and discouraged the Macedonians.

Use of Eclipses for Chronological Purposes—Although no continuous era has been used since ancient times, dates are frequently expressed in terms of regnal years, or are named after consuls or other officials of whom lists have been preserved. In these cases it is important to be able to quote certain specific years thus defined with years before the Christian era. This can be done whenever the date of an eclipse or other identifiable and calculable astronomical phenomenon is given in an ancient record.

The received Chinese chronology can be confirmed accurately by eclipses from 719 B.C. onwards. The chronology of Ptolemy's canon of kings, which gives the Babylonian series from 30 B.C. to 539 B.C., the Persian series from 538 to 324 B.C., the Alexandrian series from 323 to 30 B.C., and the Roman series from 30 B.C. onwards, is confirmed throughout by eclipses. The eclipse of 763 B.C., recorded in the eponym canon, enables us to carry the chronology back with certainty through the period covered by that canon, to 893 B.C. Assyrian, Babylonian and Persian chronology provide a stable chronology for the countries with which Assyria, Babylon and Persia came into contact, but there is no check from eclipses on Greek or Egyptian historical chronology before the Persian period. Identifiable eclipses recorded under named Roman consuls extend back to 217 B.C. The dated eclipses of Ennius and Pydna and one in 190 B.C. can be used to determine the position of Roman calendar months in the natural year, and occasionally eclipses help us to fix the precise dates of a series of events, such as those connected with the Athenian disaster at Syracuse.

Use of Eclipses for Astronomical Purposes—(1) *In Ancient Astronomy* It would appear that at least from the time of King Nabonassar (747 B.C.) a dated canon of astronomical observations was preserved at Babylon, including all eclipses. This rendered it possible to determine accurately the intervals between eclipses and must have facilitated the discovery of the 18 years' cycle, more exactly the cycle of 6,585½ days, which Suidas calls the saros and its multiple, the 54 years' cycle of 19,756 days.

These cycles govern the recurrence of eclipses. It has been seen that Thales probably used such a cycle. In a Babylonian observation tablet of 568 B.C. mention is made of failure to observe a predicted eclipse of the moon. The eclipse is found by computation to have been real, but invisible at Babylon. It was doubtless predicted by cycle. Tables based on the saros go back to the 4th century B.C. Eclipses of the moon give more accurately than any other kind of observation the actual time when sun and moon are in opposition. From an early date the Babylonian astronomers must have deduced from them not only the mean interval between two conjunctions, but the principal inequality in the motion of the moon and the similar inequality in the motion of the earth, or, as to their geocentric theory they conceived it, of the sun, and they were able to define the periods of these inequalities, which astronomers call the anomalistic month and year.

In the same way, since eclipses happen only when the two luminaries are situated at intersections of their orbits called nodes, and since the path of the shadow in a lunar eclipse depends on the position of the centre of the sun in relation to the node, they were also able to determine the position and motion of the nodes. By assuming, what is approximately true, that the saros of 6,855 1/3 days contained an exact number (a) of synodic months, or revolutions of the moon measured from the sun, (b) of anomalistic months, or revolutions of the moon measured from her apogee or perigee, that is, from her furthest removal from and closest approach to the earth, and (c) of draconic months or revolutions of the moon measured from her node, the early astronomers, perhaps in the 4th century B.C., computed the relative motions of the sun and moon, the lunar perigee and apogee, and the nodes. About 500 B.C. Naburriannu, apparently from a more accurate study of eclipse observations, obtained improved values which for the motion of the moon from the sun were 10" per annum too small, for the moon from her perigee 20" per annum too great, and for the moon from her node 5" too small. Still more accurate values were obtained by Kidinnu about 383 B.C., from whom they passed to the Greek astronomer Hipparchus. In the system of Naburriannu the distance of the moon from her node was used for the prediction of the magnitude of lunar eclipses.

(2) In Modern Astronomy.—Ancient eclipses are of the highest value for the determination of "secular accelerations," that is, for the determination of the progressive, as distinct from the periodic, changes in celestial motions. Edmund Halley asserted in 1695 his belief that the moon's motion was subject to acceleration, but did not specify the amount of the acceleration. In 1749 Richard Dunthorne demonstrated from a comparison of the recorded with the computed times of eclipses distributed over 2,000 years that such an acceleration existed and assigned to it the value of 10" a century. By this is meant that the effect of the acceleration is to produce an advance of 10" in the moon's longitude in the course of a century. Laplace in 1786 discovered that such an acceleration should be the gravitational effect of the secular diminution in the eccentricity of the earth's orbit. But J. C. Adams showed in 1853 that the acceleration due to this cause amounts to 6" only in a century. The residue must be explained by other causes.

The most recent values are 11" a century acceleration of the moon, of which 5" is unexplained, and about 15" a century for an acceleration of the earth's motion suggested by P. H. Cowell in 1905. It is usual to regard the latter as an apparent effect of a retardation of the earth's rotation, which is our standard of time. This should produce an apparent acceleration of the Moon 13 1/4 times as great as that of the earth. But, since the unexplained acceleration of the moon is only about 3 1/2 times as great as that of the earth, it becomes necessary to suppose that there is a real secular retardation of about 75" a century in the moon's motion. It is commonly supposed that tidal friction is the main cause of both retardations. (See Moon.)

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with a list of recorded eclipses. O. Neugebauer, "The History of Ancient Astronomy: Problems and Methods," *Journal of Near Eastern Studies*, iv (1945), 1-38. An excellent summary of the state of the history of ancient astronomy, without special emphasis on eclipses. An extensive bibliography is included. (J. K. F.)

ECLIPTIC, in astronomy, is the great circle on the celestial sphere which forms the apparent path of the sun in the course of the year. The twelve constellations or signs of the zodiac are arranged along the ecliptic. The plane of the ecliptic is the plane of the earth's orbit, or more strictly the plane in which the centre of gravity of the earth and moon revolves round the sun, it meets the celestial sphere in the great circle above mentioned.

ECLOGITE, in petrology a typical member of a small group of rocks now recognized as including both igneous and metamorphic representatives, and of special interest on account of the variety of minerals they contain and their geological relationships. The eclogites (from Gr. *ἐκλογή*, a selection) are mostly coarse grained and massive aggregates of green monochlorite pyroxene and red garnet, but some varieties possess green hornblende wholly or partly replacing the pyroxene, thus giving rise to the two important groups—the pyroxene and the hornblende eclogites. The minerals associated with these essential constituents include rutile, apatite and iron ores, and, less commonly, quartz, muscovite, zoisite, cyanite, albite, bronzite, olivine and chlorite. The eclogites correspond closely in bulk composition with the gabbros and dolerites, but are characteristically assemblages with high density (3.2-3.6 as compared with gabbro 2.9-3.0).

The pyroxenes show considerable variation in composition, and include both non aluminous and aluminous varieties. The latter contain significant proportions of the jadeite and aegirine molecules and correspond to true omphacite. The red garnet is a pyroxene-rich variety containing almandine and grossular, but is not so magnesia-rich as the garnet found in serpentines and peridotites. The hornblende is usually a green variety—smaragdite, or alkali-hornblende sometimes approaching glaucophane in composition.

Whether of metamorphic origin or considered as igneous rocks consolidating under excessive pressures, the almost complete absence of plagioclase feldspar makes these rocks of peculiar interest. The omphacite garnet assemblages appear to have crystallized under high pressures, in place of augite, olivine and plagioclase. Magnesian garnet appears in place of the olivine-anorthite pair, and a jadeite-chloromelanite-bearing pyroxene in place of the augite plagioclase combination of the heteromorphous gabbros.

Under the name granaite, eclogites are found as blocks or boulders in the kimberlite "pipes" of the diamond fields of South Africa. This pyroxene-eclogite is of special interest inasmuch as diamonds have been found as enclosures of the garnet of the rock, and according to one prevailing view eclogite is the parent rock of the diamonds of the South African fields, the diamonds of the "pipes" being derived from the explosive disruption of deep seated masses of diamantiferous granaite.

That some eclogites are of metamorphic origin is clearly revealed by their geological associations and microscopic structures. Such often appear as lenses intercalated among crystalline schists and show unmistakable crystalloblastic structures.

Others, such as those of western Norway occur as lenticular masses in granite gneiss or bands in olivine rocks (peridotites, dunites or their serpentine derivatives). These rocks possess no true crystalloblastic structure, and are believed to be unaltered igneous rocks. Probably some eclogites from other areas previously believed to be transmutated gabbros are of similar origin.

The amphiboles of the eclogites may represent either a direct crystallization from the magma, or arise by metamorphic processes from original pyroxene, and it is not improbable that many of the so-called "garnet amphiboles" of archaic tracts are transformed eclogites. The recognition of eclogites as primary magmatic consolidations under high pressures has led to the conception of an eclogite zone in the earth's crust immediately below the more acid silicate shell. At depth magma of basaltic or gabbroid composition may exist stable as solid eclogite, and

it is possible that in this zone is to be discovered the source of the eclogite blocks of the Kimberlite "pipes." Research revealed that the geological associations of some eclogites appear not to accord with the prevailing conception of the group as a high pressure mineral facies. In a seemingly anomalous environment are certain eclogites and, indeed, the mineral jadeite itself, found in intimate association with low-grade metamorphic schists or serpentines, in France, California and the Celebes.

Though some of these associations may be the result of tectonic transport, there remain occurrences to which such an interpretation is inapplicable.

The chief localities for eclogites are archaic and paleozoic metamorphic igneous complexes. They are known from Scotland, western Norway, Saxony, Bavaria, the Alps, Austria, Greece and California. (C. E. T.)

ECLOGUE, a short pastoral dialogue in verse. The word is conjectured to be derived from the Greek verb ἐκλέγειν, "to choose." Another derivation traces it to αἶψ, "goat," and λόγος, "speech," and makes it a conversation of shepherds. The idea of dialogue, however, is not necessary for an eclogue, which is often not to be distinguished from the idyll.

The grammarians, in giving this title to Virgil's pastoral conversations (*Bucolica*), tended to make the term eclogue apply exclusively to dialogue. The eclogues of the Spanish poet Garcilasso de la Vega (1503-36) are still admired. (See also *BUCOLICS*, PASTORAL.)

ECOLOGY, ANIMAL, is concerned with the interrelations between animals and their environments. It is a subdivision of the science of ecology, or that branch of biology which embraces the interrelations between plants and animals and their complete environments. Ecology is a basic approach to the conservation of natural resources and—together with several other biological sciences, such as biochemistry, genetics, cytology and general physiology—cuts across the sciences of zoology and botany. That is, it is concerned frequently with general principles that apply to both animals and plants.

The content of ecology may be divided in several ways. First, where attention is directed to the type of environment, ecology is divisible into terrestrial interrelations (terrestrial ecology), fresh water interrelations (biological content of limnology) and marine interrelations (biological content of oceanography). Second, where emphasis is upon plants or animals, we speak of plant or animal ecology. Third, where the point of departure deals with the level of the complexity of interrelations, we have to do with autecology, or the interrelations of the individual plant or animal with its physical and biotic environments, or with synecology, which is the study of progressively complex interrelations of natural assemblages of organisms, such as populations and communities.

These groups of ecological categories are seldom wholly separable. They are united both by the application of common principles and by natural intergradations between any two. For example, fresh-water marshes merge with grassland or forest, areas may be covered with a temporary pond at a particular season of the year, river mouth and the sea meet at the estuary. A complete understanding of an animal is impossible without considering its relationships with plants. Similarly, such an understanding is not possible without considering its interrelations with others of the same kind and animals of different kinds. Consequently, the study of the entire natural assemblage of plants and animals and their environment is desirable in any investigation that aims at completeness.

The technique of ecology is both experimental and descriptive. The science has many important interrelations with other branches of basic and applied knowledge. Several examples are notable.

In basic biology one such problem is that of the origin and establishment of species. When a new species arises, its particular adjustments of structure, function and behaviour must be such that the population may live in a particular environment or series of environments. It must adjust both to the physical influences that are in operation and to biological factors already established. Under such conditions the new population may do one of three things. It may adjust to the total environment, it may emigrate

to another environment, it may die. If the organisms adjust, this implies that they can compete or co-operate with other species for food and shelter. Consequently, the establishment of a species is the result of ecological selection of a particular heredity.

Interrelations between ecology and sociology were summarized by J. W. Bews (1935).

There are many ecological aspects of man's industrial and agricultural production. These include the relations of economic plants to soil types, diets of farm and range animals, pollution overfishing, overgrazing, overcultivation, dust storms, floods, forest fires and game conservation. Often a man-made catastrophe has its origin in the unconscious application of ecologically unsound practices. For additional information the summaries of P. B. Sears (1935) and I. N. Gabrielson (1941) may be consulted.

The importance of general conservation, whether of oil and coal or of timber, soil, migratory birds or whales, cannot be emphasized too much with reference to the future well being of mankind. Plants and animals are interrelated in highly complex natural communities and they must be manipulated or replaced with scientific care. Here the application of ecological principles ranges, from those involved in the stocking of a small lake to a national program of reforestation. Basic research and the training of personnel should precede attempts at conservation since the solution may require answers to a number of inconspicuous yet important questions. For example, the bighorn or Rocky Mountain sheep formerly ranged over high mountains from Arizona into British Columbia and Alberta but is now absent or present only in reduced numbers in many parts of that territory. Herd reduction may be a consequence of many adverse influences, including (1) shooting of bighorn by hunters, (2) insufficient forage plants, (3) inadequate range, (4) scarcity of water, (5) disease, (6) poisons, (7) competition for food with domestic cattle, (8) competition for food with other game such as mule deer, (9) predation by such hunters as the bobcat and puma.

It will be seen that ecology has many interrelations with other branches of learning and that its applications are inextricably involved with man's destiny. As information accumulates in regard to the requirements of species populations and community relations, such data become available to animal husbandry, agriculture, conservation and public health. The danger is that the information will not be available in an integrated form soon enough to ensure broad conservation of natural resources.

Solution of many problems in public health and medicine involve ecology. Thus, the effective control of a variety of diseases is achieved by control of the vector rather than by the control of the disease-producing agent or pathogen. Such vectors include malarial mosquitoes, mosquitoes carrying the virus of yellow fever and jungle yellow fever, rats and rat fleas infected with plague bacteria, ticks and mites carrying pathogens responsible for such diseases as certain relapsing fevers, forms of typhus and many more. Control of the carrier is an ecological problem since the program involves the interrelations of the vector with its environment.

BASIC REQUIREMENTS OF ANIMALS

Organisms have three basic physiological requirements to meet if they are to live as individuals and perpetuate the species. These drives are nourishment, recuperation and reproduction. Their ecological counterparts are food, shelter and certain problems involving territory. The particular ways in which species satisfy these drives involve modification of structure, functions and behaviour that are known as adaptations or adjustments. The better adjusted the organism the better its chances of living with other members of its species population and with members of other species populations. Consequently, there are recognized three general categories of adjustments: feeding, sheltering and reproductive.

Food—Starting with the problem of food, organisms must obtain nourishment to live, and, since food must be obtained from the environment, it becomes a fundamental ecological factor. Certain basic aspects of plant nourishment are discussed in the treatment of communities. A survey of feeding adjustments among animals is appropriate here. As a rule, the food types that

make up the bulk of a species' diet are associated with definite feeding adjustments. The first feeding category is that of plant eaters, or herbivores. There are many kinds of these and only a few examples can be mentioned. Numerous insects such as aphids, feed upon plant sap, and their mouth parts are in the form of a tubular, sucking beak. Other insects including certain ants, have thick crushing jaws for cracking seeds. Although lizards as a group are meat eaters, some species eat vegetation and have rounded and broadened teeth. Among mammals the domestic cow and horse, as well as the deer, have some teeth flattened for grinding their food.

The second feeding category is that of the carnivores, or flesh eaters. Within this group there are two subdivisions. The first of these are the predators. These stalk their food and kill by direct assault and then feed upon the victim. Their adjustments are for overtaking and holding prey. Here may be mentioned the long highly modified mouth parts that enable cycloid ground beetles to feed on certain snails while the latter are withdrawn into their shells, the sharp claws of cats, the recurved teeth of the black snake, and the protrusible tongue of the toad. The second group of carnivores contains the parasites. These differ from predators in that they feed on the flesh of their prey, the host, while it is vigorous and at liberty, whereas predators feed after their prey has been subdued and is dead or dying. It is to the biological advantage of parasites that the host is not killed. Here are numerous types of feeding adjustments, including ectoparasites and entoparasites, living on or within the host's body, respectively. An entire branch of biology, parasitology (*qv*), is concerned with these animals. Many parasites are adjusted to feed on a special kind of food. The blood diet is such a particular case, and feeders on blood are known as sanguivores. Such animals generally have specialized saliva that is anticoagulant and anaesthetic in its action. Common sanguivores are fleas, the majority of female mosquitoes, bedbugs, leeches and ticks. Common entoparasites include the tapeworms and flukes.

Then there are the omnivores, feeding on a variety of both plants and animals. Man is an omnivore, and his dentition enables him both to cut and grind his food. There are many aquatic omnivores and the majority of these feed on minute organisms in the water and consequently must be collected by specialized conveying and straining mechanisms. Whalebone whales, rotifers, sponges, numerous marine worms, clams, oysters and barnacles collect and devour minute, usually floating, often microscopic plants and animals in the water. Obviously, within and between these three major feeding categories there are many differentiations and intergradations.

Shelter—Turning to the second of three basic organismal drives, it is found that continuous physiological activity leads to exhaustion and finally death. Therefore, animals must undergo physiological recuperation or rest. Frequently this is accomplished during sleep or its physiological equivalent. In animals such resting periods, with their relative inactivity and relatively slower responses to external stimuli, are dangerous since the individual is more exposed to attack from its natural enemies. Consequently, the majority of animals undergo periodic rest in some protected or sheltered spot, such as the mud on the bottom of a pond, a hollow tree, beneath a log, in a subterranean burrow, or beneath a leaf or deep within a flower. These homes are known as habitat niches. They are restricted portions of larger areas known as habitats.

Habitats—Habitats may be classified as follows.

- I Habitats occupied by free living organisms
 - A Salt water or marine (polar, temperate, tropical)
 - 1 Littoral or shore
 - a Rocky
 - b Sandy
 - c Muddy
 - 2 Pelagic or surface waters of seas
 - 1 Abyssal or deep sea
 - B Brackish water, such as an estuary
 - C Salt lakes, such as the Dead sea of Palestine and Great Salt Lake of Utah
 - D Fresh water
 - 1 Standing water

- a Marsh
- b Bog
- c Ponds and lakes (polar, temperate, tropical)
 - (1) Planktonic, or fresh-water littoral
 - (2) Limnetic, or fresh water "pelagic"
 - (3) Profundal, or deep-water, and benthic, or lake-bottom
- a Flowing water
- a Springs
 - (1) Cold-water
 - (2) Thermal, or hot-water
 - (3) Chemical, such as sulphur springs
- b Streams (including small brooklets and larger rivers)
 - (1) Rapids or waterfalls
 - (2) Relatively quiet pools
- E Terrestrial
 - 1 Epigeal, or aboveground
 - a Flood plains
 - (1) Gravel
 - (2) Sand
 - (3) Silt
 - b Grasslands
 - (1) Tall grass
 - (2) Short grass
 - c Forests
 - (1) Deciduous
 - (2) Evergreen
 - (a) Tropical
 - (b) Coniferous
 - d Desert
 - (1) Sandy
 - (2) Rocky
 - e Ice desert
 - 2 Hypogeal, or subterranean, such as caves

II Habitats occupied by parasites

A Ectoparasitic

B Entoparasitic

This general classification can be expanded almost indefinitely. For example, the societies of ants, termites, certain wasps and bees and the towns and cities of man are habitats to a great array of plants and animals. Again, each category in the above list is subject to considerable variation with respect to latitude, altitude and the differential action of numerous environmental influences. Obviously there are many intergradations between habitats, too numerous to list. For example, grassland and desert intergrade in semidesert, a shore may consist of sandy mud, or a pond may be present only during the spring months.

A habitat may be occupied continuously by the same animals, termed permanent residents, or occupied at a particular period by animals known as temporary residents. Within an American elm and oak deciduous forest chipmunks are permanent residents whereas the migratory black and white warblers are temporary residents.

Many permanent residents undergo special periodic sheltering adjustments associated with dormancy. One of the adjustments associated with winter is termed hibernation (*qv*). It is accompanied by a relatively low temperature and physiologically inaccessible water in the form of snow and ice and the habitat niche is termed a hibernaculum. One of the adjustments associated with summer is termed aestivation. It is accompanied by a relatively high temperature and physically inaccessible water or drought, and the habitat niche is termed an aestivaculum.

Hibernation and aestivation are broad seasonal adjustments. There are many sheltering adjustments of a more limited nature. A familiar example is the periodic occupation of habitat niches for a part of each 24 hr cycle of day and night. Often the same niche is occupied by different populations at different times. Many nocturnal animals inhabit the carpet of decomposing leaves of a forest by day and feed on the living foliage of the trees during parts of the night, their ecological counterpart, the diurnal animals, are active by day and inactive during the night, and many of these pass their period of rest in the same layer of leaf mould.

It must also be remembered that often the several stages in the life cycle of an animal occupy a series of different habitat niches and often a series of different habitats. For example, the minute young of the common fresh-water clams are known as glochidia and, when discharged by the parent, have a brief period in the water of the stream or lake during which time they must become attached to fishes to live. If they can attach to a fish, they become

parasitic for a time and are dispersed in this manner. Eventually they leave the host, settle to the bottom and become free living clams. Again, the familiar May flies, stone flies and dragon flies hatch from eggs laid in fresh water, lead herbivorous or carnivorous aquatic lives as naiads and then transform into aerial adult insects.

Members of a particular kind of animal, a species, tend to have common structural, functional and behavioural adjustments, and consequently the population occupies a series of similar habitat niches throughout the range of the species. These niches may be identical, or ecologically equivalent if the range is great or the species is tolerant of a variety of conditions and habitats. This ability to tolerate environmental variations is known as vagility. The puma, with a range from sea level to high elevations in mountain ranges, and from Alaska to Patagonia, has a high vagility, sloths, restricted to certain kinds of tropical American forests, have low vagility.

The environment is constantly selecting the inherited adjustments of animals, and animals are constantly modifying their environment through feeding, burrowing, respiration, depositing their faeces and excreta and eventually their bodies. Consequently, through long periods of time, populations evolve with better adjustments to existing conditions through natural selection, and the habitats and habitat niches change through the influence of physical and biological factors.

In this almost constant process of change, the species that inhabit the same habitat compete for food and shelter and often co-operate for these necessities. Such competitions and co-operations are both direct and indirect, and their proper study is a vast subject (see POPULATION ECOLOGY). The sheltering adjustments that allow a species to inhabit several habitat niches over its life history is such a large subject that a few examples must suffice.

In the first place, there are the broadest levels of adjustment to media, for example, aerial, aquatic and terrestrial adjustments for locomotion as well as respiration in air or water, and within the watery medium, more specialized adaptations for life in the relatively fresh waters of inland lakes and streams in contrast with a life in the salt water of oceans. Within these broad adjustments there are progressively more specialized features that allow a species to inhabit a particular habitat and even live in a particular portion of its habitat.

Stream animals illustrate this process. They are adjusted to the whole stream in a general way, but some species (fishes, May-fly naiads) obtain their oxygen through gills while others (dytiscid beetles) carry a supply of fresh air when they dive and periodically replenish their supply by returning to the surface. Furthermore, certain types of animals tend to inhabit quiet pools, where the current is relatively slow and the amount of dissolved oxygen relatively small, whereas others tend to inhabit rapids, where the current is swift and the dissolved oxygen abundant. Consequently, there are pool mores and rapids mores indicating that such animals have a collective type of adjustment to a special portion of the stream.

Then there are still more special adjustments to a part of such a habitat. For example, there are adjustments to the surface film of the water. Water striders (Gerridae) skate over the surface on their setose tarsi. Certain species of the staphylinid beetle genus *Stenus* have an anal secretion that lowers the surface tension of the water, and the greater tension of the film on which the anterior parts of the beetle rest tends to pull the insect rapidly forward. Still others, such as the larvae and pupae of mosquitoes, lie just beneath the water surface, and the contact of the film with certain parts of their bodies supports them without expenditure of muscular energy.

Since most aquatic animals are heavier than water, those that inhabit the upper layers, rather than move over the bottom, must hold their spatial position against the pull of gravity. Such buoyancy or flotation adjustments are typically diverse. The swim bladder of many fishes aids in this maintenance of position. Many minute single celled animals or Protozoa achieve buoyancy by the presence of oil globules in their protoplasm. Certain

marine snails have egg masses that are kept afloat by a mucous pad that is infiltrated with air bubbles. One marine group of protozoans, the Radiolarians, has a dense skeleton of silicon yet lives near the sea surface. In certain radiolarians this is accomplished by the secretion of carbon dioxide that accumulates as gas bubbles in their protoplasm. Numerous surface dwellers, including some rotifers many small crustaceans of the order Cladocera and protozoans of the genus *Ceratium*, undergo a seasonal change in form in apparent correlation with the density and viscosity of the water. The warmer water of summer offers less resistance to sinking. The summer populations of these animals have the surface expanded in proportion to their mass, whereas the winter populations have a relatively compact form with fewer or shorter projections.

From what has been said it is apparent that the study of habitats and habitat adjustment is as broad in scope as the study of ecology. Over long periods of time most organisms other than man are chiefly responsible for the formation of a rich, organic soil. Activities of civilized man usually lead to strong modifications of habitats, for example, the pollution of streams and lakes, soil erosion, destruction of watersheds and dense smoke clouds are but a few ways in which habitats deteriorate.

Reproduction—Another basic drive, reproduction, has many ecological implications. Climate and weather have both long-range effects and more immediate effects upon such diverse aspects as courtship behaviour, time of mating, laying of eggs and development of the larval or immature stages. Most higher plants are pollinated by an environmental agency. This agency may be a physical factor, as in the wind pollinated trees, or it may be a biological agency, as in the transfer of pollen for many fruits and vegetables by insects. Growth of species populations through reproduction involves the problems of both food and shelter, attack by predator and parasite, disease, co operation and numerous other aspects of general ecology.

THE PRINCIPLE OF COMMUNITY

Even this brief survey of food, shelter and reproduction demonstrates that no organism can live wholly alone and be independent of other organisms. Herbivores must be associated with their food plants, and carnivores and parasites must be associated with their prey. Consequently, since no plant or animal can live in a foodless, biological vacuum, species populations form natural gatherings with other populations. Such assemblages are of various sizes, composition and complexity. They have been called biocoenoses, if the interrelations are especially closely knit, and they are known generally as communities.

Since each species inherits a particular heredity that allows it to tolerate certain environmental conditions but not others, it follows that the populations of a community can tolerate the normal environment at that place. This environment is complex. It consists of two kinds of influences. There are the physical factors, such as light intensity and quality, temperature, precipitation, evaporation, quality of the medium, substrate, salinity, air or water pressure and many others. There are the biological factors, including food, biotic aspects of shelter, population pressure, predation, parasitism, disease and many more. The community, then, includes both the inhabiting organisms and the physical environment of a particular area.

The Major Community—When a community is relatively self sustaining and self regulating, it is at the level of survival for its component species populations. Such a community is called a major community. The major community is one of the fundamental concepts in all biology. Normally single celled organisms, such as algae and protozoans, cannot exist apart from their food supply. Similarly, the separate cells of the many-celled organisms are unable to live apart from the tissues of which they are vital units. The tissue is similarly unable to exist apart from other tissues of the organismal whole. Finally, the complete organism (that is, a member of a particular species population) cannot exist without food. Therefore, the populations involved must live together in a major community if they are to exist at all. This is the level at which survival is possible. Consequently, given radiant

energy from the sun the major community is a self-maintaining, self-regulating independent assemblage. There are few exceptions to this principle. A possible exception is found in certain kinds of caves, where the initial food supply is derived largely from external sources. A forest is a major community as is in adjoining grassland, and each is independent of the other for survival. Similarly, a lake is a major community and the vast oceans form a continuous self-sustaining major community.

Within any of these major communities are almost innumerable smaller communities that are not self-sustaining, for example, tree holes and decaying logs in forests, cattle droppings in grasslands, the like bottom or profundal community and the coral reef community in the sea.

Major communities have three basic features in common: (1) a fundamental structure, known as stratification, (2) systems of interchange and recombination of foodstuffs, known collectively as community metabolism, and (3) a common system of periodicities.

Stratification.—With respect to stratification the species populations are in a vertical series of horizontal layers termed strata, and usually also in a series of concentric layers, termed zones from the periphery to the centre of the community. Major communities, then, are separable into both horizontal and concentric layers. Since a major community is always in contact with one or more major communities at its boundaries, there is always a marginal zone where the communities intergrade. This intergrading area is known as the ecotone and is familiar to all. The ecotone is a much studied ecotone between the marine and terrestrial communities. Obviously, the ecotone is not a major community since it is not self-sustaining, i.e., it could not exist in its present form without being a part of, and dependent upon, the communities that it connects.

The principle of stratification will be examined again in the discussion of the marine biome, and forest stratification will be used as an illustration of community structure. A forest almost always has the following strata: (1) subterranean, (2) floor, (3) herbaceous, (4) shrub and small tree, (5) canopy. Each stratum is dependent upon the other four and may be thought of as a community in the general sense but is not a major community. Each stratum has its own microclimate, its particularly adjusted stratal fauna and its peculiar organization. Stratal adjustments are abundant and suggest that the stratum places a positive selection value upon certain kinds of adjustments to maintain position or to procure food and shelter. Generally, stratal adjustments for a particular stratum are similar in widely separated forests over the world and species occupying a given stratum in two such forests may be widely separated taxonomically but may have similar requirements. This is the principle of ecological equivalence.

The subterranean stratum, at the bottom of the forest's vertical gradient, is most similar ecologically to the subaqueous stratum of aquatic gradients. Its matrix of soil particles is relatively continuous and homogeneous. Light is absent, and the soil temperature and soil moisture are relatively stable in contrast to higher forest strata. Here are myriads of bacteria, fungi, soil protozoans, nematode worms, earthworms, almost countless mites, numerous insects, moles and the extensive root systems of trees, shrubs and herbs. Moles are good examples of animals adjusted for life in a certain stratum. They have large horny forefeet for tunnelling short tails, minute ears and vestigial eyes. These features are fossorial adjustments and are shared more or less by numerous other ecologically equivalent mammals.

The floor is the second stratum. It is less homogeneous and less continuous than the preceding stratum but much more so than all higher strata. Similarly, it is intermediate between higher strata and the subterranean stratum in its physical and biological conditions. In contrast to the latter stratum, the floor is slightly colder in winter, slightly warmer in summer, dimly lit during the day and more easily obscured by forest fire and flood. It is an insulating layer retarding erosion and accumulating diverse foodstuffs. Its matrix consists of leaf mould and log mould. Here are included fallen leaves in all stages of decay—providing a

characteristic aspect or habitus to the stratum—rotting stumps and prostrate logs, twigs, nuts, fallen fruit and flowers, faeces of animals and their dead and decomposing bodies. In evergreen forests the leaves tend to fall throughout the year, whereas in tropical jungles and rain forests or in temperate coniferous forests in deciduous forests the leaves tend to be deposited in the autumn season.

In addition to numerous animals that live their entire life cycle in the floor stratum, such as many mites and insects, there are others that spend a part of their life in the floor. For example, ladybird beetles (Coccinellidae) move from the herbaceous stratum of grassland communities, as well as from higher forest strata, to form large overwintering aggregations that hibernate in the leafy floor stratum, other animals nest or shelter there but feed by day or by night in higher strata, still others feed in the floor stratum but have their habitat niches elsewhere.

The three succeeding strata differ markedly from the floor. They are structurally discontinuous since the herbs, shrubs and trees rise separately from the soil. Second, the essential matrix is made up largely of animate material in contrast to the largely inanimate matrix of the floor and soil. These three strata provide large amounts of food for herbivorous insects, such as the leaf-feeding chrysomelid beetles, wood boring buprestid and cerambycid beetles, sap sucking aphids and the numerous scale insects (Coccidae) and for herbivorous birds and mammals, as well as for the predators that feed upon this multitude. Many animals shelter in the shrub and tree strata. Deer mice occasionally nest in shrubs and many predators visit shrubs and trees. Tree frogs search for their insect food and the pilot black snake hunts for bird eggs and small mammals.

The leafy crowns of the topmost stratum or canopy interlock to form a forest roof that receives the full force of weather and serves to modify such physical influences as light intensity, light quality, temperature, wind velocity, relative humidity and evaporation rate from the canopy progressively downward to the subterranean stratum. Along the ecotone the canopy often continues downward to within a few feet of the ground and is often secondarily interlocked by vines. In equatorial forests there may be several strata of trees, and true rain forests have three tree strata with correspondingly complex canopies.

All of the five basic forest strata briefly discussed contribute to the well being of the whole major community. During the seasonal growth period the forest climate is relatively cool, dark and moist, and the air is relatively still in contrast to conditions external to the forest. Furthermore, these physical influences are but a few that operate from canopy to subterranean stratum and from the peripheral ecotonal zone to the centre. Consequently, each stratum differs quantitatively in its microclimate.

Community Metabolism.—Such stratified major communities, whether forest, grassland, lake or sea have a basic system of food interrelations or metabolism. This community metabolism is separable into two interlocking phases: (1) an anabolic phase, in which foods are formed, and (2) a catabolic phase, in which foods are broken down.

Community anabolism is divisible into two basic key industries. These are: (1) the bacterial industry, and (2) the photosynthetic industry. Generally speaking, both of these anabolic phases are dominated by plants.

Dead plants and animals are broken down into organic compounds by many kinds of bacteria, known collectively as heterotrophs. Other myriads of bacteria, known as autotrophs, reduce these organic compounds further into mineralized or inorganic salts. Essentially this is the bacterial key industry. It is fundamental to the life of a community and consequently fundamental to the constituent plants and animals. It is these mineralized salts that are finally absorbed by higher or "green" plants, either through their root systems in the subterranean stratum of terrestrial communities or by algae in the surface layers of aquatic communities.

The photosynthetic key industry is carried out chiefly by green plants and to a lesser degree by the poorly known photoautotrophic bacteria. The plant carbohydrates, manufactured in the photosynthetic process, are combined with mineralized salts, ab-

sorbed by the plants, to form plant proteins. These plant tissues are available for the catabolism of the community. This latter phase is carried out chiefly by animals and fungi. The herbivores feed upon the plants, and in turn, they are available as food to the predators, parasites and hyperparasites in several grades of carnivorous and scavengerism. Consequently all organisms are either directly or indirectly dependent upon the bacterial and the photosynthetic key industries, and these latter processes are entirely dependent upon each other and all of the intermediate stages in the food cycle of the entire community.

Food Web—In any given community this circulation of foods is an interwoven system of feeding interrelations. The whole system is spoken of as the food web and the separable strands of food and feeder are termed food chains, although it is apparent that a food chain as such, is an arbitrary device for studying a few directly related portions of the food web.

Many examples of food chains are available but almost none are known completely. A simple example may be cited from a prairie community: the sap of grasses is eaten by aphids, the aphids are eaten by larvae and adults of ladybird beetles, the latter are eaten by predaceous ground beetles, such as *Carabus* and *Calosoma*, these ground beetles are in turn devoured by such birds as dickcissels, horned larks and grasshopper sparrows, finally, these birds may be eaten by marsh hawks. In this chain the several links are in relative biotic balance. When the marsh hawk dies, its body will be decomposed by the bacterial industry noted previously, and eventually mineralized salts will be available for absorption by the prairie grasses, completing the food cycle in a single food chain of the prairie food web.

There are several points to be noted concerning food chains. A species may eat different foods (1) in different parts of its geographic range, (2) in different stages of its life history and (3) at different times of the year.

Pyramid of Numbers—When the food web is examined quantitatively, by counting or estimating the number of animals present per given area or volume of environmental medium, it is found that not only are there many more small animals than large animals, but that the size classes involved form a triangular figure when size is plotted against abundance (fig. 1). Charles Elton in 1927 called this relationship the "pyramid of numbers." Small

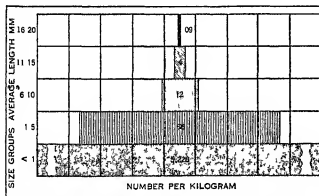


FIG. 1.—A MICRO ELTONIAN PYRAMID OF NUMBERS OF THE METAZOAN FAUNA OF THE FOREST FLOOR STRATUM. CARLE WOODS, A GREEN TIGER BEETLE-SUGAR MAPLE-HORNBEAM FOREST NEAR EVANSTON, ILL. FIVE SIZE GROUPS SHOWN.

animals have a higher reproductive potential than larger ones. Since the energy value of food eaten eventually must balance the physiological energy expended in obtaining and assimilating this food, predators generally eat animals in the next lowest size level or so to conserve this energy expenditure. For example, in the prairie food chain cited, the marsh hawk probably could assimilate the aphid protoplasm but the energy expended in eating such minute prey would be greater than the potential energy of the food. Pyramids of numbers have been investigated carefully for only a few communities. The pyramid has been figured for an

Illinois deciduous forest by Orlando Park, W. C. Allee and V. E. Shelford (1939), for an equatorial forest in Panama by E. C. Williams, Jr. (1941), for tree holes by Orlando Park, S. I. Auerbach and Glenna Cooley (1950) and for certain Wisconsin lakes by Chancey Juday (1942). The food and feeder relationships in the pyramid were examined mathematically by R. L. Landeman in 1947 and his formula was extended and modified by Allee, A. E. Emerson, Orlando Park, Thomas Park and K. P. Schmidt in 1949 as follows:

Trophic Levels—We may consider the community pyramid of numbers to have four or five trophic levels (levels of feeding interrelations), each level containing a variable number of species and each species population containing a variable number of individuals. In the following formulation of the concept, the symbol A represents a trophic level, S is a species population, I is an individual and t is a time component:

$$\left(\begin{matrix} (I_1 & n) \\ (S_1 & n) \\ A_1 & \end{matrix} \right) t, \left(\begin{matrix} \text{etc} \\ A_2 & \end{matrix} \right) t, \left(\begin{matrix} \text{etc} \\ A_3 & \end{matrix} \right) t, \left(\begin{matrix} \text{etc} \\ A_4 & \end{matrix} \right) t, \left(\begin{matrix} \text{etc} \\ A_5 & \end{matrix} \right) t \rightarrow A$$

Photosynthetic plants Herbivores Carnivores Heterotrophic bacteria and fungi Chemoautotrophic bacteria

In this system A_1 would include photosynthetic plants (either or both higher green plants and the photoautotrophic bacteria), that is, the producers. A_2 would include the herbivores, that is, the primary consumers. A_3 would include the carnivores, that is, the secondary consumers. A_4 would include the saprophagous organisms (heterotrophic bacteria and fungi), that is, the tertiary consumers. A_5 would include the chemoautotrophic bacteria, that is, the quaternary consumers. This terminology is one of several devised to clarify major feeding patterns within the whole community. Naturally, all organisms consume, transform, produce and otherwise rearrange and reorganize their protoplasm and their habitats.

Two points need amplification. First, omnivores encompass both A_2 and A_3 . Second, A_2 must be factored to allow for several predator grades within this level. That is, S_1 population feeds on A_1 , but S_2 usually feeds on S_1 , S_3 feeds usually on S_2 , etc. The result of this series of internal relationships within the level of secondary consumers complicates the third term of the trophic level formula, where P stands for a given grade of predator, as follows:

$$\left(\begin{matrix} (I_1 & n) \\ (S_1 & n) \\ P_1 & \\ A_2 & \end{matrix} \right) t$$

There are exceptions to the pyramid of numbers. These are generally found in animals that have special feeding adjustments which enable them to concentrate on small prey. The whalebone whales strain enormous numbers of minute organisms from the sea, and the paddlefish strains many small crustaceans from the waters of the Mississippi valley.

Biomass—When a species population is weighed, in part or as a whole, the weight of the population can be examined in relation to other parts of the pyramid or food web. Walter Pickles in 1937 developed this concept in relation to ants and defined biomass as the weight of a species population per unit of area. Obviously, the biomass could be determined for each link of a food chain, or for each stratum of a community or for the whole community.

Productivity—When pyramids, or numbers of animals, and biomasses, or weights of animals, are discussed, the production potentials for a given area or volume of a given habitat become important. Productivity can be thought of in several ways. There is the annual crop production as well as the standing crop production, this latter meaning the amounts of protoplasm or protoplasmic products present at a given time and place. In these two concepts amounts are involved, as bushels of corn, board feet of lumber or pounds of beef or herring per acre of prairie, forest or sea surface.

A second way of thinking of productivity is in terms of the efficiency of production. For example, E. N. Transeau calculated that the photosynthetic efficiency of field corn (10,000 plants per

acre) was only 1.6% in terms of the total solar energy that was available for one acre. Corn production is usually thought of as high, yet the actual efficiency is low, and the relative efficiencies of animals feeding on this staple food are important to man and his domesticated animals. A third way in which production can be viewed is in direct energetic terms, calculating the rate of production and amount of production in gram calories (g cal) per unit of area per unit of time, using the solar energy as the total amount available. G. L. Clarke discussed this aspect of productivity for a part of the North Atlantic in 1946. His general conclusions are applicable broadly to community metabolism. On Georges bank, off the coast of New England, the energetic input for the marine community in terms of light energy is 3,000,000 g cal per day per square metre of sea surface. The diatoms are important phytoplanktonic organisms in the photosynthetic industry. These abundant minute algae had a net production rate of from 0 g cal to 9,000 g cal per day per square metre of sea surface, that is, the efficiency of diatom production was 0.3%. The zooplankton feeds primarily upon the phytoplankton. The net production rate of these minute, free floating animals was from 0 g cal to 440 g cal per day per square metre of sea surface, that is, the efficiency of zooplankton production was only 0.015%.

In turn, the fishes feed directly on the zooplankton, or on bottom-dwelling organisms, or are indirectly dependent upon these animals in the case of predaceous fishes at higher predator levels. That is, both zooplankton and fishes are dependent directly or indirectly upon the phytoplankton. These latter organisms are directly dependent upon the light energy and nutrient salts dissolved in the water, as previously discussed. On Georges bank data were obtained on the weight of whole fishes of all species landed annually. Weight of the catch varied from 63,000,000 lb to 289,000,000 lb per year over the 10,000,000 ac of Georges bank. This represents a yield of from 7 to 33 lb of fish per acre per year. Assuming an energy content of 740 g cal per pound for raw fresh fish, the yield of fish landed per acre per year is equivalent to a production rate of 1.6 to 7.7 g cal per day per square metre of sea surface. That is, the efficiency of production was from 0.00005% to 0.00025%.

From this analysis it is clear that production efficiencies decline rapidly from lower to higher trophic levels in the pyramid of numbers of a major community. Naturally, the details will vary as between parts of the same community, and between different communities of the same type and between different types of communities.

Ecological research is essential in productivity problems. At present there is much more solar energy available than is being utilized by plants and animals. Man uses more and more food as his population increases but returns relatively little available energy to the food cycle. When his global population cannot be supported by the available food supply, the problem of overpopulation will affect adversely the conservation of natural resources. Loss of natural resources will in turn adversely affect the food supply.

Periodicity.—Another basic feature in community organization is that of periodicity. The activities of animals, in their search for food, shelter and mates, fall into one of two categories. These are periodic activity and aperiodic activity. Most of the large activities of communities are periodic and are correlated with the regular march of such physical influences as relative length of day and night, daylight intensity, air temperature and distribution of precipitation. In fact, correlation of community activity in the large with the periodic physical environment is essential for survival.

Periodic activities are of three general kinds at the level of the major community. The first of these is seasonal. Involved are the growing season for plants, the mating periods for animals, the several aspects of dormancy including hibernation and aestivation; the correlations in photoperiodicity, or the relation between the leafing, flowering, fruiting of many plants with the relative length of day and night throughout the year, and the problem of migration. Study of periodic, seasonal events is known as

phenology, and when a sequence of phenological changes is followed through the annual cycle and related to environmental factors, the general process is termed seasonal succession, or aspection. The year is often divided into a series of periods that are correlated with seasonal phenomena, such as the peaks of abundance of certain populations that are characteristic of a particular community or type of community. Typical species are frequently known as index species, and their seasonal population peak, or the appearance of some characteristic behaviour or structural change may serve as an index of the time of year as well as the kind of community under examination.

Within this seasonal frame, certain animals exhibit reproductive phenomena that are correlated with tidal or lunar events. Such animals include the palolo worms, e.g., certain marine annelids that swarm and spawn at certain times of certain months. All such phenomena are embraced by the term lunar periodicity.

Finally there are the changes in community activity that are correlated with the regular march of day and night and are termed diel activities. These are divisible into diurnal and nocturnal activities, associated with the day and the night, respectively. Where the crepuscular periods of overlap between day and night are examined particularly, the dawn and dusk periods are termed auroral and vespereal, respectively. Probably the most important diel activity is the diurnal manufacture of carbohydrates by photosynthetic plants. The nocturnal complementary process is the distribution of much of this carbohydrate material to other parts of terrestrial plants. Another diel phenomenon is the vertical migration of many minute animals that inhabit the surface stratum of the sea. These animals include many protozoans and copepod and cladoceran crustaceans. They move to the surface during the night and move downward during the day, apparently as a direct or indirect response to light intensity, as well as being carried passively by diel convection currents.

Communities commonly have a well defined diurnal fauna and a well defined nocturnal fauna, and there are numerous special adjustments that allow animals to compete and co-operate within this diel periodism of the physical influences. The vertical pupil of many snakes, such as rattlesnakes, is not necessarily an indication of their venomous nature but is an adjustment to their nocturnal habits. Some diurnal tree squirrels have the lenses of their eyes slightly yellowish in colour whereas the lenses of the nocturnal American flying squirrels (*Glaucomys*) are perfectly translucent and allow all available light to filter upon the retina. Again, most nocturnal cats have a reflecting layer, or tapetum, back of the retina and a similarly light-reflecting layer is found in the eyes of certain nocturnal moths and beetles. The tapetum is the structure that causes the eyes of such animals to glow in the light of an electric torch at night. The bioluminescent organs of the common fireflies or lightning bugs (lampyrid beetles) are adjustments that enable these nocturnal beetles to light at night.

Almost all communities are divisible into two periodic faunas, the diurnal and the nocturnal. As a consequence, the number of available habitat niches as well as the population is increased. This in turn increases the number and kinds of possible interrelations and renders the community more biologically complex. By this more complete utilization of the space time lattice, the whole community considered as a unit approaches aperiodicity with respect to day and night in a physically periodic environment.

In the second category of activity, the aperiodic type does not exhibit rhythmic correlation with the 24 hr cycle of day and night. Instead, in aperiodic species populations some individuals are active and some inactive at any given time. Such aperiodic patterns are of two kinds. First, there are those species that inhabit relatively stable environments that are removed from direct periodic diel influences. These include the cave crayfish (*Cambarus pellucidus*) of Mammoth cave, Ky., certain animals that inhabit the relatively constant subterranean stratum of terrestrial communities, or the interior of decaying logs on forest floors, such as the subsoil beetle, *Pogonocherus disjunctus*, the flour beetle (*Tribolium confusum*) that lives in the relatively stable habitat of stored food products. Second, some of the social animals are aperiodic, such as many kinds of ants and termites. Also, as man's

social organization becomes more complex, his activities as a whole tend to become arrhythmic. Other social species are not aperiodic, as for example many bees and wasps and some ants, but it is difficult to conceive of a wholly social species having its activity rigidly controlled by the periodic environment. Whether animals such as man evolved socially first and became aperiodic as an adjustment to social life, or were aperiodic first and became social later is an unanswered question. At least the aperiodic pattern is correlated with a relatively constant environment, whether this is the complex social medium or a habitat that is removed from direct control of diel factors.

PRINCIPLE OF SUCCESSION

Turning from community organization, another important aspect is the growth and change of communities through time. This process is known as ecological succession and can be separated into two components. The first of these is physiographic succession and has to do with changes induced by physiographic factors. This form of succession was described by H. C. Cowles in 1901 with respect to the series of communities that gradually arose as post-glacial Lake Chicago drained away leaving the smaller Lake Michigan and the Chicago plain in its place.

The effects of physiographic influences were summarized by H. C. Cowles in a classic statement ("The Plant Societies of Chicago and Vicinity", The Geographic Society of Chicago Bulletin No. 2 [The University of Chicago Press, 1901]).

Having related the vegetation largely to topography, we must recognize that topography changes, not in a haphazard manner, but according to well-defined laws. The processes of erosion ultimately cause the wearing down of the hills and the filling up of the hollows. These two processes, denudation and deposition, working in harmony produce plantation, the inequalities are brought down to a base level. The chief agent in all these activities is water, and no fact is better established than the gradual eating back of the rivers into the land and the wearing away of coast lines, the material thus gathered fills up lakes, forms the alluvium of flood plains, or is taken to the sea. Vegetation plays a part in all these processes, the peat deposits adding greatly to the rapidity with which lakes and swamps are filled, while the plant covering of the hills, on the contrary, greatly retards the erosive processes. Thus the hollows are filled more rapidly than the hills are worn away. As a consequence of all these changes, the slopes and soils must change, so, too, the plant societies, which are replaced in turn by others that are adapted to the new conditions.

Successional changes of this kind are widespread and basic. Erosion and deposition of soil by both wind and water profoundly modify the earth's crust within a given climatic period, and such changes alter the structure of terrestrial and fresh water communities to such an extent that established populations of plants and animals are unable to cope with the changed conditions, and their place is taken by other species that can adjust, hence, the communities succeed each other through time.

The second component in ecological succession signifies changes in community structure brought about through biological action, e.g., the numerous changes induced by the plants and animals resident in a given community. These processes and their effects collectively have been termed community development. For example, waste products, faeces, decay of dead organisms, formation of organic soils, filling up of lake and pond bottoms with organic sediments, and other influences gradually change a com-

climax in that, for a given latitude, altitude and climatic period, the physiographic and biotic changes have become relatively stabilized and can be tolerated by resident populations. At high latitudes the substratum of the climax community may be very unstable. Normal community succession may be modified, deflected or arrested within any sere. The normal filling up of ponds to form marshes, and of marshes to form pioneer grassland or forest, and these latter to form a climax high grass prairie or a climax beech sugar maple forest in a certain area will occupy a long period of time. This has important practical significance for the formation of man's food supply, his fisheries, duck populations, corn and wheat yields or lumbering activities. Scientific management is clearly indicated rather than hasty action in attempting to alter natural processes. Where a community originates and is maintained by human disturbance it is an artificial community and is termed a disclimax. Where succession and development take place relatively unmolested by man, or his indirect influences, the sequence is a primary sere (prisers), where development and succession are controlled by man, or his indirect influences, the sequence is a secondary sere (subser).

Succession and development of a sere are also frequently controlled by local conditions primarily, rather than by the prevailing climatic conditions. Local effects are termed edaphic, and edaphic seres are common. Two powerful edaphic influences are soil and water. The edaphic aquatic sequences are of two general kinds: the flowing water sere, in which the change is from small, swift brooks with high velocity, to the edaphic climax of an old, meandering river that has cut its bed to the base level and meanders through a silted flood plain, and the standing water sere, in which the change is from bare bottomed ponds and lakes to marshes or bogs, and finally filling up to form the pioneer stages in a terrestrial sere, either grassland or forest, as a rule, depending on the seasonal distribution of rainfall and other climatic factors.

As the community as a whole undergoes this change, there are almost innumerable intracommunity sequences taking place. These are known as microseres and include changes that take place in cattle droppings in the prairie community, in the decaying bodies of animals, the decomposition cycle of fallen logs and stumps, tree holes and the disintegration of fungi in the forest community. All of these microseres follow a regular sequence of biochemical, structural and biotic changes but are without a climax stage as they are incorporated into the major community as it matures.

PRINCIPLE OF CONVERGENCE

Consequently, an important principle emerges at the level of community maturation. This is the principle of convergence. That is, there is a general tendency for edaphic seres to run their course, for microseres to wax and wane and for climatic seres to mature from pioneer to climax. In the end, often over many centuries, an entire region tends to develop into the regional climatic climax.

Convergence was emphasized by H. C. Cowles in 1901. With his aid, V. E. Shelford applied the principle to the Chicago area in 1913. It was generally treated by F. E. Clements and V. E. Shelford in 1939. The principle is illustrated well in northern Indiana. For example, four seres may be mentioned. These are: (1) sand, (2) clay, (3) flood plain and (4) pond. The pond eventually fills, passes through a marshy cattail stage, the ground is captured by a series of terrestrial communities, the sand and clay seres accumulate humus and, in the end, all four seres meet in the common development of a beech sugar maple forest. This latter is a climatic climax for the particular area. The faunistic and floristic composition of the climax varies with altitude and altitude, but the principle of convergence has many broad implications.

BIOMES

changes may be described, are relatively continuous and to some extent are directional and hence may be predicted. This process of change continues until a stable end product is reached that will endure normally for the existing climatic period. A sequence or series of communities is termed a sere, the early stages are known as pioneer communities and the relatively stable end product is the climax community. This latter community is a climatic

Communities and major communities, whether edaphic or climatic, pioneer or climax, are distributed over the terrestrial parts of the world in a series of broad belts from poles to the equator. In general, although edaphic influences alter the regularity of these

belts, they are couched with similarly broad climatic zones. The communities that occupy any one of these zones, including the extensions caused by the latitude factor, are known collectively as a biome. The biome is the largest ecological unit. It is seldom continuous, covers a large part of the earth and is subject to considerable intrabiome variation. The biome consists of a single climatic type, which usually varies in composition with latitude and altitude, and many subsidiary seres. It holds almost innumerable major communities, each self-sustaining and each consisting of many dependent communities and species populations. Convergence operates over any given biome through time.

The accompanying table gives the major details about the terrestrial biomes. This highly condensed summary of a tremendous subject does not stress the obvious fact that there are many intergradations between biomes, such as semidesert. Study of biomes is an important aspect of ecological animal geography and cannot be evaluated properly here (see DISTRIBUTION OF ANIMALS).

coral reefs 100 mi apart are independent of each other but are dependent upon the minute organisms in the adjacent sea water for their initial food supply. The coral reefs are communities, but the whole sea is the major community.

The marine biome has the same basic structure as any other major community. That is, it possesses both vertical and horizontal strata and zones, its metabolism is based upon the photosynthetic and bacterial lake industries and its food cycle involves the same general principles, finally, its activities in lighted regions are primarily periodic, involving seasonal, lunar and diel rhythms.

Aquatic organisms are separable into three ecological categories. These are plankton, nekton and benthos.

Plankton—Plankton comprises feebly swimming and free floating organisms that cannot move against a current. On the basis of size planktonic organisms are separable into (1) macroplankton organisms that are visible to the unaided human eye, (2) net plankton, organisms secured by a plankton net with meshes

| Terrestrial Biomes | | | |
|---|--|---|--|
| Biome | Distribution | Climate | Typical animals and generalities |
| Equatorial forest (tropical rain forest) | Circa 10° N to 10° S About 6,000,000 sq mi, mostly in Amazon basin, Central Africa, India, Malaysia, Congo basin, Australia and Oceania. In much of Central America and northern South America. | Rainy low latitudes Humid and warm rainfall 50 in to 150 in per year, evenly distributed but with some areas having one or more dry seasons. | Monkey, lemur, antelope, ape, shark, lion, elephant, army ant, driver ant, many termites, arboreal ant, <i>Peripatus</i> and allies, toucan, parrot and parakeet. Mammals typically thin haired (fauna 40% diurnal and 60% nocturnal). 11% amphibious, 10% diurnal and 10% nocturnal. Communities with many strata, e.g., true rain forest at least 70 m in annual with three tree strata and arboreal adjustment extensive. |
| Grassland (temperate steppe, prairie, pampas, llanos) | Bordering deserts of Asia, Minor and central Asia. North America from Texas northward into Canada and eastward to the 100th parallel. | Great temperature extremes in winter and summer. Annual rainfall 20 in to 40 in for tall grass and 10 in to 20 in for short grass. | Antelope, gazelle, Mongolian gazelle, wild ass, Bactrian camel. North America: bison (buffalo), pronghorn (pronghorn antelope), prairie dog, grasshopper, typically abundant. Many adaptations to hibernation and aestivation. Steppe mammals 40% diurnal and 60% nocturnal in general. Grasshopper swift, mule deer and bison fertility. Cursorial and for social adjustments many. |
| Tropical (savanna, pampas, llanos) | Tropical areas in Africa, Australia and South America. | Generally warmer with shrubby plants or trees scattered over grassy floor. | Australia: kangaroo. South America: pampas deer, armadillo abundant. Africa: certain baboons, lion, hyena, certain buffalo, giraffe, zebra, square-jawed rhinoceros and many genera of antelope (eland, kudu, addax, wildebeest, hartebeest, blesbok, bontebok, etc.). |
| Desert | Many areas over the world. Death valley in United States, parts of southern South America, Sahara and Kalahari in Africa, Syrian Arabia, Iran and Tibet in Asia, part of Namibia and interior of Australia. | Annual rainfall less than 10 in. Death valley and Sahara have July means 10° F, January means of 64° F with usually cold nights and hot days. | If semidesert and desert are combined, this biome would cover about one fifth of terrestrial area, or 11,500,000 sq mi. Aestivation common and nocturnalism typical. Characteristic desert forms include: Gila monster, sidewinding rattlesnake, desert fox and desert jack rabbit, fennelbush, desert monitors (Australia), horned viper (North Africa and Arabia). |
| Temperate deciduous forest | North temperate zone of eastern North America, Europe, western and eastern Asia, Japan. Parts of Northeast China, eastern coastal areas in Australia, New Zealand. | Annual rainfall of 40 in to 60 in, usually well distributed. Winter and summer well defined with at least four months with a mean temperature more than 50° F. | Wombat (European bunnies) and red deer. In the United States: Virginia deer, black bear, bobcat, flying squirrel, tree squirrel and chipmunk, numerous snails (<i>Polysylla</i>), carabid beetle (<i>Dicranus parvulus</i>), certain salamanders (<i>Plethodon cinereus</i>), common box turtle and the pilot black snake are typical. The biome has numerous types of climax forests: the chief trees being red oak, hickory, sugar maple, tulip, chestnut, black cherry, magnolia, live oak and cypress. |
| Tundra (coniferous forest) | Circumpolar in the subarctic and north temperate zone of America, Europe and Asia. | Annual precipitation between 0 and 40 in, much of which is snow. Winter season long and severe. | This vast forest is notable for lumber and fur, and in many areas its fur is intergraded with the deciduous forest fauna (e.g., in North America tree squirrel, flying squirrel, chipmunk, Virginia deer, bobcat, black bear). Moose, caribou or reindeer, lynx, wolf, for marten, weasel or ermine are characteristic for both Europe and North America. The maral stag, wild dog, and tiger are Siberian. Caribou has the skunk and puma. There are numerous woodpeckers; canbills are especially typical of coniferous woods. |
| Tundra (snow and ice deserts) | Polar and alpine regions of the northern hemisphere, tundra and barrens for most of the year. Generally from northern limit of tundra to Polar sea. Southern hemisphere: alpine zones of Andes, and certain mountains in Australia. | Annual precipitation small, not more than 10 in except for part of Greenland. Winter long and summer short. Temperature of warmest month never exceeds 50° F. | Birds and mammals are either migratory or depend on ice for food supply with the exception of few birds including the reindeer and ptarmigan. Typical mammals include the reindeer, caribou, musk ox, ermine, arctic hare, arctic fox and lemmings. |

Marine Biome—The seven terrestrial biomes summarized in the table, with their numerous alpine extensions and interbiome intergrades, cover only about 10% of the world's surface. The remaining 90% is covered by ocean waters and their adjacent seas.

This vast expanse forms the eighth or marine biome. This biome contains almost innumerable communities but is a single, self-sustaining, independent, major community. Consequently, whereas terrestrial biomes each have many major communities, the marine biome and major community are synonymous. For example, given radiant energy from the sun, two oak forests 100 mi apart are independent of each other and of adjacent meadows and lakes. Each forest is a major community. Two

between 0.03 and 0.04 mm wide and (3) nanoplankton or microp plankton, minute planktonic components that pass through the meshes of a plankton net. Commonly, plankton is divided into phytoplankton and zooplankton. Phytoplankton consists of the minute, unicellular plants and animal like plants. This important group forms the major part of the photosynthetic key industry of the marine biome as a consequence of the diatoms, dinoflagellates and their allies, it also includes myriads of bacteria and consequently plays an important role in the bacterial key industry previously discussed.

Phytoplankton is so important to the food cycle and numerous related problems in productivity that some mention must be made of the seasonal abundance of diatoms. In arctic and temperate

upper waters the diatom population is relatively low in winter, increases rapidly in the spring, falls off in summer, increases slightly in autumn and falls again to the winter low. This cycle in seasonal abundance is illustrated in fig 2.

Many ecological influences are involved in this population cycle. For example, light intensity, water temperature, nitrate and phosphate salts, and winds. Sea water is enriched constantly by marine salts that have been formed by bacterial action, and these salts are utilized by phytoplankton in building the protoplasm. In the winter the concentration of these salts is high, but the light is insufficient for maximum photosynthesis and the diatom production is low. In the spring the production is rapid since salts and light are ample, but meanwhile the upper layer of water is warming rapidly and a discontinuity layer forms between the upper warmer and lower colder layers of water. This interposed layer, because of its electrical properties, prevents upwelling of nitrate and phosphate salts in sufficient amounts to be utilized by the rapidly growing diatom population. Consequently, the production falls rapidly since the diatoms have exhausted the supply of these salts in the upper level, above the discontinuity layer. Summer, then, has a lowered population, although light is ample. In fact, it is an illustration of J. von Liebig's "law of the minimum," which states that growth is limited by the factor that is operating in minimal quantity. As summer draws to a close, the falling temperature of the upper water approaches that of deeper waters, the discontinuity layer disappears and phosphate and nitrate salts are diffused upward by partial pressures, as well as by the mixing of waters that occurs during autumnal gales. Since the light intensity is still sufficient for photosynthesis, and salts are present for metabolism, there is a second, or autumnal, peak of diatoms. This latter does not equal the spring, or vernal, peak, since the approaching winter, with its lowered light intensity, will prevent an equal growth of the diatom population.

The production of vernal and autumnal peaks or pulses of phytoplankton in the temperate zones of the sea are paralleled by similar peaks in large lakes, but not necessarily in smaller bodies of fresh water.

Zooplankton consists of many groups of animals, most of which feed upon the phytoplankton. Zooplankton commonly is divided into several categories. There is the temporary plankton, consisting of planulae eggs and larvae of nonplanktonic adults of both fishes and invertebrates. Permanent plankton makes up the rest of the zooplankton, animals that live all their lives as planktonic individuals. Temporary plankton and permanent plankton are called at times meroplankton and holoplankton, respectively. The latter includes protozoans, especially radiolarians and foraminiferans, many worms, jellyfishes and siphonophores, certain molluscs, such as the pteropods and heteropods, and especially crustaceans. These latter are to the sea what the insects are to terrestrial habitats and include chiefly copepods, ostracods and amphipods. The copepod, *Calanus finmarchicus*, is an especially important member of the surface-water community since its numbers provide suitable food for many animals higher in the pyramid of numbers.

Nekton—The nekton consists of animals that can move against currents. These are generally larger animals, including fishes and squids. Most commercially important fishes are nektonic and feed upon the plankton or are predaceous (such as sharks) and feed on other fishes. Marine mammals such as seals, porpoises and whales are nektonic.

Benthos—The last division of marine animals, the benthos, includes those forms that inhabit the sea floor and subaqueous strata of the community. They consist of active benthos, such as many crabs and snails that move over the floor or burrow through the bottom substrate, and the passive benthos, such as numerous colonial coelenterates and sponges that remain attached to the bottom as benthonic adults.

Stratification—Stratification of the sea is both vertical and horizontal. The upper sea, or less, is illuminated by daylight that is reduced gradually in intensity and spectral quality with increasing depth. This upper layer is called the photic zone. The plankton inhabit this zone primarily since the phytoplankton must stay in the upper stratum of this zone to carry on photosynthesis, and the zooplankton feed chiefly on these minute plants. Most nekton live here as well, since they too are directly or indirectly dependent upon

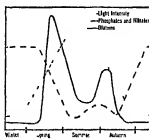


FIG. 2.—THE RELATION OF DIATOM SEASONAL ABUNDANCE TO THE CONCENTRATION OF NITRATES AND PHOSPHATES IN THE UPPER LAYER OF THE SEA AND TO LIGHT INTENSITY. ONE OF THE BASES OF THE MARINE FOOD CHAIN. (AS ADAPTED WITH PERMISSION AFTER RUSSELL AND YONGE THE SEAS OUR KNOWLEDGE OF LIFE IN THE SEA AND HOW IT IS GAINED. PUBLISHED BY FREDERICK WARNE & CO. LTD.)

for photosynthesis. This, incidentally, is an illustration of J. von Liebig's "law of the minimum," which states that growth is limited by the factor that is operating in minimal quantity. As summer draws to a close, the falling temperature of the upper water approaches that of deeper waters, the discontinuity layer disappears and phosphate and nitrate salts are diffused upward by partial pressures, as well as by the mixing of waters that occurs during autumnal gales. Since the light intensity is still sufficient for photosynthesis, and salts are present for metabolism, there is a second, or autumnal, peak of diatoms. This latter does not equal the spring, or vernal, peak, since the approaching winter, with its lowered light intensity, will prevent an equal growth of the diatom population.

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the phytoplankton for food.

Below the photic layer is a deep aphotic zone, where light gradually fades out, the water pressure gradually increases, and the temperature is relatively constant at a few degrees above freezing.

These two zones include the water mass of the sea and are often known collectively as the pelagic division.

The sea floor forms the second or benthic division. It consists of the more or less concentric zones attached to the sea bottom between terrestrial and marine, or fresh water and marine, communities and extend seaward. The sea floor is divisible primarily into two subdivisions, the littoral system and the deep sea system.

The littoral system is again subdivisible into two zones. The first of these is the eulittoral zone, from high tide level on the shore seaward to a depth of about 40 to 60 m. The seaward limit is placed at about the place where attached plants can grow. This photic aphotic limit naturally varies with latitude. Within the eulittoral zone is a relatively well defined intertidal zone that is bounded by high water and low water extremes of tide.

The sublittoral zone as a whole is rich in life, having an abundance of both pelagic and attached plants and animals. Its substrate is also highly variable. There are three chief types—sandy, rocky and muddy—as well as intergrades, such as sandy-mud.

The second littoral zone is known as the sublittoral. This extends from the seaward limit of attached plants seaward to about the 100 m limit of the sublittoral zone downward to about the 1,000 m limit of the depth of the water at the outer edge of the continental shelf and also more or less with the depth that divides the aphotic and photic zones noted previously.

The deep sea system is similarly divisible into two zones. The first of these is known as the archibenthic zone. It extends from the 100 m limit of the sublittoral zone downward to about the 1,000 m limit. Its exact lower limit is variable. From about this latter depth to the sea bottom is the second deep sea zone, the abyssal region.

The archibenthic zone is relatively uniform physically. Daylight is absent and the temperatures vary from about 5° to -1° C. Since there are no seasons, the seasonal rhythms so typical of the eulittoral zone are absent. Since there are no attached plants and no phytoplankton, the animal populations consist of parasites, carnivores and scavengers.

The abyssal zone is similar generally in physical conditions to the deep sea zone, save that of increasing water pressure. The abyssal populations are sparse, decreasing in numbers with increasing depth and with increasing distance from the shore. The fauna is thought to be endemic, limited to the area rather than impoverished ecological extensions from higher zones. Scarcity of food appears to be the chief limiting factor. These weird animals are predaceous, feed on detritus or are parasitic. Attached plants are absent, save possibly for bacteria. The abyssal forms are entirely dependent on upper levels for food. This is sparse since decomposing animals, falling from the surface layers, are broken down by heterotrophic bacteria in the upper and intermediate strata as a rule. Food input for the abyssal region then, must be derived largely from pelagic animals of intermediate depths that are, in turn, dependent on the surface layers above them. The abyssal animals exhibit numerous structural adjustments to the great pressures of their habitat, and many deep sea and abyssal fishes are provided with bioluminescent organs.

HISTORY

In this brief survey of animal ecology only a small portion of the science can be dealt with. Historically, the subject is old in that some of its material is derived from natural history and some autecology was known to Aristotle. In modern terms, ecology is of recent origin as an organized science. It was established at about the time that another biological science, genetics, was recognized.

In the 18th and early part of the 19th centuries there was considerable tact and fancy in natural history. In 1869 Ernst Haeckel stated that the individual was a product of co-operation between the environment and organismal heredity. This relationship he termed "oecology."

Haeckelian "oecology" was more or less forgotten in the activity that resulted from publication of Charles Darwin's theory of natural selection in 1859, which was strange since Darwin's theory was primarily an ecological theory of evolution, stressing the environment as a selection agent over long periods of time. Ecology was placed on a modern basis, more or less, by F. A. Forel in Switzerland in 1892, E. B. Warming in Denmark in 1896 and by the Americans F. A. Birge, H. C. Cowles and F. E. Clements between 1891 and 1905.

Thereafter, research in ecological subjects tended to stress quantitative and statistical methods increased the scope of the science and more interrelations became apparent between ecology and taxonomy, physiology, biochemistry and geography. Study of microclimate and microhabitat became increasingly important. There was a growing emphasis among ecologists to evaluate their data in terms of evolution and of conservation.

BIBLIOGRAPHY—The British Ecological Society was founded in 1913 and publishes the *Journal of Ecology* and the *Journal of Animal Ecology*. The Ecological Society of America was founded in 1916 and publishes the *Bulletin* and the research journals *Ecology* and *Ecological Monographs*.

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ECOLOGY OF PLANTS AND PLANT SCIENCE

ECONOMIC ARTICLES The large subject economics is dealt with in this work under many headings. The article **ECONOMICS** is a general survey of the development of economic theory. Further discussions of different branches of the subject will be found in the articles entitled **CAPITAL, EXPORT OR, CAPITAL AND INTEREST, CAPITALISM, COMPETITION IN INDUSTRY, DEMAND, DIMINISHING RETURNS, ECONOMIC MAN, LABOUR, LAND, LAND NATIONALIZATION, LAND TENURE, ECONOMIC AND AGRARIAN ASPECTS, MINIMUM WAGE, PRICE, PRICES, STATISTICS OF, PROFIT, RENT, SUPPLY AND DEMAND, UTILITY, VALUE, WAGES, WEALTH**.

Various schools of economic thought are treated in the articles **ANARCHISM, BOLSHEVISM, COLLECTIVISM, COMMUNISM, CO OPERATION, CO PARTNERSHIP, LAISSEZ-FAIRE, MERCANTILE SYSTEM, MUNICIPAL TRADING, PROFIT SHARING, SINGLE TAX, SOCIALISM, SOCIALISM PRINCIPLES AND OUTLOOK, SYNDICALISM**. A special article is devoted to **FASCISM** in its economic aspect.

For a key to the many articles relating to banking, money, finance and taxation, see **FINANCE, ARTICLES ON**.

The department of fiscal policy is treated under the headings **COMMERCIAL TREATIES, CUSTOMS UNION, FAIR TRADE, FREE TRADE, IMPERIAL PREFERENCE, PROTECTION, RECIPROCITY, TARIFFS**.

For related articles of importance see **COST OF LIVING, HOUSING, LUXURY, PROFITEERING, RURAL DEPOPULATION, SOCIETY, TRADE CYCLE, URBANIZATION, USURY**.

There is a group of articles relating to industrial and commercial combinations under the headings **COMBINATION IN INDUSTRY, COMBINES, COMPETITION IN INDUSTRY, MONOPOLY, PRICE MAINTENANCE, TRUSTS, etc.** For associations of trades, see **INTERNATIONAL CHAMBER OF COMMERCE, INTERNATIONAL TRADE ASSOCIATIONS AND CONGRESSES, TRADE ORGANIZATION**. The organization of labour is treated under **INTERNATIONAL, THE, TRADE UNIONS**.

For the relations of capital and labour see **INDUSTRIAL RELATIONS**.

The problems of poverty are dealt with in the articles **CHARITY; POOR LAW, POVERTY LINE, SLUM, SWEATING SYSTEM, UNEMPLOYMENT; VAGRANCY, WORKHOUSE**.

Under **INSURANCE** will be found reference to various methods of insuring.

As to economic practice and the actual production and distribution of wealth, reference should be made to the economic sections under the heading of each country and, in addition, to the articles **AGENTS IN BUSINESS, AGRICULTURE, A GENERAL SURVEY** (a spe-

cial key will be found under the heading **AGRICULTURAL ARTICLES), COMMERCE, EXPORTS, IMPORTS, INDUSTRIAL RELATIONS, RESEARCH, INDUSTRIAL, SALESMANSHIP, SCIENTIFIC MANAGEMENT, STANDARDIZATION, TRADE, WORLD STATISTICS**.

For the discussion of questions of population, in which all economic endeavour may be said to be summarized, see the articles **BIRTH CONTROL, BIRTH RATE, DEATH RATE, MARRIAGE RATE, POPULATION**.

ECONOMIC MAN The term *homo economicus* has often been employed with an ironical significance, by critics of political economy, and has been especially directed against the English economists who founded the Classic school, such as David Ricardo and Nassau Senior. Critics reproach them with having based a science of economics on the conception of an "abstract man," a creature moved solely by exclusively economic motives. The German economists, in particular, have opposed to this conception a rival method, the so called "historical," or "realist," school, which studies *men* (not man) under the sundry aspects evolved in different ages and countries. They maintain that this method alone is fruitful and capable of indefinite renewal, while the conception of the *homo economicus* can lend only to a few general formulas devoid of any practical application. It must, however, be admitted that the science of economics could never have been developed had it not seen men as something more than different individuals and had it not first regarded the characteristics common to all. Long ago Aristotle said, "there is no science except of the general," individuals, objects, facts, being, so to speak, merely accidents, deviations from the true type. The existence of a science of economics implies that men generally, if not invariably, behave in the same fashion when placed in the same circumstances. If they are purchasers, they will always prefer the cheaper of two products of equal quantity, or, if price is equal, that of better quality. If they are workers, they will seek the kind of work which is least laborious and best remunerated. If they are owners of an object, they will not part with it or lend it without return.

The real failing of the early economists was their habit of too wide generalization. The French economists of the late 18th and early 19th centuries, such as the physiocrats and Jean Baptiste Say, declared that political economy is possible only if every distinction of time and nationality is suppressed. The historical school was right in protesting against this conception of a universal and eternal national order, and substituting for it that of economic systems differentiated by time and circumstance. It does not study the "typical man," but the man of the 20th century or of the 1st, the bourgeois or the workman, the man of the west or him of the east, the town dweller and the country dweller, and restricts its concentric circles progressively to approach reality through successive approximations. Nevertheless, these remain generalizations, although increasingly narrow ones. The individual case, the conduct of John or William, so far as it is isolated, "eventive," as it has been well termed, is of no interest for the economist, unless this individual case, by generalizing itself, becomes the starting point for a new generalization, and inaugurates a new column to a statistical table.

The dispute between the economists of the *homo economicus* school and those of the realist, or historical, school is a revival of the great conflict which divided the mediæval scholastics for several centuries, between the "Universals" and the "Nominalists," the former affirming, with Aristotle, the reality of abstract and general ideas, the latter seeing in them nothing but words, names, categories, corresponding to no reality.

The Nominalists were ultimately victorious, and founded modern science, the product of observation and experimentation. The latter is directed toward the particular, and, indeed, the most minute facts, which were considered negligible by the Universals, are most highly prized by the students of today. It has been said that the domain of discovery begins beyond the fourth decimal point, which is to say that it is only at this point that a universal law can be shaped, unless a sagacious observer sees a new vista open before him. Only when observations, pressed to the last limit of precision, revealed certain discordances in the movement of luminous rays, could Albert Einstein's theory be formulated.

Nevertheless, the rôle of deduction in physical science is far from played out, for while students struggle to relate phenomena to unity, others work unceasingly to discover divergences in that unity. It is the same in the science of economics.

The Abstract Man—The general expression "homo economicus" has, however, a further significance. It is not merely the individual, the "average man", not merely the typical man who unites within himself all the characteristics of the human race. On the contrary, it is man stripped of all characteristics other than the purely economic, that is to say, impelled by no motive other than that of interest. It is here, above all, that this view of the science of economics lends itself to criticism, and seems to merit Carlyle's virulent description of "the dismal science." This criticism is, however, misplaced, for it is obvious that after having reduced man, *ex hypothesi*, to a skeleton, one cannot expect to find in him a heart.

Here, too, we must grant science, even in the case of a social science, the right, even the necessity, of elimination. If a physicist studying mechanics must eliminate all phenomena capable of affecting the motion, such as friction, so much the more may the economist, to clear his way in the tangle of social facts, simplify them by eliminating from his field of vision everything not concerned with the desire of gain.

In the introduction to his "Theory of Political Economy," Stanley Jevons said

"The theory which follows is entirely based on a calculus of pleasure and pain, and the object of Economics is to maximise happiness by purchasing pleasure, as it were, at the lowest cost of pain."

This was the origin of the so-called "hedonist" school. Thus political economy becomes a sort of mechanical science, and can even be expressed in mathematical formulae.

Pure Economy—Attempts have been made to constitute an exact science, known as "pure economy," which was promoted by Cournot and Walras in France, Stanley Jevons in England, Gossen in Germany, and to day has a certain number of adherents. This method appears to us to have a perfect right to a place in instruction, although we cannot think that it has yet enriched knowledge by any very important contributions, except, perhaps, Leon Walras's theory of economic equilibrium.

Pure economy cannot, however, claim to exhaust all political economy. These social mechanics can but give a schematic representation of political economy which is a science as living and as complex as man himself. As in the vision of the Prophet Ezekiel, who saw dry bones live, these skeletons must have been restored to them the flesh and blood removed by elimination. Man is not a creature governed solely by his interests, but also by his feelings, his convictions, his passions. Besides, it must be remarked that his so-called "interests" include very various motives, for there is not only pecuniary interest, the desire of profit, there is also the desire of leisure, that factor which has proved so potent in the struggle for the limitation of the working day, there is the desire for independence, which revolts the working class against the wage-system, there is the desire for security, which creates in every country the immense apparatus of social insurance. Personal interest expands progressively, and becomes family interest, corporate interest, class interest, national interest, and even, reaching its last limit, the interest of humanity.

It is impossible to explain economic evolution if no factors outside egoism are considered, and the action of altruism is not also regarded. The so-called institutions of social service, solidarity, and mutual assistance—communal conditions inspired by collective interest—grow more numerous every day. Family allowances, for example, supplementary to the wage, occupy a growing place in modern economy. Consumers' co-operatives transform commerce by eliminating all purposes of profit.

If demography is admitted as part of political economy, then the sexual interest must be placed beside and above the personal interest. It is not "economic man" that begets children, for his individual and class interests often conflict with his sexual interest.

Most economists, however, consider that this progressive extension should not pass beyond the limit which should divide

political economy from ethics. Their provinces should remain separate, in the one case interest, in the other duty, in the one utility, in the other justice. We think, however, that it is neither possible nor desirable to respect this dividing-line, which we consider to be arbitrary. No doubt, from the point of view of classification, it may be well to distinguish the two provinces, just as in a library it is proper to separate the books dealing with the two sciences. Yet neither can be ignored in explaining social facts. Study of modern economic questions—social questions, as they are called—shows that one almost always arrives at an *impasse* where political economy fails, and only ethics can afford a solution. The ethics of political economy are justice.

According to pure economy, any price, any wage is just if it has been determined by the interplay of supply and demand under conditions of unrestricted competition. This is the tenet of the hedonist school, and they are right, if the word "just" be taken as meaning "exact," as when one says that a weight "just balances" when the two scales are in exact equilibrium. But what sort of political economy is that which in determining prices and wages eliminates "justice" in its true, ethical sense, and how can it give any solutions to the problems of the present generation, the problem of high prices, or of the remuneration of labour? When the authors of the Treaty of Versailles solemnly proclaimed in art. 427 "labour should not be regarded merely as a commodity or article of commerce" (one of the principles of which the International Labour Office is the embodiment), they meant that labour conditions cannot be treated solely by the principles of pure economy. When the governments of every country endeavour to limit the rise of prices and lower the cost of living, this is because they believe that there is a conception of a just price which stands above that evolved from the blind caprice of the law of supply and demand, and that this higher law ought to prevail.

If we consider the history of labour, we see that it has passed through many stages. Formerly it was impelled by constraint, when slavery was current, later in the stage of wage-labour, this constraint still exists, on account of the necessity imposed on the proletariat of earning its bread, but by degrees, as the working class becomes stronger and better organized, forced labour is replaced by interested labour—already a great progress, not only from the moral point of view, but also from that of the return. Yet another stage may be foreseen—a stage already reached in the liberal professions—where interested labour becomes a social service, a public function, in the noble sense of this term, that is to say, its motive will be duty.

Similarly, as regards consumption, how can the economist set aside every moral consideration regarding the use of wealth, refuse to distinguish between that whose only aim is pleasure, such as the consumption of alcohol, and that which meets the public interest, such as the education of children?

In conclusion, then, it must be said that *homo economicus* has a justification in existing, and may form the object of the abstract science of pure economics, but that the object of political economy is social man—a fact which is, indeed, sufficiently indicated by the very adjective "political." (C. G.)

ECONOMICS The term economics came into general use in the 20th century, replacing the older "political economy" as the name of a somewhat vaguely defined branch of social science. The change of name reflected changes in the discipline itself which had become subdivided into a number of specialties. A separation had been made between a pure science and the treatment of public—and to some extent of private—problems of policy, more or less explicitly applications, also, another separation was made between empirical fact—historical or statistical—and theory. The word economy comes from two Greek roots referring to the management of a household or estate. But in the past two centuries or so, the meaning has become generalized to cover all use of means in such a way as to husband them, to make them go as far as possible. Political economy itself is a modern term. It was introduced about the beginning of the 17th century (in French—corresponding to the German *Kameralwissenschaft*) to describe the study of the problems of the princely states which at the close of the middle ages in Europe replaced

the feudal ecclesiastical political order. It referred to the economic affairs of the state or principality—the raising and use of revenue and increase of resources—treating the state as the estate of the ruler. But this study never was generally known by this name. After the nationalistic epoch gave way to individualism or liberalism at the time of the enlightenment in the late 18th century political economy was adopted as the name of a science based on the new moral and political world view, and the older "statistic" literature came to be designated as mercantilism.

Epochs in the Development of Economic Thought—The sketch above suggests four main periods or epochs in the evolution of modern economics, corresponding to those usually recognized in European history. They are the Greek (or classical in the meaning of general history, but the Roman contribution was minor), the mediaeval, the early modern (16th to late 18th century) and the modern, roughly the 19th century. Each corresponds to a distinctive political order and to distinctive conceptions of man and society, and it is an important fact that books were written by and for different social classes in the different periods. The Greek literature was written by aristocratic philosophers and publicists, and related to the problems of the city state, nominally democratic but based on slave labour and with further exclusion of the merchant and financier from civic life. Such writers as Plato and Aristotle commented on many of the obvious facts and principles, such as the importance of division of labour and the use of money. But their interest centred in such moralistic and metaphysical notions as the condemnation of lending at interest as unnatural. Modern knowledge of the economic and industrial life of ancient Greece is derived mainly from other sources, incidental references in literature and archaeological remains. Many of the ideas were in fact survivals of primitive attitudes; they are found also in the older parts of the Bible and survive as a strong influence even today.

Mediaeval economic thought is still more moralistic, and alien to the modern outlook. The literature was produced chiefly by and for monks, at a time when the monastic life was accepted as the ideal, when worldly interests were denounced in favour of salvation in a future world as the one serious concern of man. The dominant social organization was the church, and recorded thought was more of the nature of preaching or theology and metaphysics than of science, as words are now used. For this world, the accepted ideal was a static or customary society and civilization, every man working out his lot in the situation to which he had been called. Trade was frowned upon beyond limited routine exchange at "fair"—meaning customary—prices, corresponding with a customary standard of living for each social class and interest taking was condemned outright. In the later middle ages, however, the canon law and the church courts played a large role in everyday affairs, and the monasteries themselves were the spearhead in great advances in both industry and trade, as well as agriculture. Numerous evasions of the prohibition against interest taking, achieving the same result through other contractual arrangements, came into use and were recognized as legitimate. Men's interests were shifting to the concerns of earthly life, cultural, aesthetic and scientific, as well as maternal, i.e., political and economic. The evolution of economics must be seen as integral with that of economic life and of European civilization as a whole.

The third period is best designated as that of economic nationalism but the economic thought is usually called mercantilism (See **MERCANTILE SYSTEM**). It dealt with the economic policies of the national monarchic states which displaced the feudal order at the close of the middle ages, and in general dominated the church, whether or not they established national churches, following the Reformation. Vast changes came over social life and men's conceptions and interests. A great cultural renaissance spread from Italy to Northern Europe, modern science, based on observation and measurement, displaced speculative thinking and technological advances were made in all fields. Paper and printing, and especially modern Arabic notation, the foundation

of both science and business, were even more important than gunpowder and the compass and greatly improved methods in mining and metallurgy. The distinctive writings on economic matters were produced by political pamphleteers. It was the age of the commercial revolution, the monarchic states saw wealth obtained through foreign trade as the basis of political power, and money as the embodiment of wealth (*pecunia nervus belli*). Europe was flooded with silver and gold, especially from the new world, chiefly by way of Spain, and the northern countries which had no mines, at home or in colonies, centred attention on sharing in the treasure through a favourable balance of trade, an excess of exports over imports. A quasi alliance was formed between the governments and the wealthy merchant and financier class, against the ecclesiastical power and the higher nobility. Meanwhile, social, moral and intellectual as well as economic forces had tended, especially in the towns, to the emancipation of labour from slavery and serfdom. But men were not ready for the ideal of individual freedom, an authoritarian state took the place of the church and of the town oligarchies that grew out of the guilds as the local regulative authority, and its aggrandizement became the accepted end of policy, with control over economic life as the means.

Mercantilism flourished from the 16th century down to the 18th, and was exemplified in innumerable writings and in the restrictive and regulative policies of such statesmen and rulers as Jean Baptiste Colbert, Lord Burghley, Oliver Cromwell and Frederick the Great. Besides attempting to secure a favourable balance of trade (an excess of exports, bringing in money or bullion), other aims were low interest rates, low wages, encouragement of population growth and colonies. It has been interpreted as nation building, and as in advance toward free trade, which was promoted within the national domain, in contrast with the application of similar policies by smaller units in the mediaeval towns. Whether the measures advocated met the immediate needs of the times is still a disputed question. In economic terms, the fallacies have long since been exposed, but the general attitude survives today, as the reader will observe, in protectionism. Contrary to the admitted advantages of international specialization this is favoured and practised not only by the national states but by smaller units, such as the US states and municipalities.

Transition to Modern Political Economy or Economics—Modern economics is an aspect of modern thought and of the individualistic or liberal outlook on life, of which capitalism, or the competitive system or free business enterprise, is the expression on the economic side, as democracy is on the political. Our fourth epoch takes its rise in a second great cultural revolution in western Europe, in which the period of the Renaissance moved into the enlightenment, or age of reason. In this development, leadership shifted, in the early modern period, from Mediterranean Europe to the northern countries, and especially to England, with the British colonies in North America playing an important role. England escaped the wars of religion which devastated western continental Europe for more than a century after the Reformation, and here especially religious toleration eased the tension between church and state. England was predominant in the great scientific movement of the 17th century, and the great Civil War and the Revolution of 1688 established representative government at the same time that the treaties ending the Thirty Years' War fastened political absolutism on the major continental states. In England, science was inspired with a "practical" philosophy, formulated by Francis Bacon, a contemporary of Galileo Galilei, the heir of Nicolaus Copernicus. This movement led naturally to the technological revolution of the later 18th and early 19th century, which involved the triumph of free enterprise, and modern economics is essentially the theory of free enterprise. It is interesting to observe that the great mercantilist writers of the later 17th century in England (contemporaries of John Locke in political philosophy) were in substance free traders, as Sir William James Ashley has pointed out in detail. Thomas Mun's famous booklet, *England's Treasure by Foreign Trade* (published posthumously in 1664 but in circula-

tion much earlier) sophistically used the balance of trade argument in favour of freedom to export specie. Other writers, such as Charles d'Avenant, Nicholas Baibon, Sir Josiah Child and especially Sir Dudley North, worked out the theoretical argument for freedom in foreign trade about as explicitly and clearly as did Adam Smith himself, nearly a century later. North argued that the wealth of a nation is that of its citizens and that the businessmen, traders and producers are the best judges of when trade involves a net gain. It remained for someone to apply the same reasoning to internal policy against the surviving guild restrictions or national control of apprenticeship, of wages and interest, grants of monopolies and the like.

All through the later mercantilist period, economic relations were gradually becoming more free, controls falling into disuse, particularly in England. The process, like the earlier disappearance of serfdom, is one of social development, to be explained by the sociologist and culture historian, the formulation of a general theory lagged behind the factual change, at least until the latter was far along. In notable respects the statement of free trade doctrine came earlier in France, where the movement itself was much slower. It was here, of course, that the phrase *laissez faire* (earlier associated with *laissez passer*) originated, in the first half of the 18th century. The kingdom of France was still subdivided into many districts with customs frontiers, until after the Great Revolution. About the same time appeared one of the most notable of the books anticipating the liberal point of view, the somewhat mysterious *Essai sur la nature du commerce en général*, by Richard Cantillon. It is apparently a translation, perhaps by the author himself, of an English manuscript which has disappeared. Cantillon showed a fairly clear insight into the mechanism by which a free market will direct resources into the production of the goods most in demand. Similar insights were conspicuous in the nearly contemporary essays of David Hume, though he wrote no systematic treatise. Early in the second half of the century much attention was attracted by the writings of a French school, who called themselves *les économistes* but are now referred to as the Physiocrats. The word is practically equivalent to law (or rule) of nature. The leader was the court physician François Quesnay. Like many of the mercantilists, these writers used rather absurd if ingenious arguments, and it has been pointed out that the position was connected with the self-interest of certain groups that had achieved wealth and power in the disturbed conditions in France after the death of Louis XIV, especially in consequence of the ambitious schemes of John Law and the famous "Mississippi Bubble." (A similar wave of speculative fury in England at the same time is known as the "South Sea Bubble," from the name of the most spectacular of many visionary or fraudulent companies that were organized.) But the Physiocrats are to be credited with an attempt to see and analyze a national economy as a whole. Their most characteristic doctrine was the view that only agriculture yields a "surplus" beyond what is required for the support of the workers, hence land rent alone is available for the support of the state and higher culture or the increase of wealth, and is the only proper subject for taxation. These ideas survived in part in the work of Adam Smith and the British classical economists. The pre-Revolutionary statesman, Anne Robert Jacques Turgot, renowned for his courageous but abortive economic and fiscal reforms, was to some extent a disciple, his work, *Reflexions sur la formation et la distribution des richesses* (1766), is an exceedingly able treatise.

The Classical Political Economy—In 1776 Adam Smith published *An Inquiry into the Nature and Causes of the Wealth of Nations*, a work in which wisdom, learning and the power of analysis are joined to an extraordinary degree. As already noted, Smith shared many of the popular prejudices that were evident in the writings of the Physiocrats. He held that "in agriculture nature works with man,"—as though this were not true of all other pursuits—and that only labour is productive, and indeed only that labour is really productive which at least reproduces the capital which supports it. Also that the interests of businessmen, as a class, are more often opposed to the interests of the com-

munity than are those of landowners. Nevertheless, Smith gave the world a new view of the advantages of trade as a mechanism for working out the division of labour, and a new philosophy of commerce. But he saw in commerce, as well as internal trade, a means to welfare, not merely to the aggrandizement of the state. His book was in one leading aspect, a formidable tract directed against mercantilism. Money, from the communal point of view, he held to be merely an instrument, a wheel of trade. The real source of a country's wealth, he said is its annual labour, and its wealth or well being could be increased only by making its labour more effective, particularly by extending specialization and accumulating product in the form of capital. (For "labour" we should now say "productive resources.") "The division of labour is limited by the extent of the market" is one of his most famous sayings.

These were Adam Smith's fundamental principles. He elaborated them with great skill, in relation to concrete problems, showing unusual powers of fresh observation in his selection and use of illustrative material, and passing large sections of economic history and the whole range of the contemporary commercial and fiscal problems of Britain under survey. Although the book is the most influential brief ever formulated for unimpeded trade, neither hampered nor coddled by governments, its greatest importance lies not in that circumstance, but in the general picture, at once simple and comprehensive, which it gives of the economic life of a nation. It shows how the apparent chaos of competition, the welter of buying and selling, are resolved or transmuted into an orderly system of economic co-operation by means of which, under individual freedom in contrast with central direction, the community's wants are supplied and its wealth increased. This general picture has been in the minds of economists ever since, whatever their opinions with respect to the efficiency or morality of the competitive system, and its general outline is admitted even by collectivists to be valid for their systems. Despite some sweeping phrases which invite another interpretation, Smith was no doctrinaire advocate of a hands off policy by governments in respect of economic matters. His treatment must be understood against the background of conditions of his day, in which so much was a hold over from the period of mercantilism and even the middle ages. He was opposed to monopoly, exclusive combinations, and special privileges of all kinds, quite as much as he was to the type of legislation which aims at fostering a country's prosperity by restricting its trade. He is often styled the "apostle of self interest," but he took no pains to conceal his dislike for some of the forms in which self interest manifests itself in trade and industry, and had no aversion to legal measures wherever they actually promised to be beneficial. What his attitude would have been under the later conditions of the 19th and 20th centuries towards the factory acts, social insurance and particular measures intended to foster equality of opportunity, we cannot tell. But there is nothing in the aims of these newer types of legislation which runs counter to his principal contentions or is inconsistent with his general economic philosophy.

Adam Smith's work had a profound influence, not in Great Britain alone, but in almost every part of the western world. It was partly responsible for some radical changes in the commercial policies of governments, though its influence cannot be measured, because the current of the times was moving in the direction of his contentions. Its effect upon scientific thought and upon the character and quality of public discussions of economic questions cannot be questioned. Men like Jean Baptiste Say in France and Karl Heinrich Rau in Germany based their work very largely on Smith's and helped to diffuse his influence. Say, however, was more than a mere popularizer. He had some clear-cut views of his own and developed Smith's work in directions other than those it took in the hands of Smith's British successors. In the United States, Say's work came to be about as widely read as Smith's.

The particular trend which the development of economics took in Great Britain after Smith was largely determined by the character of the economic problems which confronted the nation, partly by reason of rapid changes in its own industrial structure

(the industrial revolution) and partly in consequence of the French Revolution and Napoleonic Wars. Population increased rapidly and in particular there was a "mushroom" growth of new industrial towns, foreign trade expanded, especially the export of industrial products and import of agricultural, reversing the previous situation, yet agricultural cultivation was extended, with commercialization of farming and a vast improvement of methods both of tillage and of stock breeding. The changes were accentuated by interference with trade through the wars and governmental effort to maintain self-sufficiency in food (or to benefit the landed interest, which controlled the government), land rents rose with the increase in agricultural prices relative to industrial, the currency was depreciated (a practically universal accompaniment of any major war), rates of interest and of profits were disturbed and, after the peace, both industry and agriculture experienced depression conditions. Some of these conspicuous and important phenomena engaged the attention of parliamentary committees, all of them attracted the interest of thoughtful men who, with Adam Smith's picture of the mechanism of organized economic life in their minds, thought of them as inter-related, and attempted to explain them in some consistent and comparatively simple way. Out of the discussions of the period, in pamphlets and controversial tracts, there emerged a formal system of political economy. It owed much to Smith, but it stressed matters to which he had given little or no attention, and amended his views at a number of important points. This newer political economy was concerned more largely with abstract general relations, but it dealt with real problems and dealt with them in what was intended to be a practical way. There is an appearance, of paradox, but only an appearance, in the fact that the type of economics which grew out of attempts to deal intelligently with the problems of a period of economic storm and stress was one which gave particular attention to normal tendencies and to the conditions of economic equilibrium rather than to the immediate causes of economic maladjustments. A parallel may be found in the way in which the study of pathology has contributed to men's knowledge of normal physiology.

For convenience, the period of which we are now speaking may be taken as definitely beginning with the publication of David Ricardo's *Principles of Political Economy and Taxation* in 1817, and as culminating with the publication of John Stuart Mill's *Principles of Political Economy* in 1848. One who comprises the economic tracts and the systematic treatises of that period with the *Wealth of Nations* will be impressed with the increased importance given to a group of problems which have continued to be principal concerns of economics, problems now commonly grouped under the head of theory of value and distribution. These problems of price mechanics unfortunately tend to get separated from the real issues, of the way in which the price system organizes production and distributes the result. The theory of value, of course, attempts to explain why goods exchange at particular ratios, why some are relatively expensive and others cheap. (Absolute money prices are of course a matter of the value, or purchasing power of money, a distinct problem.) The modern theory of distribution is really a part of value theory, dealing with the prices of productive services, with a view to explaining the sharing of the national income or social dividend, or why some are poor and others rich. But the classical economists (from Smith to J. S. Mill) did not look at the problem in this way; they held a more metaphysical theory of the division of the total product into the three traditional shares, wages of labour, profits of capital and rent of land. This theory will be considered presently. Later on, the conception of a fourth share, the profits of enterprise, or of the successful direction of production, was taken over from the French economists (by and his followers), the earnings of capital, separated from the entrepreneurial functions of management and responsible risk-taking, came to be called interest (whether actually paid out for borrowed money or imputed to that of the owner, an individual or a group). This has been more true in the United States than in Britain, where economists still rather typically speak of the profits of capital, in the language of business and of everyday life. And the

treatment of enterprise or risk-taking (better called uncertainty bearing, since there can be no measurement of the risk as in gambling or insurance) raises problems on which there is no general agreement among economists.

The three fold (or four fold) classification of factors is clearly in part arbitrary. Some economists use a two fold classification, treating land as a particular form of capital, others point out that a logical classification would recognize many different kinds of capital, of labour, and of natural resources, with some kinds under one head economically less similar to others in the same class than to some in other classes. And it must also be recognized that in the long run, all productive agents largely represent a cost of production, an investment of resources, in the past (with wide variation in the relation between such cost and present value because of uncertainty), and that this investment is more or less subject to recovery and reinvestment in other types of productive agent. Yet the three forms of income are very real to ordinary thinking, which does not distinguish, for example, between the four or five elements obviously present in most personal earnings. One part is based on natural capacity, one on the "pain" or irksomeness of the work, one on the investment in training, and there is the factor of risk or imperfect foresight, which so profoundly affects the return on any investment for return in a fairly remote future, and finally, noneconomic motives affect in special ways the investment in human capacity. A somewhat similar analysis could be made of the payments for the use of what are commonly classed as either natural resources or capital goods. (See CAPITAL AND INTEREST.)

The classical theory of value stressed chiefly the tendency for the prices of goods produced and sold under competitive conditions to be proportionate to the respective costs of producing them. However, costs meant not the money outlays of the producers (entrepreneurs) but the "real" costs, human sacrifice or pain. For Ricardo in particular this in turn meant quantity of labour, that labour alone is really productive, other factors only assisting, was basic to the labour theory of value, which was taken over and exploited for propaganda purposes by the various schools of socialists and economic radicals. Later, the notion that the abstinence involved in saving and accumulation of capital is also a pain cost was introduced by Nassau William Senior (*An Outline of the Science of Political Economy*, [1836]). The socialists of course scornfully rejected this innovation. The classical economists did not see, at least not at all clearly, that what is economized is the use of resources, both human and nonhuman, and that the ultimate meaning of the cost of any product is the nonuse of resources for some other end. This fact is now known as the alternative cost principle. But the alternative end sacrificed is not always and entirely a quantity of another marketable product, it may be the leisure use of time and labour, or some direct (non-market) use of any other resource. Interpreted in this way, the notion of pain cost has some validity. It should be noted that, as all modern economists have recognized, the cost explanation of value applies only in a long-run view, over time sufficient to adjust production to demand. The classical economists freely recognized that over short periods, price depends on demand and supply, *i.e.*, the demand for the existing supply already produced, or for which commitments have been made.

A similar division between short and long run views was inevitable in connection with the theory of distribution. Neither theory has stood up well under later criticism, though many important facts and principles were recognized. In a general way, the short run theory held that labour gets as wages its means of subsistence, and the capitalist the excess of the product (of labour or labour-plus capital) on marginal land—or at the intensive margin on better land, in any case where no rent was deducted—after payment of a subsistence wage. Land (of a quality above that barely worth using) retrieved as rent the excess (surplus) product above that of the same amount of labour and capital on no rent land. The foundation of the position is the subsistence theory of wages, but it is hard to make out whether this limitation to a minimum was due to the power of the employer over the worker (Adam Smith sometimes comes near to stating the

exploitation theory of the later socialists) or to a tendency of the working population to multiply up to the means of subsistence. The latter view (more conspicuous in Smith's treatment) would clearly operate only in the long run. And somehow, another theory must be fitted into the picture—that of the famous wages-fund. In its simplest version, this meant that the capital (the annual product or some ill-defined part of it) was supposed to be advanced to labourers each year, making the average wage simply the total capital divided by the total working population. Ricardo and later members of the school recognized that the period of production or turnover is longer than a year in industries employing fixed capital, but they failed to see that capital is never produced by labour alone but rather reproduces itself (unless it is disinvested), so that no determinate period or cycle in production can be found.

In the long run theory of distribution, the notion of cost played a part—though not as large a one as it logically should have in view of the fact that all productive agents, human or other, are in a general sense products. In the long run interpretation the idea that the standard of living determines wages is in effect a cost of production theory of the price of labour. This doctrine rested upon the theory of population associated with the name of Thomas Robert Malthus, though it was clearly stated in general terms by Adam Smith and by still earlier writers. In the latter form, the notion of subsistence, as a physiological minimum, was replaced by, or interpreted to mean, a standard of living, a scale or level which labourers think of as necessary in order to undertake family life. If wages fall below that level, it was thought, the rate of growth of the working population will be negative (births fewer than deaths), and the decline in the labour supply will raise wages. If wages are above this level, population will increase and wages will fall—unless a higher standard of living becomes effective as a control of marriage. Somewhat similar reasoning was applied to profit, the rate of return on capital. The supply tends to increase as long as the return is above what savers generally consider sufficient to compensate for the abstinence required to save, and will decrease when it is below such a level, hence the rate of profit tends toward this level as a position of equilibrium.

The rent of land, however, was held not to be affected by the principle of cost. Land was thought to be permanently fixed in supply, it was deemed by Ricardo as "the original and indestructible powers of the soil." Hence, a rise in rent will not tend to counteract itself by bringing forth an additional supply—or reciprocally for a decline. Correspondingly, as already noted, rent was not supposed to be a part of or to influence the price of its produce, which in this view is determined by their cost (wages plus profit) on land barely worth using and yielding no rent—or by the cost at the intensive margin. Changes in rent were thus the effect, not the cause, of changes in product prices. This doctrine rested on a sharp separation between land and capital (capital goods) which later economists have tended to view as unrealistic. It also rested on an assumption that land is used only to produce a single distinctive product, hence is not, like labour and capital, transferred from one use to another in response to changes in relative prices. This view has also given place to recognition that raw produce is less a product than a stage in the production of all final products. But there is an important element of truth in the older views. In the classical system of distribution as a whole a very important place was ascribed to the "law of diminishing returns," in a particular long-run or historical interpretation. As the theory ran, the growth of population, itself dependent on growth of capital, requires resort to poorer land and also to more intensive cultivation of land already in use. In either case, the increase of product would not be proportionate to the increased amount of labour (and capital). Manufactures, in contrast, were thought to be subject to increasing returns, because of larger opportunities for the economies of the division of labour and for invention and the application of the fruits of scientific progress to industry. Agriculture also benefits by technical progress, but here the possibility of improvement was thought to be smaller and to be more than counter-

balanced by the increasingly disadvantageous proportioning of labour and capital to land. Since labourers must always get the same real wages—the means of subsistence—the profits of capital must decline, until the growth of population and wealth would come to an end in a stationary economy. Taken as a prophecy, this doctrine has so far been disproved by the course of events. The possibilities of improvement in agricultural technique were underestimated, new lands of good quality have been brought under cultivation and their produce brought to market by cheap transportation, and the Malthusian "law" has been partly falsified by declining birth rates going with the general progress of civilization—the rise in the effective standard of living already referred to.

Any general system of value theory must have something to say about the measure of value, hence the value of money on the general price level, in contrast with relative prices. This problem was of especial concern to Adam Smith, because of the price revolution which had swept over Europe after the discovery of America, and of its startling effects. And later this interest was nourished by the monetary and price changes of the period of the great wars of the French Revolution and of Napoleon. On this point, the classical school held to the doctrine later known as the quantity theory of money—other things being equal, the value of money (and reciprocally the price level) depends on its quantity in relation to the volume of production and trade. Allowance would also be made for the use of money substitutes, such as bank credit, already familiar in Europe. As a long run view, this was supplemented by the notion that the quantity of money is determined by the costs of mining the precious metals. Among different countries, especially those with and those without mines, prices would tend to be equalized by a flow of money or bullion from countries in which it would buy less to those in which it would buy more. This part of classical value theory has in general stood up better than the views on value and distribution. It would be an error to think of these earlier economists as altogether preoccupied with abstract theories, or not to recognize that their interest in these was born of an interest in practical problems. And in general, they were not such uncompromising opponents of any sort of interference by government in industry as some later critics and pretended expounders of their views have made them out to be.

The Critical Schools.—Before reviewing the later progress of economics, especially the revolutionary developments of the later 19th century, it will be helpful to look at the principal types of criticism which have been directed against the older political economy, and in part are still maintained against the later developments, and at the conceptions which have been proposed as replacement. In the first place, romanticists, like Adam Müller in Germany and John Ruskin in England, intensely disliked the new individualistic economic mechanism into the workings of which the economists were trying to probe. And consequently, they particularly disliked the defense of this mechanism, of economic *laissez faire*, which the economists in general did defend, by statement or implication. They preferred an ordered society, with economic subordinated to moral or religious or aesthetic values, such as they typically thought had been more or less fully embodied in the social structure of the middle ages. Work, they inclined to insist, is not merely a means to an end, particularly what are called economic ends, good work is worth doing for its own sake and for its effect upon character. They did not impugn the fitness of economics as an instrument of attack upon its special problems so much as they belittled these problems.

Another group of writers, for whom there is no better descriptive name than "the critical school," come much closer to meeting the orthodox economists upon their own ground. One of the earliest, and much the most influential, of them was Simonde de Sismondi (*Nouveaux principes d'économie politique* [revised ed. 1827] and other works). Other able writers, often without any conscious discipleship, have taken a similar position. These critics urge that more attention be given to the defects of the competitive economic mechanism, even viewed merely as a means of providing

for material needs. They contend that the economists contemplating the long run or nominal tendencies and the theoretical beauties of the automatic processes by which the pursuit of individual economic interests becomes or is urged into a vast scheme of economic co-operation forget how often the mechanism breaks down and normal economic life is interrupted by crisis and depression, how unemployment chronic as well as epidemic, is a disease of this economic order, how unequally the aggregate product is distributed among individuals or families, and how many of the things men do for their own economic advantage are in fact inimical to the interests of the community. As later critics have put it, businessmen are interested primarily in making money, which does not always mean making more goods. The picture of the economic harmonies (the title of a mid 19th century French apologetic work) requires, it is urged, rationalizing of the facts to an unwarranted degree. These criticisms also undoubtedly go too far. They unduly play down the role of the abstract principles stressed by the older economists, in the general course of the economic activities of the community. And no economist of the first rank has ever been a devotee of the pure automatism of the market. But the critical school has had a wholesome influence on the progress of economic science. It should be observed that this school occupies a position between that of the orthodox school and that of the socialists who denounce the works of the latter as mere apologetic, a product of the existing economic order and prompted by the interests of those who benefit by its inequities.

Another line of attack was adopted by the historical school—or more accurately, "schools," since the term covers several different groups. This position has been represented in all countries, but it has been most influential in Germany. The most important of its early exponents were Friedrich List (*Das Nationale System der politischen Ökonomie* [1841]) and Wilhelm Roscher (*Grundlagen der Nationalökonomie* [1854] and other works). The term of a nation's economic life, said these critics, is a historical category, peculiar to a given nation at a given time, a product of its past and therefore only to be understood through a study of that past. The wisdom of particular economic policies is relative to conditions of a place and time, and the supposedly universal laws of abstract economics need to be supplemented by or even subordinated to study of concrete facts of the national situation. If they had gone no further, the historicists would have found many to agree with them. But they tended to make of the historical method something arbitrary and doctrinaire (Karl Kries, whose work, *Die politische Ökonomie vom Standpunkte der geschichtlichen Methode*, appeared in 1853, is a notable exception). Not content with looking to history for the causes of these concrete differences of economic structure in which they were interested they proposed to derive from history itself universal and binding laws, akin to those of the physical sciences. They were fond of schemes of stages of economic development through which they thought every nation must pass. In these speculations they were really elaborating suggestions found not in historical research, but in the Greek speculative historians. They regarded the forms taken by economic life, past and present, as inevitable products of historical forces, and at the same time, unconscious of the inconsistency, they advocated a rather heavy handed control of economic activities by the state.

The British and French economists had looked upon the organization of economic life as being shaped and determined by the interplay of the interests and rational activities of individual men, and had viewed the state as an instrument of individual purposes—well being as judged, in the main, by each person for himself. The spokesmen of the historical school, in contrast, were strongly influenced by the philosopher Georg Wilhelm Friedrich Hegel, who ascribed a prior and independent value to the state, with individuals somewhat in the role of means, on the analogy of cells or organs in the human body, the view is related to that of the mercantilists, though more sophisticated. Although they pushed their views to extremes, they gave a needed emphasis to what has come to be called the institutional view of economic activities, as contrasted with the individualistic or contractual aspect. But

both the older historicists and the later institutionalists (largely a U.S. movement of the early 20th century) slurred over the contrast between two kinds or meanings of institution, i.e. patterns of action moving in predestined grooves under the influence of relatively unconscious social forces, versus those embodying deliberate organization and control, such as the political organs of the state. The state, in turn, was conceived by the older schools in what would now be called totalitarian terms, while the institutionalists, like the socialists (in contrast with the communists) thought of it as democratic. Historical economists have also been more ready to think of change, as contrasted with stability, in the pattern of economic organization, and they gave a useful impulse to the study of economic history, which is valuable both in itself and is a complement to economic theory. Under the influence of historical study the old dogmatism of the historical economists gradually gave way to a realization of the variety and complexity of the fabric of economic history, and the newer schools of historical economics, under the leadership of such scholars as Gustav von Schmoller in Germany and Ashley and George Unwin in Great Britain (to name only men no longer living) are, as they should be, devoted to historical research. The movement also broadened out, particularly in Germany, under such leaders as Max Weber and Werner Sombart, into what is often called sociological economics, a position also well represented in France (François Simiand, Maurice Halbwachs, C. Bouglé).

The Progress of Economic Theory—Economic theory is the name now commonly given to the more general and abstract parts of economics, the principles. These parts are no less practical than concrete descriptive or applied economics, but are less directly related to immediate problems. The mechanics of price relations or of markets afford a general explanation of the organization of production and distribution in so far as this is actually worked out and controlled through competitive buying and selling—which would largely be true even in a planned or socialist economy that stopped short of complete military regimentation. This branch of the study bears somewhat the same relation to economic politics that pure physics bears to the engineering sciences. Hence the problems of value and distribution have continued to hold their place among the central concerns of economists. However, there has been a notable—one might say a revolutionary—change in the general character of the analysis. The older classical economists, as we have seen, centred their attention on the long run relations between value and costs and were generally content to dispose of short run variations of price by merely invoking the formula of demand and supply. This was used without careful analysis of the short-run situation, particularly of the role of demand. Work directed toward filling in this gap had important effects in changing the whole conceptual picture. Similar steps introducing the new analysis were taken independently and almost simultaneously, in the early 1870s, by William Stanley Jevons in England, Karl Menger in Austria, and Marie Esprit Léon Walras in France and Switzerland. (It presently became known that they had been in part anticipated by earlier writers who were ignored and forgotten.)

Adam Smith, in a famous passage, had contrasted value in use with value in exchange, noting that the former is high for water and low for diamonds, and conversely for the latter. The new discovery was that there is nonetheless a definite relation between value in use (or utility) and exchange value, hence price. The value in use is not properly measured by the difference between having the normal supply of a good and having none at all, but by the difference it makes to have a little more or a little less, that is, things are actually valued by increments in consumption. Water, for example, has a wide variety of uses, all progressively satiable, and its exchange value at a particular time and place depends on its marginal use, the use and the degree of importance in that use, which would have to be forgone if the supply were just a little smaller. From the standpoint of action since a buyer has choice of how much he will take, all units are alike and the use value as well as the exchange value of any total supply is the product of the value of the unit (increment) in the least important-use by the number of units. Thus where water

is scarce its value—both use and exchange value—is exceedingly high, because the marginal use meets an intense desire or need, and if diamonds were abundant enough their value would be small. Goods, however important, that are superabundant, the supply being unlimited by any cost, have no economic utility or economic value, though to common sense this seems a paradox. The earlier utility or subjective value theorists tended to think of the consumption of any quantity of a particular good as representing or causing a definite quantity of pleasure, and of rational economic behaviour as that which yields a maximum of pleasure or happiness. It is now generally agreed that this is dubious psychology, and that the economic theories had better use the notion of a maximum without trying to say exactly what is maximized—much as the physicist speaks of matter or mass in terms of the way it is measured without trying to define its nature. Perhaps the most important feature of the new views, considered as theories of demand and of price, was not the psychological explanation but clarification of the nature of what Adam Smith called the "effective demand." It was seen that the demand for a commodity by any consumer or in any market is not a definite magnitude but a functional relation (most commonly represented in textbooks by a descending curve), showing a whole schedule of decreasing amounts that will be purchased as the price is higher. The actual quantities depend on both the desires or tastes of the consumer or consumers and on their purchasing power, and in addition on the availability of other products competing for the expenditure of income, and the prices of these. This idea served to clarify the relation that Smith and his followers had crudely expounded between market price and natural price, now more generally referred to as price in the short run versus the long run. In the former case, the supply is typically the amount already on the market, and the price is the marginal demand price for this amount. But in the longer run, production itself responds to price and price to supply, so that the long-run or normal or equilibrium price is that at which the amount consumers will take is equal to the amount which producers find it profitable to produce. This advance is largely to be credited especially to Alfred Marshall (*Principles of Economics* [1890] and numerous later editions, considerably revised).

Still more important were indirect consequences of the new theories, in connection with supply and cost. One such consequence was a gradual shift of emphasis from wealth to income as the primary fact in economic life and the centre of attention in the science. With respect to price analysis, the earlier economists had recognized—though not clearly or consistently, but N. W. Senior was an exception for clarity—that even in the long run cost affects price only indirectly, by influencing production and supply, hence, as it was now seen, it acts by affecting marginal utility, which is the direct determinant. But the cost of which producers take account is the payments they must make for the productive services they require, and the value of these is derived from, or merely reflects, the value of final products. But with respect to any single product, the costs that must be incurred reflect the value of resources in other uses, giving rise to the principle now generally known as alternative cost, in contrast with the older theory of real cost or pain cost. Subjective sacrifices do play some role, but the correspondence between such cost and the money cost to the producer is very imperfect and the relation may be inverse. (J. S. Mill pointed out that higher paid labour typically involves less pain than lower paid, not more, but he proposed no satisfactory way of meeting this difficulty.) It was also gradually recognized that the costs of production consist of the payments which at the same time constitute the shares in the distribution of the product among the different productive agents. Thus a rational conception of production in terms of the allocation of productive capacity among alternative modes of use, through the competitive bidding of business units (or their managers or entrepreneurs), explains at the same time the prices of final products, the costs of production and functional distribution. Personal distribution depends in addition on the amount as well as the value of the productive services of all kinds that are owned or controlled by the various participants in

economic activity.

Goods are typically produced by the co-operation of various kinds of productive services, and the special problem of distribution, in modern terms, is that of the division of this joint product among the different kinds of co-operating productive services or agents. If only one kind were employed, or even if a number of kinds were always used in fixed proportions, the problem would be simple, the value of the productive service (or combination) would obviously be the value of the product. But the fact that goods can be produced by combinations in variable proportions, which sets the problem, also affords the solution. One type of agent can be substituted for another, or the product can be increased or diminished a definite amount by varying the amount of one factor, all others being held constant. This will be clear if one thinks of a farm producing, say, wheat and assumes that the manager uses the three traditional factors, land, labour and capital (embodied in capital goods), however distinguished. But using increasing amounts of any one factor involves diminishing returns. It follows that under effective competition the joint product—of a whole economy as well as of each single enterprise—tends to be divided up in the proportions which measure the efficacy of each factor in increasing the product when the available supplies of all the factors in the economy are used in the way that yields the maximum total product, measured by the economic demand. Around the end of the 19th century a number of writers (especially Philip Henry Wicksteed) pointed out that the principle of diminishing returns, previously applied only to the use of more labour and capital on a given amount of land, is reversible and quite general in application. It governs the competition of different industries and enterprises for given amounts of all the factors, and the historical question whether labour and capital really increase faster than the supply of land is a separate issue and is to be answered only by observing the facts. Hence, under given conditions and under free and frictionless competition, the amount of product assigned (in technical terms "imputed") to any particular labourer or other agent or unit is the amount which really depends upon the use of that particular agent. A labourer or other agent counts for more and in effect produces more when there is a larger supply of other agents to work with him or it. The amount earned will of course depend on effort and skill and the quality of management, and the real wage or other share will also depend on the prices of the final products for which the labourer or property owner spends the money income he receives. The effort of managers (entrepreneurs) to secure maximum return for their expenditures for productive resources will lead them to buy these in such proportions that at the margin equal expenditures secure equal increments to total product. Any resource will tend to move toward employments where the yield—of a dollar's worth—is highest. And the tendency, again in so far as competition is free and frictionless, is to establish such prices that all dollar's worths of each are of the same value to all employers.

This theory, or principle, that every agent tends to get what it produces does not mean that each person gets what he deserves, and in fact tells us little about the ethical quality or social desirability of the result. It must be remembered that differences in respect of training and of opportunity greatly affect men's productive capacities as workers, and that institutions, especially inheritance, enter into this picture as well as into the ownership of property and the opportunity to accumulate. And the swift process of change in technology and demand often robs men of the fruits of skill acquired at great cost—and also of the savings committed to particular industries. In particular, such innovative activities as invention and exploration for minerals may yield anything from zero to a reward quite disproportionate to the outlay in effort or money. These facts set the general problem of profit, and of its ethical significance. Finally, even when a venture is not undertaken on a gambling chance, various impediments, including the antisocial activities of monopolists, prevent the free mobility of capital and labour from uses of lower to those of higher yield. The doctrine that rewards tend to be proportionate to products is true only as a tendency, but it is

highly important is a corrective to the belief that there is little or no connection, and product itself (value product), to repeat, is no measure or moral desert. The social problems raised must be examined on their merits in terms of ethical principles and the pros and cons of the expediency of political measures. Enforcement of equality may reduce incentive and production, most especially the incentive to take the large risks or chances that always affect innovations. With respect to profit in particular—properly separated analytically from both wages of management and the yield of investment in fairly safe forms—it must be remembered that a prospect of disproportionate gain if successful is necessary if men are to assume voluntarily the risks of loss. The final judgment as to ideal right, and the balance between that and expediency where they seem to conflict, must be left to 'that insidious and crafty animal vulgarly called a statesman or politician' to use a famous phrase of Adam Smith. Experience seems to show however, that considerable taxation of exceptional gains is possible without demonstrably affecting incentives. As just suggested profit, in realistic business usage is a mixed form of income containing elements of interest and of wages for that vaguely distinguishable part of management activity which may be treated as labour, and both the amount of the owner's capital and the proper rate of interest to allow are also uncertain. The distinguishing mark of profit is that its amount is not stipulated in any agreement or fixed in an exchange but is contingent upon the success of a particular enterprise or undertaking. In general profit arises from error, or imperfect foresight, on the part of the responsible entrepreneur, in making policy decisions or in delegating these to salaried managers as his agents (in a corporation the agents of the voting stockholders as a group). Pure profit is the amount left over after making all stipulated payments for productive services, raw materials etc., and after deduction of the going rate of payment for the entrepreneur's own capital and services. It may be a negative as well as a positive sum, and it is impossible to say conclusively whether the gains are greater or less than the losses in the aggregate for a whole economy. Pure profit is of course increased in any individual case by greater accuracy in the ultimate managerial decisions, and tends to be decreased by excessive optimism on the part of entrepreneurs.

The rate of interest has also received much attention in modern discussion. Controversy was stimulated in particular by the publication, in the 1880s of two books by Eugen Boehm von Bawerk, a disciple of Karl Menger. He propounded two views of interest, both adumbrated a half century earlier in the work of N. W. Senior. One is a reworking of the abstinence theory into one of postponement or waiting, or discount of the future. Interest is viewed as the reward or necessary inducement for waiting, hence as the measure of the superior attraction of near over remote enjoyment. The other view regards interest as the yield or productivity of investment due to the greater efficacy of more roundabout processes. Boehm von Bawerk followed the Ricardian notion that capital-goods are produced by labour, or labour and land, it has since been pointed out that co-operation of previously existing capital is also involved and that in terms of value, capital reproduces itself and in addition yields a surplus for consumption or for further investment. The interest rate on loans tends to equal the ratio of the yield obtainable on investment to their amount, i.e., the ratio of the net rental on capital goods (after provision for maintenance and eventual replacement) to their cost, and the cost is the value of consumable goods sacrificed in using productive capacities to create them. When conditions change, after an investment is made the capital which the good represents (its value) is the least cost of producing an item of the same earning power. The psychology of postponement operates by affecting the supply of savings for investment. (See CAPITAL AND INTEREST.) Interest is a form in which the yield of a capital-good (or some part of it) is paid and received, rather than a distinct share in distribution, coming from a distinct source, the lease of a farm or building or other piece of property for a rental achieves the same general result as its sale coupled with a loan, and under perfect competition the choice would be a matter of indifference to both parties. The theory of interest is of the

greatest importance in the general system of value theory, since the value of all durable goods bought and sold is immediately determined by the capitalization of the expected future income. This tends to be the same as their cost since no such good will be produced, or long maintained, unless it is expected to yield at least the going rate on its costs, and if it yields more, new supply will lower the rate. But errors and unexpected changes in conditions often for a time cause capital goods to be worth more or less than cost (to yield less or more than interest on cost). The difference is a profit, or loss.

Methods of Economics—Reference has already been made to the controversy between the critics and the expounders of analytical or theoretical economics—albeit in its methods and aims to the older political economy, even when different in content. It is essentially abstract and deductive, proceeding from a few general principles, such as the laws of diminishing returns and diminishing utility, and the uniformity of price to all buyers and sellers in an effective or competitive market. Most of its conclusions can be viewed as cases under a general principle of economic behaviour. The principle is that resources tend to be allocated among alternative modes of use in such a way that they will be equally remunerative in all and so will yield the maximum total return. In another form of statement, it posits an economic man, whose behaviour under given circumstances is completely rational. A free economic order must assume that men actually tend to be rational in the use of means—that they try to be, and tend to succeed. The given circumstances include the wants to be satisfied, the resources themselves, and the modes of use or technology extant in the society at the time. These must be explained or treated mainly by other disciplines than economics. Any science which explains phenomena in terms of measured cause and effect must be abstract, economics (by this method) is often compared with theoretical mechanics, based on frictionless conditions, and the concept of adaptive behaviour in biology is a similar principle, since in fact adaptation is always more or less imperfect. The careful economic theorist does not confuse the abstraction of perfectly economic behaviour, or the economic man, with actual behaviour of real men, any more than the physicist or engineer assumes that friction is absent in real machines. Applied economics must try to take account of the role in business life of error and of motives (good or bad), such as prejudice, curiosity and the various forms of the play interest, which do not conform to the pattern of economic rationality. Competition itself, in the psychological meaning, is a noneconomic interest. The economic interest is merely a striving for efficiency in the use of means, whatever means are available, and whatever ends are pursued. It does operate, at least in modern civilization, in a peculiarly regular and predictable fashion, and a community whose policies disregard its principles will suffer loss if not disaster. But these principles alone do not make it possible to predict the course of real events or the results of action. They must be filled in with data secured by inductive investigation, as well as qualified to allow for various departures from the behaviour pattern of economic rationality.

Hence it will be evident that the other methods, or approaches to economic data, notably historical research and statistical investigation, are not to be thought of as substitutes for sound theory, along the traditional lines, but as complementary to it. This is true also of social sciences other than history and statistics, notably psychology, with or without such qualifiers as social, political, analytic, etc. All are needed to supply data and interpretation to put content and definiteness into the valid but highly abstract laws of economic choice and of market phenomena. Without such supplementation economic laws have little value for prediction, since the essential factor of wants is not open to sense observation and any course of events that occurs can be fitted into the theoretical pattern. The growing accumulations of numerical information covering a wide variety of economic facts, coupled with the advance of statistical technique, have been working a notable change in the character and content of economics as a whole, without nullifying any of its established principles, but giving more knowledge of the actual degree of stability or vari-

ability in the relationships in real life. Interpretation of records covering averages and aggregates and their movements can add much to what can be inferred from common sense principles or observation of particular cases. This does not mean, however, that economics will be or can be purely statistical, a new kind of political arithmetic. The broader the average or aggregate the more heterogeneous the data it covers, and these magnitudes become subject to limitations similar to those of abstract principles. If statistical magnitudes and correlations are to be understood and intelligently used—in guiding such measures as taxation and the regulation of business in the public interest—they must be understood through weaving them into the general structure of our knowledge and relating them to other things we know.

On the other hand, any brief statement of general principles is bound to make economic theories appear thinner and more remote from the concrete facts of economic life than they are. There is a place and a need for all degrees of generality. In recent decades this need has found increasing expression in the developing and spreading study of mathematical economics, in which exposition is made accurate and compact by the use of graphs and of algebraic formulas. In the form of econometrics this movement also brings analytical theory into close alliance with concrete facts, statistically presented. Only by the use of mathematics is it possible to bring together into a single comprehensible picture the variety, the complexity, and most of all the interdependence, of the numerous factors which determine prices, costs, output and demand and the wages or hire of productive agents. The mathematical treatment of economic principles was first successfully undertaken by the French economist, mathematician and philosopher, Antoine Augustin Cournot (*Recherches sur les principes mathématiques de la théorie des richesses*, [1838]). Elaborate mathematical formulations of the conditions of general economic equilibrium have been worked out, notably by Walras (*Éléments d'économie politique pure*, [1874-77] and later editions) and his follower Vilfredo Pareto (*Manuale di economia politica* [1906] and other works). The principal value of such elaborate and abstract systems lies in forcibly reminding the enquirer that a change in practically any economic variable has direct or indirect effects on innumerable other magnitudes, and so preventing him from fatally oversimplifying conceptions of economic cause and effect. Other writers, notably Alfred Marshall, adopted an intermediate position. Marshall was a competent mathematician, but used and advocated the literary form of exposition (contemptuously so named by Pareto), relegating the mathematics to footnotes and appendices in his monumental work. He also emphasized the interdependence of economic phenomena, but centred his attention on the relations between the more closely connected factors, the relations of greatest practical import, in contrast with system building. But his successors, of the Cambridge or neoclassical school (notably A. C. Pigou), were impelled to make more direct use of mathematics in their exposition, and the study and use of algebra and calculus spread rapidly among economists in all countries. And, in line with the older classical tradition, the science places increasing emphasis upon factors which make for change and disequilibrium, as well as those making for stability.

Problems of Present Day Economics—Since all general principles are necessarily abstract, the more theoretical parts of economics cannot be taken to be a complete and adequate account of the mechanism of modern economic life. They afford serviceable approximations to partial, but important, aspects of the truth, and the study of history and factual data yields other true and important generalizations. Even in their present imperfect and incomplete state the generalizations an economist has at hand constitute an organon of proved effectiveness, an instrument by means of which some of the results of economic changes, whether planned or not planned, may be predicted with a fair degree of certainty. New problems constantly appear and challenge attention, as facts change and new interests emerge, and different groups of problems have their special literature and engage the attention of corps of specialists. The most striking and possibly the most important characteristic of recent work in economics,

as contrasted with the older, is its greater realism. It does not attempt to do without abstract conceptions, but it does attempt to take these from the world of affairs, or bring them into line with facts.

This trait is conspicuous in the treatment of the two great practical problems or groups of problems which have particularly forced themselves on the attention of the public and of statesmen and economists in roughly the past two generations. These problems centre respectively in the growth of large scale corporate business and associations of firms which concentrate power and tend to exploit the public through monopoly and high finance (and labour problems are related to these), and in the mechanism of money and credit commonly held responsible for the recurring phenomena of industrial fluctuations or business cycles, with their attendant wastes and hardships. Depressions and the measures taken by different countries for dealing with them, in connection with the impact of two world wars, have also intensified interest in international economic relations affecting money and capital movements and trade in general, and in tariff duties and other devices for controlling it. The depression of the 1930s and World War II generated a world wide movement toward state control or planning of economic life, and particularly toward use of quotas on imports and strict control of foreign exchange, and even governmental conduct of foreign trade. In none of these fields is the ground completely explored or all the issues settled, but findings have been reached which appear to have permanent value. The outcome of the various fiscal and monetary measures to which governments have resorted, and the results of the restrictions imposed upon trade and industry have in general been about what competent economists predicted, and this is true of the experience with reparations and monetary stabilization after World War I. The tendency has been to confirm long established principles, though political considerations have made it difficult for governments to learn, or at least for them to apply, the lessons taught. This fact is especially prominent in connection with the perennial issues of protection in international trade, and of inflation, through cheap money or credit. Inflation is tempting as an easy way to finance a government at war or under special financial stress from any cause and as a way to achieve a bogus prosperity, not to mention the fallacy of making capital cheap and lightening the burdens of debtors through an abundance of money. (But inflationary measures may be justified to counteract deflation and relieve depression.)

The general form given to economics by the early classical writers was determined very largely by preoccupation with certain special types of problems, notably problems of national commercial policy. Recent events have brought this group of problems again to the fore and later experience and discussion, while confirming earlier views in a general way, have led to some modification. The older economists, in their efforts to dig beneath that surface view of economic life which had deceived the mercantilists, held that money is merely an instrument or tool. They carried this idea to extremes, though in some types of pure economic theory today it is found convenient to go still further and assume that trade is conducted by barter, without the use of any special medium of exchange (all commodities having equally the character of money). But the phenomena of inflation and deflation and of boom and depression, have forced modern economists to recognize that the use of money and credit has important effects on the character of effective demand and on production and distribution. Quite naturally, the great depression of the 1930s gave a tremendous impetus to discussion in this field, and its importance was further enhanced by the fear of depression, or boom and then depression, to follow World War II, and by measures taken or proposed in this connection. A landmark in this discussion was the publication, in 1936, of a book, *The General Theory of Employment, Interest and Money*, by John Maynard Keynes, of Cambridge university. Fuller treatment of these issues is given in other articles. It must suffice here to note that the discussion has at least called attention to one fact. The famous "law of the market" (often called "Say's law" from its formulation by the great French economist) stating that the demand for any good

is the supply of other goods, and the supply of any one is the demand for others while a truism for a barter system is not valid in the short run in a complex monetary economy. And further, the short run may be both longer and more important than is likely to be inferred from the orthodox or neoclassical expositions of economic theory. In emphasizing the nature and conditions of a theoretical equilibrium, these writers have tended to undue neglect of changes in monetary circulation (hoarding and dishoarding, or changes in the quantity of money or substitutes, such as bank credit, or its velocity of circulation) and their often serious and protected consequences. In particular, it cannot be assumed that monetary saving will be followed automatically and immediately by investment. The funds need not be offered on the loan market, and if they are offered they may not cause a sufficient decline in the long-run interest rate to cause real investment, since this depends largely on speculative anticipations and these in turn often depend more on conjecture and mass psychology than on definite knowledge and rational calculation of future prospects. In consequence, production of capital goods, particularly the more lasting forms, including durable consumption goods, may decline heavily, and unemployment in these industries will cause shrinkage even in the industries producing for immediate consumption.

Even if it is admitted, as it doubtless must be, that if all prices were immediately and uniformly responsive to monetary changes, this is not what happens in reality. In particular, monetary wages are "sticky," and are especially resistant to downward movement. And wages are the largest factor in production costs, and notably in the variable and marginal costs which are most influential in producers' planning. Thus wage policy becomes a crucial factor in the problem. There is a real danger, even a probability, that reduction of wage rates may reduce total disbursement of purchasing power in the field of consumption, which may react seriously on the effective investment demand. Drastic action in the direction of inflation (or deflation, a word that came into use in the early years of the great depression) may be the only feasible way of counteracting the tendency to a downward spiral. The appropriate methods and instruments of such action came to occupy a large place in the discussion and controversy set in motion by the distress of the 1930s and particularly by Keynes and his followers and opponents. Accentuation of issues in international economic policy was another result, which can only be mentioned here, the need for any country to protect itself against economic repercussions abroad runs into measures open to the accusation of export unemployment, and in the absence of wise concerted international action they certainly tend to aggravate the situation.

One of the conspicuous phenomena in recent economies has been intensified activity in the field of labour problems, already mentioned as a development consequent upon the labour movement of the 19th century and after, connected with the growth of large corporations and other forms of unified action among business interests. Up to the last quarter of that century there was little careful analysis of those problems, apart from discussion of the general theory of wages under some approximation to free competition. Now however, there is hardly a field of economic inquiry which is more thoroughly cultivated or in which there is more controversy. It runs into the general problems of economic planning and socialism. The labour union movement and its significance, the pros and cons of collective bargaining, the length of the working day, factory legislation, profit sharing, the organization of control within the enterprise, labour turnover, the legal minimum wage, the prevention and settlement of industrial disputes, compulsory arbitration and social insurance in its various forms, as well as the causes of unemployment and its possible remedies, are all burning issues in both economic science and practical politics.

It is important to observe that all these practical problems have been brought into the scope of economics by the course of change in economic and business life, the attention now given to them does not mark a change of attitude or general social position among economists. The earlier thinkers, in response to the conditions and needs of their times, at the beginning of the modern industrial era, were primarily concerned with exploding popular fallacies with respect to the ways in which the prosperity of the community can best be secured and, with that end in view, in showing how the economic activities of individuals may work together, through the open market, and be so interrelated as to constitute a great communal economic mechanism. Under the circumstances, they were more concerned with what governments could not or should not do than with what they could wisely attempt. Thus they often gave the impression—an impression which careful study of

the writings of the ablest of them will dispel—that they regarded that mechanism as all-sufficient, needing neither interference nor direction on the part of the community. While the need for a better understanding of the theory of the open market organization and better appreciation of its merits is still present, modern economics tends to strike a different note. Its tone is less negative, it is more insistent in its search for and scrutiny of possible ways of altering for the better the organization of the community's economic life, while remaining on guard against the dangers of disaster from undue results of wrong lines of action. Since almost every game has its cost, most of the problems resolve themselves into a question of a balance of advantage. But the advantages and disadvantages are hardly ever purely economic and therefore no analysis in terms of purely scientific economics can completely dispose of such questions. Political, social and ethical ideals and issues must also be taken into account, and economists are showing an increased awareness of these broader considerations. The economist, however, may gauge the general character of the probable effects of a specific measure upon production and distribution, and so make it possible to discuss the wisdom of any proposed action in the light of its probable consequences.

In connection with this shift of emphasis an important factor is the vast accumulation of more—and more reliable—factual data. Reliable records of economic activities, or at any rate of their results, are now brought together and published by governments and by business and other private organizations, on a scale which would have excited the envy of the earlier economists. A much wider range of economic experience is now available for study and analysis, and dealing with this material—in a sense a by-product of the activities which it records—economics is impelled toward a more realistic and concrete view. It has to deal with economic events in the forms in which they actually occur, and to search for the systematic relations which run through the mass of real events. But although the interests of economics have become more varied and concrete, and although its conceptions have become better adapted to handling the facts of economic life as those facts present themselves, economics remains a political or social science and also, in the old sense as well as new senses, a theoretical discipline. Particular findings or tenets have been discarded and replaced, or fundamentally restated, and sweeping additions have been made. But the general picture of a scheme of communal economic life remains a picture sufficiently useful for analysis and prediction, though imperfect enough to give point and purpose to its continued study, elaboration and refinement, in spite of changes of viewpoint and of method.

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ECONOMICS, PRIMITIVE Comparatively little is known about the economic organization of savage peoples. Being apparently one of the simplest and least interesting aspects of their social life, it has been the last to receive attention from the anthropologist, though in reality it presents complex problems of vital concern for native welfare. Most of our knowledge of the principles of savage economic life is due to the work of German scholars. The earliest studies in economic anthropology were largely of an evolutionary nature, attention being concentrated on the somewhat barren aim of fitting phenomena into schemes of stages of progress and constructing theories of development from one stage to another. Best known of all is the *Dressstufenschema*, the three stage scheme of society by which mankind, having first lived as hunters and fishers, advanced through the pastoral grade of existence to attain the state of agriculture, which represented the final achievement of primitive industry. This scheme of the economist Friedrich List persisted for several decades, though the idea of a universal course of evolution for all mankind soon disappeared. Rival theories, as that of the barter, money, credit periods of development of Bruno Hildebrand, were also advanced. In time the old three stage pattern of economic progress was abandoned, owing to the destructive criticism of geographers such as Friedrich Ratzel and anthropologists like Eduard Hahn. Other schemes of classification of culture, associated with the names of Hahn, Ernst Grosse, Alfred Vierkandt and Heinrich Schurtz, came in rapid succession, but the value of such work lay in the collection of data and the incidental analysis of native economic conditions—as in Hahn's distinction between hoe-cultivation and agriculture proper with plough and domesticated animals—rather than in the actual theories propounded.

The writings of Karl Bucher, by drawing the economy of primitive man into relation with that of our civilization, have done much to provoke interest in the subject. His classification, however, of all savage economic life as being either a selfish individual hunt for food or at best a sharing of goods within the closed circle of the household, does not conform to the facts as now known, nor do his theories of the development of exchange from the custom of giving presents and the origin of work in play find much modern support.

Exponents of the *kulturhistorische* method in anthropology, notably Wilhelm Koppers, have also laid due stress on the economic factor as a prime determinant of culture. But their study of economic life is made subservient to their attempt to establish certain theories regarding the history of mankind which involve a hypothetical scheme of *kulturkreise* or stages of culture. This interest in the problematical origins of native custom has led to a neglect of its real place in native life.

Studies by such writers as M. Marcel Mauss, Prof. Richard Thurnwald and Dr. Bronislaw Malinowski have done much to retrieve the position. The attempt to establish evolutionary sequences has been discarded, and the imagined history of institutions left on the side. Primitive economic organization is studied for its relation to the existing social mechanism, for the ends which it serves in the present, not for what it may have been in past ages. In short, the "functional method" of inquiry is employed. The institution of the exchange of gifts, for example, is shown to be part of the native economic system, not in virtue of being a transition stage from gift making to trade, but because it satisfies certain practical needs and allows for the expression of social sentiments—ideas of rank, prestige, liberality and fulfilment of obligation. Recent work of this type in primitive economics has thrown light upon such questions as the character of leadership in native labour, the social stimuli involved, the part played by co-operation, the nature of economic reward, the action of the principle of reciprocity in exchange, the value of magic in industry, and the influence of wealth upon chieftainship and rank.

Such problems are concerned with vital issues, and the investigator here is grappling with the reality which lies at the foundation of the life and work of the native. Such study, apart from its interest to the economic historian in throwing light on

the nature of less developed forms or traces the land eastward natural value. An adequate knowledge for a distance of aboutization of a native people is essential labour, and river on which is trade with them, utilize their labour, secure gulf and its northern political affairs, or preserve them from the numerous estuaries contact with white civilization the Estero Salado

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ECONOMIZER An important adjunct to a steam generator plant. Instead of being allowed to escape to the chimney directly from the furnaces, the waste gases are led through passages in

which are placed sets of vertical tubes. Water passes through the tubes and the heat of the gases raises it to a useful temperature for various purposes, not merely to supply the feed for the boilers, but also for supply where a large quantity of hot water is required, as in laundries, hotels, breweries, dyeworks and so on. At the same time, strains on the boiler plates and parts through exposure to an inflow of cold water are prevented. Scale trouble in the boiler is also greatly reduced, because the scale forms instead inside the economizer tubes, and these are readily cleaned. About 15% to 20% of coal is saved on the installation of an economizer. Evidence of this is found in one example of an economizer for which the gases leave the boiler at 650° F., the feed water entering the economizer at 100° F. leaves it at 272° F., reducing the temperature of the gases to 330° F. The Green economizer consists of a number of vertical cast-iron tubes, 4½" in external diameter, made up in sections, and connected with branch pipes at top and bottom. The outside of each tube is kept clean by encircling scrapers, which travel slowly up and down all the time, actuated by automatic mechanism at the top. The soot falls into a pit for convenient removal. There is also a horizontal tube of economizer which is mounted above a water tube boiler. In some designs of economizers tubes with gills are used, to obtain the maximum heat transference, and the soot is cleaned off by steam blowers.

ECONOMY, the thrifty management of the financial resources of a household or of an individual, hence a "saving," not only of money, but of time, labour or effort, and generally, the least expenditure of means to attain a required end. "Economy" is also used in theology in such expressions as "Mosaic" or "Christian economy" as a synonym of "dispensation," for the administration of the world by God at particular times or for particular races. From the meaning of organization or administration of a house or State the word is applied more widely to the ordered arrangement of any organized body, and is equivalent almost to "system," thus the "economy" of nature or of animal or plant life may be spoken of. "Political economy" is the science dealing with the production, distribution and consumption of wealth (see **ECONOMICS**).

ECORSE, a village of Wayne county, Mich., U.S., on the Detroit river, 7 mi SSW of Detroit. It is served by the Detroit, Toledo and Ironton, the Michigan Central and the New York Central railways. The population was 17,557 in 1950 and was 13,209 in 1940 by the federal census. It is an industrial suburb of Detroit. The village was founded about 1812 and was incorporated in 1902.

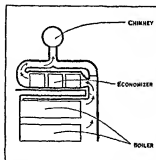


DIAGRAM TO SHOW PASSAGE OF WASTE GASES FROM BOILERS WHICH ARE MADE TO HEAT WATER IN ECONOMIZER BEFORE ESCAPING BY CHIMNEY

sometimes reaches 2,600 ft altitude

The *montañas de Cojimes* in the western part of the province of Esmeraldas, lie between the Pacific and the Rio Quinde. These "mountains" are a narrow ridge about 35 mi long and reaching 1,000 ft altitude. Just southeast of the town of Esmeraldas is a narrow ridge called *montañas de Atacames*. It is about 20 mi long and its summits attain an elevation of nearly 1,000 ft above the sea.

Scarcely anything is known of the coastal region between the rivers. Esmeraldas province is supposed to be a tableland having summits of about 1,000 ft elevation and valleys dissected to nearly sea level. The Guayas river and its tributaries form a large part of the coastal region. The river is in part an estuary extending north from the Gulf of Guayaquil and is the largest navigable stream on the Pacific coast of South America. At Guayaquil to which seagoing vessels ascend it is about 2 mi wide. The river rises near the equator, and its main tributaries are the Daule, the Vinces, Rio Zapotal and Rio Chumbo, all navigable on their lower courses and having extensive swamp areas. Steamboats go regularly from Guayaquil up the Rio Bodegas to Babahoyo 80 mi above Guayaquil and for 40 mi up the Daule. The navigable channels of the Guayas and its tributaries are computed to be 200 mi long, the drainage basin is said to cover about 14,000 sq mi. The second large river system of the coastal region is the Rio Esmeraldas, which like the Guayas has tributaries whose sources are in the snows of the Andean highlands. The Rio Esmeraldas is formed by the Guallabamba and Blanco about 42 mi from its mouth and discharges into the Pacific at $1^{\circ} 1' N$ and $79^{\circ} 40' W$ through a narrow and precipitous gorge. The most northerly important coastal river system is the Santiago, formed by the Cayapas and the Santiago. The Cayapas is navigable by canoe for a long distance, the Santiago for only a few leagues above its junction with the Cayapas. Below La Concepcion, the Santiago is a broad, deep stream. Near its mouth it divides and forms many islands, chief of which are La Pola, Santa Rosa and San Pedro. The Mira, north of the Santiago, forms for a part of its course the boundary between Colombia and Ecuador.

Bays—The coast extends from about $1^{\circ} 30' N$ and $78^{\circ} 55' W$ to lat $4^{\circ} 30' S$ and curves westward to $82^{\circ} W$. Most prominent headlands are La Puntilla, Cabo de San Lorenzo, Cabo Pasado and Punta Galera. The bays are commonly broad indentations with the exception of the gulf of Guayaquil, and the rivers discharging into them are generally obstructed by bars so that the small ports of the coast do not afford much protection to shipping. The most northerly of these bays is Ancón de Sardinias, lying south of the Mira delta. The head of the bay is fringed with islands and reefs behind which is the mouth of the Mataje, the boundary between Colombia and Ecuador, and that of the Santiago. The small bay of San Lorenzo would form an excellent port terminus for Quito. The coast for about 80 mi E and W of the mouth of the Esmeraldas consists of rocky promontories and of high cliffs broken here and there by short river ravines. The Esmeraldas has a wide mouth with islands and shoals constantly altered by the swift current. The port of Esmeraldas is on the left bank of the river. As the mouth is obstructed by a bar and the river current is swift, the anchorage for ships is outside in an open roadstead with slight protection. Between Cabo Pasado and Cabo de San Lorenzo is a broad indentation in which is the Bahía de Caraquez, a small bay, now the terminus of a railway which runs inland 473 mi to Chone. The southern portion of the broad indentation is called Bahía de Manta and on this is a small port served by a railway extending inland 37 mi to Santa Ana. The Bahía de Santa Elena is formed by a broad curve from Punta Ayacucho to La Puntilla. At Salinas a small settlement on the end of the point "La Puntilla" is the landing place of the All-America cable. A pipe line terminates on the shore east of Salinas bringing petroleum from the wells of the Anglo-Ecuadorian Oil Co., situated on the south coast of the peninsula. Ships anchor with little protection in the roadstead between Salinas and Balentea. The gulf of Guayaquil is the largest on the Pacific coast of South America. Its mouth is 140 mi wide between La Puntilla on the north and

Cabo Blanco on the south and it penetrates the land eastward with a slight curve northward at its head for a distance of about 100 mi, terminating in the Guayas estuary and river on which is the port of Guayaquil. The upper end of the gulf and its northern shores are fringed with swamps through which numerous estuaries penetrate for some distance inland. Of these, the Estero Salado west of the Guayas, formed of many shallow tide water channels, penetrates as far inland as Guayaquil, but is used only by canoes. Near Guayaquil in the Estero Salado is good bathing. The upper end of the gulf of Guayaquil is filling up with the silt brought down from the Andes. It is divided midway by the large island of Puna, at the eastern end of which is the anchorage for steamers too large to ascend the Guayas. The steamship channel passes between this island and the Peruvian coast and is known as the Jambeli channel. The Morro channel west of Puna, is obstructed by shoals and is dangerous for shipping. In the Jambeli channel on the southeastern shore of the gulf is the small port of Puerto Bolívar, serving Machala and the Zaruma mining district.

Islands—There are few islands off Ecuador, and only one of any considerable size that of Puna in the northeast part of the Gulf of Guayaquil. This is 29 mi long by 8 mi to 14 mi wide. Puna generally is low and swampy and its shores, except on the east, are fringed with mud banks. It is densely wooded, in marked contrast to the opposite Peruvian shore and is unhealthy the greater part of the year. It has a population of about 3,000, about 800 living in the village of Puna at its northeastern extremity. Pilots are taken on there to ascend to Guayaquil. Twelve miles southwest of Puna island and 50 mi from Guayaquil is Amortajado (or Santa Clara) island, whose resemblance to a shrouded corpse suggested the name which it bears. It rises to a considerable elevation, and carries a light 256 ft above sea level. There are some low, swampy islands, or mud flats, covered with mangrove thickets, in the lower Guayas, but they are uninhabited. On the coast north of the Gulf of Guayaquil there are only two small islands of more than local interest. The first of these is Salango, in $1^{\circ} 35' S$, which is about 2 mi in diameter and rises to a height of 524 ft. It is well wooded, and has a well sheltered anchorage formerly frequented by whalers in search of water and fresh provisions. The next is La Plata, in $1^{\circ} 16' S$, which rises to a height of 790 ft, and has a deep anchorage on its eastern side where Drake is said to have anchored in 1519 to divide the spoils of the Spanish treasure ship "Cacafuego." The Galapagos Islands (*q.v.*) belong to Ecuador, and form a part of the province of Guayas.

The Amazon Region—The region east of the Andes mountains or the Amazon region is called the Oriente and is entirely forested. It begins at the eastern base of the Andes mountains which may be taken at about 4,000 ft above the sea, and the southeastern portion of the region was involved in the frontier dispute with Peru (*see* above on boundaries).

The land surface in general slopes eastward, at first rapidly until at about 850 ft above the sea it becomes a part of the Amazon lowland. Very little is known of the interstream areas. Immediately east of the Andes the general surface is deeply dissected by rivers, but in a measure as one proceeds eastward the land surface tends in general to meet the level of the rivers. Near the Andes are here and there mountainous masses like the volcano Sumaco (12,490 ft above the sea) and the cordillera Galeras which in reality belong to the Andean region for they are connected to the Andes by the 4,000 ft contour. A few detached mountain masses such as the Lumbaki mountains on the equator in longitude $77^{\circ} 20'$ west of Greenwich are known to exist and doubtless others will be discovered later.

The main rivers of the Oriente originate on the Andes. All flow into the Atlantic and those whose sources are in the Andes emerge in great gorges on to the Amazon lowland. They are torrential and not navigable till they reach a low elevation when they suddenly become navigable, not only for canoes, but for launches and steamers.

This uppermost point of navigation, or fall line is clearly marked. The streams for about 100 mi east of the Andes are torrential and full of rapids. Their courses in this part are usually

"braided", i.e., choked with debris from the Andes so that there are many channels and islands. The beds are of boulders which decrease in size eastward. At the fall line which on the Rio Napo for example is 850 ft above the sea in longitude $77^{\circ} 00'$ W of Greenwich, and about 3,000 mi from the Atlantic, the braided character disappears and the rivers become deep sluggish and wide, with low mud banks.

Tributaries.—The streams are all tributaries of the Amazon (qv) divided into two classes, those which rise in the Andes and those which have their entire courses east of the mountains. In the first class are the Rio Napo, Rio Pastaza, Rio Santiago and Rio Chinchipe. To the second subdivision belong the Rio Tigre and the Rio Morona. The Rio Tigre, the tributaries of which rise on the Andean slopes from Cotacachi north to Tulcan, is the largest of these rivers. Its total length is about 700 mi and it enters the Amazon at about 385 ft above the sea, in lat $3^{\circ} 20'$ S and long $72^{\circ} 40'$ W of Greenwich. From the village of Napo near the base of the Andes where it has an elevation of 1,580 ft above the sea, it descends in 90 mi to an elevation of about 900 ft above the sea, at the mouth of the Rio Coca. From there it drops 515 ft in about 464 mi or about one foot per mile. In the stretch between Napo and the mouth of the Rio Coca, the river is shallow and canoes can be used but going upstream against the current and with bad rapids, it is slow work, about 14 mi per hour. The descent from Napo to the mouth of the Coca is done by canoe and by shooting the rapids, in two days, i.e., at the rate of about 5 mi per hour. At the mouth of the Coca, the Napo is about 1,500 ft wide, at its mouth it is nearly one mile wide. Steam launches can ascend to a point several miles above the mouth of the Rio Coca. The principal tributaries of the Napo are the Aguacico and the Coca from the north, and the Curaray from the south. The Coca unites with the Napo in lat $0^{\circ} 30'$ S and long $77^{\circ} 00'$ W of Greenwich and is about 150 mi long. This river was explored by J. H. Sinclair, who found that at Papallacta it is about 10,333 ft above the sea and at Baena 20 mi farther east, 5,863 ft having a fall of about 233 ft per mile in this distance, a total of 4,470 ft. The main tributary of the Napo from the south is the Rio Curaray. This stream rises east of the Andes 18 mi north of Canelos, in hills about 2,000 ft above the sea. It is about 400 mi long and joins the Napo about 143 mi from the Amazon. Near its headwaters it is a creek with a serpentine course and it is described as having this feature all the way to its mouth. It is said to be navigable on account of its sluggish current as far as Canelos, about 300 mi from its confluence with the Napo. Sinclair crossed it in 1921 in long $77^{\circ} 40'$ W of Greenwich and gave its elevation there as 2,000 ft above the sea with a fall of about 5 ft per mile.

The Rio Pastaza which is about 450 mi long enters the Amazon at a point $76^{\circ} 20'$ W of Greenwich and about $4^{\circ} 55'$ S lat. The upper portion of this river, 127 mi long lies on the Andean high lands and has been described above as far as Mera, 3,808 ft above the sea where the river enters the Amazon lowland. From Mera the river drops at the rate of 40 ft per mile to the mouth of the Rio Pindo (2,700 ft above the sea), where it is still a torrential stream. Apparently the river is not navigable for canoes above Andoa, a settlement about 68 mi below the Pindo, for the usual route of Indians and travellers eastward leaves the Pastaza near the mouth of the Pindo, to proceed overland to Canelos (1,690 ft above the sea, in lat $1^{\circ} 35'$ S and long $77^{\circ} 45'$ W of Greenwich) on the Rio Bobonaza where canoes are taken to its confluence with the Pastaza at Andoa, a point about 216 mi from the Amazon. It is said that boats of a draught not exceeding 4 ft may ascend about 110 mi from the Amazon.

The Tigre is an affluent of the Amazon and rises east of the Andes. Its length is a little over 400 mi. It joins the Amazon in $73^{\circ} 55'$ W of Greenwich and in $4^{\circ} 20'$ S lat. It is navigable for boats drawing 6 ft at high water from the confluence of its tributaries, the Cunambo and the Pintuyacu, to its mouth, a distance of about 400 mi. About 104 mi from its mouth it receives the Rio Corrientes, an affluent from the west which is navigable for about 100 mi. The Rio Pucacuri joins it from the north about 152 mi from its mouth and this latter stream is navigable

it is said for about 37 mi above its mouth. The width to the mouth of the Corrientes is 650 ft to 980 ft and its depth from 25 ft to 30 ft. The current is said to flow at about 13 mi per hour. The ascent of 400 mi can be made in about 67 hr, there being only two bad places, the Island of Tacuma and at Piedra Lisa.

The Morona is an affluent of the Amazon, whose course is also entirely on the lowlands east of the Andes. Its sources are said to be in the Rio Cumasi and other streams north of Macas at elevations of about 4,000 ft above the sea. Its length is about 340 mi. It joins the Amazon at 485 ft elevation in longitude $77^{\circ} 02'$ W of Greenwich and $4^{\circ} 45'$ S lat. It is a meandering river and at 243 mi from its mouth is only 660 ft above the sea, 203 mi further down its elevation is 515 ft and the fall is thus only 144 ft in 203 miles. From there to the mouth, 41 mi, the drop is only 30 ft. It is navigable from its mouth to the Manahuasica, 310 mi upstream at all times and for two thirds of its length by stern launches drawing 4 ft. Its depth is from 40 ft to 50 ft and its width from 260 ft to 490 ft.

The Rio Santiago empties into the Amazon in $77^{\circ} 38'$ W of Greenwich and $4^{\circ} 25'$ S lat at an elevation of 580 ft above the sea. Its mouth is just above the Pongo de Manseriche. Its total length following the tributary Rio Zamora is 281 mi, the Rio Zamora being 150 mi long. From Macas, 3,580 ft above the sea, on the Rio Upano, to the mouth of the Santiago, 580 ft elevation, the distance is about 182 mi and the drop 3,000 ft, i.e., about 16 ft per mile.

The Rio Chinchipe is about 88 mi long and is almost entirely in the Andes. It joins the Amazon in $5^{\circ} 27'$ S lat and long $78^{\circ} 32'$ W of Greenwich at an elevation of about 1,205 ft.

(J H Sn, X)

Geology.—The Andes reach great heights in Ecuador, where they include several lofty volcanic peaks. The volcanoes are of Tertiary or later origin and are most numerous in the northern half of the country. Cotacachi, Chimborazo and Cayambe are volcanoes that rise more than 19,000 ft above sea level, and these and other snow covered and ice capped peaks form the culminating points of the mountain mass. This has been divided into the Eastern cordillera, composed of gneiss, mica schist and other old crystalline rocks, and the Western cordillera, composed of porphyritic eruptive rocks of Mesozoic Age and of Mesozoic sedimentary beds, mainly Cretaceous. Between these ranges are recent deposits that contain plant remains. Northward this depression is in large part filled with lava, tuff and agglomerate from the volcanoes, which stand either upon the folded Mesozoic beds of the Western cordillera, on the old rocks of the Eastern cordillera or on the floor of the depression. The lavas and ashes are mostly Andesitic. Ecuador is more subject to volcanic disturbances than any other South American country, excepting perhaps Chile.

The mineral resources of Ecuador have been only slightly developed. Gold, mercury, copper, iron, silver and lead are mined. Platinum was discovered in the Santa Elena peninsula, north of Guayas Gulf. The largest development is that of gold, centring around Zaruma in the province of El Oro. Some sulphur deposits exist in the Pichincha and Chimborazo districts, and in the Galapagos Islands. There is coal in the interior of the republic. Ecuador has important petroleum fields, the coastal region of the Santa Elena peninsula, the Amazon country in the east and the Andean plateau.

(G McL W, X)

Climate.—Were it not for its lofty mountains and the Humboldt current the climate of Ecuador would be entirely tropical, for it is traversed by the equator. But, inasmuch as the elevations extend from sea level up to 20,576 ft, the climates vary from the temperate of the lowlands east and west of the Andes, through the temperate of the higher slopes, to the Arctic climate of the peaks of Chimborazo, Cayambe, Antisana, etc.

The tropical lowlands are along the Pacific coast and the tributaries of the Amazon, east of the Andes. The former are comparatively dry, the latter extremely humid because of the Atlantic trade winds in their southwestern course across the low and extremely wet basin of the Amazon.

The Pacific coast is one of transition between the arid climate of the coast of Peru to the south and the northerly humid one of

Colombia. The former climate is caused mainly by the presence of the Humboldt current which flows from the coast of Chile north, and the latter by the warm south flowing waters of the Central American current. These two currents, with a difference of temperature of from 6° to 8° F., meet off the coast of Ecuador and flow west to the Galapagos Islands. Only at rare intervals is their relative strength altered, as in 1925 when the Central American current flowed farther south than had ever been known and the Humboldt current appeared to be missing entirely. Consequently the deserts of Peru and of southern Ecuador were visited by large quantities of rain for the first time in many years.

Under normal conditions, the inner shores of the Gulf of Guayaquil, the island of Puna, the valley of the Guayas and all the coast of Ecuador north of Cape San Lorenzo have considerable rainfall, while the coast from the Santa Elena peninsula north to Cape San Lorenzo, including the island of La Plata, is a region of scanty rainfall. From Cape San Lorenzo south there appear to be four climatic provinces. In the Montecristi region the climate is normally semiarid but the hills receive a typical heavy Scotch mist. In the *cordillera de Colónche*, a ridge about 1,800 ft high south of the above region, there is more humidity and very thick vegetation. In the Santa Elena peninsula there are no hills and the climate is extremely arid. Finally along the shore of the Gulf of Guayaquil southeast from Santa Elena the climate is tropical with luxuriant and profuse vegetation. The Santa Elena climate is characteristic of the arid type.

There seems to be a clearly marked division in the Pacific coastal region into cooler months from July to November and warmer months the rest of the year. The tropical region east of the Andes is the zone of greatest rainfall.

Flora—The flora varies from that of the tropics to that of icy mountains, from vegetation characteristic of humid and arid regions on the Equator to lichens on the snows at 18,400 ft. above the sea. Corresponding to the broad climatic divisions the vegetation is classified into five types: (1) that of the arid regions on the low-lying Pacific coast, (2) that of the humid regions on this same coast and in the low lying Amazon region east of the Andes, (3) that of the forests on the eastern and western slopes of the Andes up to about 10,000 ft. altitude, (4) that of the so called "cereal" zone, a treeless region on top of the Andean plateau, and (5) the *páramo* or Alpine region which terminates in the region of perpetual ice and snow. Because of this great diversity of climate, the flora of Ecuador is exceedingly rich, and species before unknown from this region are constantly being discovered. J. N. Rose raised the number of known species of cacti from 12 to 30. A. S. Hitchcock studied the grasses which extend in great diversity from the lowlands to the snow line. W. Popeo described about 100 species of fruits. Ferns are abundant and of many types ranging from the filmy ferns of the fog covered forests to the giant tree ferns of the tropical valleys. The genus *Eupatorium* occurs in many forms, more than 50 species being reported. Numerous species of the heath family are found in the forested mountains and the high *páramos* .

Among the more common economic plants are the *corozo* or ivory-nut palm (*Phytelephas macrocarpa*), which furnishes vegetable ivory for manufacturing buttons, the cacao tree (*Theobroma cacao*), from which the cacao bean is gathered, the hbr plant *Carludovica palmata* (not a palm), used for making Panama hats, the balsa (*g v*) tree or corkwood (*Ochroma lagopus*), furnishing the lightest timber in the world, and the cinchona tree which yields quinine. Wheat grows at elevations of from 4,500 ft. to 9,800 ft. and barley up to 11,500 feet. More than 100 kinds of useful woods have been described.

Mammals—While in general mammals are comparatively scarce, according to G. H. H. Tate they are represented by a very wide range of species. In the forests east of the Andes the Primates are numerous, but on the west coast only three genera occur: spider monkeys, howlers and capuchins. The Carnivora include the jaguar, puma, ocelot, foxes, weasel, tayra, otter, skunk, grison, racoon, coati-mundi and kinkajou. The Ungulates comprise the tapir, two kinds of deer and two sorts of peccaries. Among the rodents are the amphibious capybara (east of the

Andes), paca, agouti and the rare *Dinomys*, the smaller forms include squirrels, rabbits, cavies and numerous rats and mice. There are numerous species of bats, including the bloodsucking vampire. Representatives of the sloths anteaters and armadillos are not rare. The opossums, with half a dozen genera, include the web footed *Chromectes*, and the curious little *Caeolestes*, the so called "living fossil," of the high Andes.

The chief governing factor in the distribution of these animals is the Andes mountains which run north and south through the country causing wide variations in the climate. Broadly speaking the climates are tropical from sea level up to 5,000 ft., subtropical from 5,000 to 11,000 ft., and temperate, from 11,000 ft. up to snow line. These conditions, modified by rainfall, act directly upon the vegetation and the animal life within the several zones, resulting in the evolution of specially adapted forms. The only indigenous animals under domestication are the llama and alpaca. Neither is abundant. But horses, cattle, sheep, goats and pigs are now raised everywhere. In the high plateaus, sheep and cattle thrive particularly well.

Remains of extinct vertebrates, such as mastodons and horses, are found in the Pleistocene deposits of the highlands and also of the Pacific coast. The natives at the time of the arrival of Francisco Pizarro, in 1537, ascribed these to a race of giants which formerly inhabited the country.

Birds—Frank Chapman stated that about 1,500 species of birds had been found in Ecuador. This is approximately one fourth of the South American avifauna and is doubtless a larger number of birds than has been recorded from any other area of similar size. Ecuador owes its exceptional abundance of bird life primarily to the extent and altitude of its mountains, which add to the lower or tropical zone, three additional zones, each of which has species that are restricted to it (endemic). They are the subtropical zone (alt. from 3,000 or 4,000 ft. to 9,000 ft.) with 237 species, the temperate zone (alt. 9,000 ft. to 12,000 ft.) with 142 species and the páramo zone (alt. 12,000 ft. to snow line) with 33 species. These endemic zonal species have been derived from the tropical zone at the base of the Andes and also from both the south temperate and the north temperate zones. Their existence affords an admirable illustration of the stimulating effects of change of environment on the evolution of species. For example, Ecuador is known as the land of humming birds, but it is not generally realized that only 66 of its 147 species are found in the tropical zone, while 81 are confined to the upper life zones and in large part at least, have therefore been evolved since the latter part of the Tertiary when the mountains they occupy were elevated.

The brilliantly coloured tanagers (Tanagridae) are also commonly considered as characteristic of the American tropics, but of the 106 species found in Ecuador only 52 are known from the tropical zone, while 46 are confined to the subtropical and 18 to the temperate zone. Other birds with numerous species in Ecuador are the pigeons (Columbidae) 26 species, parrots (Psittacidae) 38 species, toucans (Ramphastidae) 19 species, woodpeckers (Picidae) 37 species, antbirds (Formicariidae) 114 species, woodhewers (Dendrocolaptidae) 31 species, flycatchers (Tyrannidae) 160 species, and wrens (Troglodytidae) 32 species.

Sixty six species of birds that nest in North America visit Ecuador in winter. Among this number are the Carolina rail, or sora (*Porzana carolina*), blue-winged teal (*Querquedula discors*), kingbird (*Tyrannus tyrannus*), barn swallow (*Hirundo erythrogastrus*), red eyed vireo (*Vireo olivaceus*), redbird (*Setophaga ruticilla*), rose breasted grosbeak (*Zamelodia ludoviciana*) and scarlet tanager (*Prangia erythromelas*).

Fishes—When compared with the Amazonian fauna, the fresh water fish fauna of the Pacific slope of Ecuador (see Carl H. Eigenmann, "Fishes of Northwestern South America," *Memoirs of the Carnegie Museum*, vol. 12, no. 1), is relatively meagre, only about 60 species being included. The fishes of the eastern part of Ecuador are as yet practically unknown. Although the species and many genera are now different, all of the fishes of the Pacific slope streams are similar in character to their Amazonian relatives and were evidently derived from, them before the uprising of the

Andes. This Pacific slope fauna is characterized by the lack of certain usual Amazonian types such as the electric eel and the piranha. One of the most remarkable of Ecuadorian fish is according to Arthur W. Henn of the Carnegie Museum is the rasbora (*Plecotomus spinosissimus*) which is a sort of plicated catfish so well protected by its spiny covering that, if care is taken not to frighten it it may be picked up by hand from the sundrivers. In the same waters, the Guavira system, occurs a blind catfish the ciego (*Citopops occidentalis*), the eyes of which are covered with thick skin.

Another celebrated Andean species found in Ecuador is the so called volcano fish (*Astroblepus gualan*) which, by means of its duck-like sucking mouth and prickly fins is enabled to live in torrential mountain streams. Formerly this fish was erroneously said to be thrown in great quantities during eruptions from subterranean lakes within volcanoes.

Reptiles—All the major groups of reptiles are known. According to Alexander G. Ruthven there are fresh water and land turtles, crocodilians, lizards and snakes. Among the lizards, the beautiful fan lizards, Amazonian chameleons or Anoles, are conspicuous for their delicate changeable colours and flashing throat fans. Other interesting lizards are the *Amazilia*, active and conspicuous on bright warm days, the blind lizard *Amphibaena*, frequently found in ant and termite nests, the spiny *Echinosauro*, and several geckos. The snakes of Ecuador vary in size from threadlike *Helminthophis*, which burrows in decaying wood, to the large boa (*Constrictor constrictor*). There are fresh water snakes, sea snakes, tree snakes, ground snakes and burrowing snakes. Many are harmless, but there are numerous venomous species. Among the latter are several opisthoglyph snakes, several proteroglyph snakes, coral snakes (*Elops* or *Micrurus*) and the dangerous solenoglyph pit vipers, notably the *fer de lance* (*g v*). There are also various tree snakes such as *Oxybelis*, interesting for their attenuated form and habit of resembling vines. The crocodilians are represented by a true crocodile and the broad snouted cuman. A few fresh water turtles and the large land tortoise (*Testudo denticulata*) are known.

Insects—While the insect inhabitants of Ecuador embrace numerous genera and species representing the most important orders, no comprehensive survey has been completed. Campos enumerated about 1,550 known species chiefly butterflies and moths (Lepidoptera), beetles (Coleoptera), grasshoppers and their allies (Orthoptera), bees and ants (Hymenoptera). Of beetles alone there are estimated to be 3,000 species. In general it may be said that for each 1,500 ft. of elevation there is a new province of insect life. Lepidoptera have been collected on the slopes of Antisana at 16,000 ft. altitude. A giant beetle (*Dynastes hercules*) attains a length of five inches. Certain click beetles and fireflies are noted for their phosphorescent light. Among the Diptera is found or rather was found the mosquito *Aedes argenteus*, the carrier of the yellow fever germ, known also as *Sigomyia fasciata*. Below 1,500 ft. elevation also occurs the mosquito *Anopheles albimanis*, carrier of the malaria germ. Numerous parasitic insect pests abound among the Indians.

HISTORY

Archaeology and Antiquities—All that is known about human life in Ecuador up to a few years before the arrival of the Incas, i.e., about two or three generations before the arrival of the Spaniards in 1537, is contained in archaeological and linguistic remains, for writing of any kind was not only unknown to the earliest inhabitants but even to the Incas themselves.

At various places in the western lowlands, in the central highlands and even in the forests east of the Andes are found archaeological remains, which prove the existence at certain times of a considerable culture. Although objects have been found which according to Max Uhle point to a relationship with the Maya civilization in Central America which was flourishing as early as A.D. 68 and probably much earlier, other objects indicate the presence of man in Ecuador several thousand years ago.

The pre-Inca archaeological remains of Ecuador are of three unrelated types of culture. One, peculiar to the high Andean

valleys a second, to the Pacific coast lowlands, and a third, to the forested region east of the Andes. The first two types prove, says Uhle, that two perhaps independent, migrations from Central America took place and that the emigrants were profoundly influenced afterward by a widely different environment. The region east of the Andes has furnished little archaeological material, but this shows a close affiliation with objects found in the great forest area along the upper Amazon, whose inhabitants Uhle believes migrated from Central America but turned eastward from the isthmus of Panama to follow the north coast through Colombia, Venezuela and the Guianas to the mouth of the Amazon, which they ascended. Perhaps at the same time there was a contemporaneous filtration of people south by way of the numerous waterways which drain into the Caribbean sea. The first type of remains, i.e., those peculiar to the high Andean valleys of Ecuador, may be subdivided into three minor classes in each of which the remains show a more or less centralized development. Remains of the first subdivision are found in the three northern provinces, Carchi, Imbabura and Pichincha. Those of the second class come from the region near the volcanoes, Tungurahua and Chimborazo, and those of the third subdivision from the provinces of Cañar, Azuay and Loja in southern Ecuador.

The most noteworthy features of the ceramic art of the first subdivision are long slender vessels found in large numbers in the deep, well like tombs at Angel and vicinity, and bowls painted with many motifs of great interest in aboriginal decoration. The second subdivision is characterized by vessels with thin walls, or named with straight or wavy parallel lines. This is the most important of all the ancient culture centres of the Andes because of the stratified sequence revealed in excavations where six horizons have been recognized according to Uhle. The lowest of these, which is called the Proto-Panzaleo, no. 1 shows profound Central American influence, as Uhle has declared. The Proto-Panzaleo, no. 2, which overlies the first, is a continuation of the first but with marked traces of a new influence from the north. The Tuncabian overlying this is thinner and therefore indicates a period of shorter duration than the others, but it is more wide spread, being found over almost the entire Andean region of Ecuador. It is marked by the disappearance of tripod vessels, by abundance of negative painting, and by the first white pottery ornamentation. There also appear objects of copper. The next, or San Sebastian, layer contains new types of pottery vessels, and there progress was made in architecture, as shown by the ruins near Guano. In the fifth horizon from the bottom the art of Chimborazo reached its highest development. Negative and positive painting of earthenware flourished, and jars with conventional human faces and arms, placed in low relief on the necks and upper body parts of the vessels are characteristic. In this restricted region there is much pottery of this style, but none has been discovered beyond. Human bones and innumerable small shell beads have been found in some vessels, while in others yellow powder reveals Chicha sediment showing that they had been filled with liquid for the refreshment of the deceased with whom the receptacles had been buried. Many copper ornaments are in this horizon. This is the art of the Puruha who lived as late as the time of the Spanish conquest. The sixth horizon, i.e., the most recent, is called the Huavalac and is characterized by "lost colour" ware.

CENTRAL AMERICAN INFLUENCE

Near Cañar, Azuay and Loja, a high degree of culture is revealed, of marked Central American influence, says Uhle. There architecture reached a high plane as the ruins of splendid fortresses and other edifices attest. A wealth of gold ornaments and implements has been found in tombs at Chordeleg and Sigas. In the second great cultural area, viz., that of the Pacific coast, climatic conditions were very different from those in the highlands, for the region is comparatively low and almost entirely covered with forests. This zone contains two cultural centres, one extending from what is now Esmeraldas south 150 mi., and the other in the province of Manabí with its alternate arid and humid climatic conditions. These two cultures, says Marshall Howard Sewille, prove

the existence of two distinct peoples whose occupancy extended over a considerable period, and whose highest development seemingly was reached long before the coming of the Spaniards. Their cultures differ widely from those represented by the artifacts of the highlands, and apparently there was no connection between the two.

In some respects the most interesting culture in Ecuador is that of Esmeraldas. Prominent features are the surprising advancement it shows in modelling clay figures and the great progress in gold working. A dominant feature is the almost microscopic character of many of the objects fashioned in filigree, another is the occurrence of jewels of pure platinum or of platinum and gold filigree. Many pieces are so closely allied to Mayan artifacts as to be almost indistinguishable. The type of culture in general is intermediate between the Mayan and that of the Peruvian coast.

Of the Manabí culture, the outstanding feature is the development of stone architecture, almost entirely unknown in the interior highlands and entirely on the Esmeraldas coast. The Manabí sculptures are unique in South America, says Saville, and have been found in the ruins of houses in hilltop villages and in a few town sites on the arid plains of Manabí. These sculptures include stone seats, believed to have been used ceremonially in household sanctuaries, sculptured slabs of stone, or bas reliefs, representing female deities, etc., columns recalling those of Costa Rica, birds, animals and human figures in stone. A few pieces of copper and some ornaments of gilded copper are the only examples that have been discovered thus far of the metal work of the ancients of Manabí. In their towns the dead were buried in bottle-shaped tombs cut into the solid rock as well as in mounds or "tolas."

The third great zone of culture east of the Andes has not been studied. It is represented by a few remains in the Napo region which distinguish it from that of the neighbouring highlands and the Pacific coast, it is apparently related to one farther east near the mouth of the Amazon.

Writing was unknown before the Spanish conquest. At the time of the arrival of the Incas in Ecuador, a number of languages were spoken. Several of these survived the superposition of the Inca language, *i.e.*, the Quechua, to the time of the arrival of the Spaniards. One, the Esmeraldas, has died out only in recent years, while two, the Cayapa Colorados and the Jivaro still survive owing to their existence in inaccessible regions. On the basis of geographic names as well as the vocabularies of the three known pre-Inca languages above mentioned, the following languages are recognized as having been in existence at or shortly before the arrival of the Incas:

Quillacingas, Pastos, Caranquis (or Imbaburas or Cayapa-Colorados), Tacungas or Panzales, Purihuas, Cañaris, Palltas and Jivaros, Bolona (Rabona and others), Esmeraldas, Manabitas or Mantenos and Mochica (or Yunga).

Jacinto Jijón y Caamaño thinks that the oldest types represented in Ecuador were the Cayapa Colorados, the Jivaros and the Chimus and that the others represent modern elements in Ecuadorian ethnology. For Inca history see INCA.

SPANISH CONQUEST

Spaniards' Arrival.—In 1526 Bartolomé Ruiz, the pilot of Francisco Pizarro, having been sent south from the main base of the second expedition for the conquest of Peru, at that time situated at the mouth of the San Juan in what is now Colombia, rounded Cape Pasado to 1° S and returned. He was thus the first European to cross the equator on the Pacific coast of South America, and to see the shores of what is now Ecuador. Ruiz first reached the Esmeraldas where the present town of Esmeraldas is situated and discovered there three large settlements of Indians who received him in a very friendly manner. They wore jewels of gold and three of the Indians who came out in canoes to receive Ruiz wore golden diadems on their heads.

Ruiz on his return to the San Juan informed Pizarro of his discoveries, and then, joined by Pizarro and Diego de Almagro, made a second voyage as far south as Atacames, discovering more large towns, much cultivated ground and a formidable array of

well armed Indians. Returning to the island of Gallo in 1° 57' N they sought reinforcements. Early in 1537 Pizarro sailed to the Gulf of Guayaquil opposite the town of Tumbes where they saw the undoubted signs of a great civilization, confirmed by a cruise as far south as Santa (9° S). Pizarro returned to Spain where, by the contract between himself and the crown, dated July 26, 1529, he was appointed captain general and *adelantado* of the region. He returned, this time with a large retinue, among them his four brothers, his young cousin Pedro Pizarro (the future historian), and several Dominican priests. He sailed from Panama on Dec. 28, 1531, with three small vessels carrying 183 men and 37 horses, and in 13 days arrived at the Bay of San Mateo, in northern Ecuador, where he landed his forces and commenced a devastating march along the entire western coast to the Gulf of Guayaquil. He crossed this in boats to Puná, where a destructive war was waged with the unfortunate natives. After subjugating them Pizarro crossed over on ships to the mainland where now is situated the town of Tumbes. Pizarro and his forces left Tumbes on May 18, 1532, founded the city of San Miguel, marched on ward in search of the Inca Atahualpa, made him prisoner and massacred his forces. Atahualpa was executed in the square of Caxamarca on Aug. 29, 1533, and the Inca empire came to an end.

Pizarro, desirous of forbidding the entrance of adventurers into Peru to make discoveries on their own account, sent Sebastián de Benalcázar as his representative to govern San Miguel which was at that time the key to Peru. In Nov. 1533 Benalcázar learned that Pedro de Alvarado, one of the conquerors of Mexico, had sailed from Guatemala to take the kingdom of Quito, which was famous for the riches of Atahualpa. Benalcázar collected a few Spaniards and Indians, marched from San Miguel in the last days of 1533 and crossed the cordillera of the Andes to the great highway of the Incas in the province of Loja, now Ecuador, at that time inhabited by peaceful tribes of Palcas. Following this north without opposition, he reached the pueblo of Tomebamba in the country of the Cañaris and persuaded these tribes to join forces with him against their enemies to the north. He then marched north through the province of Azuay, defeated the Indians at Riobamba and finally in May or June 1534 arrived at the city of Quito which he found in ruins. He then continued north to Cayambe where he received word that Almagro had been sent by Pizarro to join forces with him in opposing the expedition of Pedro de Alvarado, which had landed at Puerto Viejo in March 1534 and which was proceeding with frightful hardships straight east from the coast through unknown forests to ascend the west slope of the Andes where no trails even existed. Returning to Riobamba, Benalcázar met Almagro and they founded the city of Santiago de Quito on Aug. 15, 1534, as an evidence of formal possession of the territory by Pizarro. This then was the first city to be founded in Ecuador. Alvarado when he finally reached the summit of the Andes, after one of the most extraordinary expeditions of the Spanish conquest, found that he had been outmatched. On Aug. 26, 1534, Alvarado agreed to retire from Peru.

Pizarro then proceeded to pacify Ecuador. The city of Santiago de Quito, founded near the present site of Riobamba, was moved to the present site of Quito, on Aug. 28, 1534, and the name changed to San Francisco de Quito. The territory embracing the most northern limits of the Inca empire was soon conquered and finally the conquest continued north into what is now Colombia. It was then continued east of the Andes. Lured by the account of fabulous riches, Francisco Pizarro appointed his brother Gonzalo governor of Quito on Dec. 1, 1540, and the final conquest of Ecuador took place. Leaving Quito in Feb. 1541, Gonzalo Pizarro crossed the Guamaní pass of the Andes, 13,350 ft. above the sea, wandered in the forests east of the Andes many months and finally, after a feat of exploration which brought him to the Amazon and permitted Francisco de Orellana, one of his lieutenants, to descend it to its mouth, returned to Quito in rags and with but 97 men, leaving his companions in unmarked graves in the forests east of the Andes.

Conquerors' Discords.—The period of conquest was followed by civil war among the *conquistadores*. Diego de Almagro and Francisco Pizarro perished by assassination and Gonzalo Pizarro

rebelled against Spain. All the new possessions in South America were now erected by the crown into the viceroyalty of Peru and in this governmental body was concentrated the executive power. To this was added a judicial body, the *audiencia*, and the first viceroy was the president of the first *audiencia* of Lima. In addition Roman Catholicism, the state religion, was put in charge of a bishop, the first bishopric embraced practically all the viceroyalty. The first viceroy, Blasco Núñez Vela, arrived in Ecuador en route to Peru but was defeated by Gonzalo Pizarro at the battle of Incahuasi, near Quito, Jan. 18, 1546. He himself was killed and his head exhibited at Quito. Gonzalo Pizarro, however, did not long enjoy the fruits of his rebellion for a new royal representative, Pedro de la Cueva, met and defeated him at Jacuri, January, Peru on April 9, 1549. Surrendering, he was executed almost forthwith.

The government by viceroys continued for 74 years. For the first few years after the establishment of the viceroyalty of Peru the territory now known as Ecuador was ruled by its representatives in the cities of Quito, Guayaquil, Puerto Viejo, Loja and Cuenca. In 1545, the bishopric of Quito was formed of that portion of the bishopric of Luzco extending from Payta north into what is now Colombia, and on Aug. 29, 1563, the *audiencia* of Quito was established with judicial authority over the region from Cuzco on the north to Buenaventura on the Pacific and to far east of the Andes, covering all the explorations of Gonzalo Pizarro in 1541, south as far as the latitude of Payta, thus embracing the bishoprics of Quito and Popayan. Because of the isolation of the region from viceregal authority and the presence of the governor as president of the *audiencia*, that body came to be not only judicial in nature but administrative as well.

The *audiencia* or presidency, of Quito, as it was almost interchangeably called, remained a part of the viceroyalty of Peru until, by royal edict of May 27, 1717 it was transferred to the newly created viceroyalty of Nueva Granada, whose seat was at Bogotá. Six years later, the new viceroyalty was abolished and Quito returned to the authority of the viceroy of Peru but in 1740, when the viceroyalty of Nueva Granada was restored, Quito was again put under its jurisdiction, where it remained until the end of Spanish domination.

Independence.—The ultimate phase of colonial history, viz., the movement for independence, had its birth in the activities of Eugenio Espejo (born in Quito, 1747), Antonio Ante, Juan Pío Montufar and others. The first blow was struck in Quito on Aug. 10, 1809, but the new revolutionary government established soon perished and on Aug. 2, 1810, most of the leaders responsible for it were massacred in Quito. A second attempt on Oct. 11, 1810, set up the "Eight Provinces of the State of Quito" which fell in Dec. 1812. The royalists then maintained their power until May 24, 1822, when, with the assistance of Antonio José de Sucre sent by Simon Bolivar, the republican forces defeated the royalists at the battle of Pichincha and two days later Aymerich, the last president of the *audiencia*, capitulated. Ecuador, under the name of "department of the south," now joined with Venezuela and Colombia in the confederacy known as the republic of Colombia.

RULE OF THE PRESIDENTS

The efforts of Bolivar to maintain this greater republic were unsuccessful. Although Bolivar defeated Peru in 1829, fixing the limits between Peru and Colombia as those of the old viceroyalties of Lima and Bogotá, Venezuela soon after withdrew from the confederacy (Nov. 29, 1829) and a constitutional convention in Riohacha (Aug. 13 to Sept. 28, 1830) the three departments of Azuay, Guayas and Quito formed themselves into an independent state called the Estado del Ecuador or Colombia and adopted the first constitution of what is now Ecuador.

The history of Ecuador since its separation from Bolivar's great state has been very largely that of its great dictators, of whom three stand out most prominently. Juan José Flores, Gabriel García Moreno and Eloy Alfaro. Its course has been complicated by internal struggles of Liberals against Conservatives of section against section, and, particularly in the 20th century, by economic factors.

The first president of the new republic was Gen. Juan José Flores, a Venezuelan by birth, who had identified himself with Ecuador and had led the movement for separation. President Flores represented a Conservative group, whose stronghold was inland Quito, conservative, aristocratic, and devoutly loyal to the Roman Catholic Church, in politics as well as in religion. There were, however, particularly in Guayaquil, elements in whom the liberal ideas of the 18th century ran strong. Coupled with this was sectional rivalry between Guayaquil and Quito.

By 1833, opposition to Flores, headed by Vicente Rocafuerte, became formidable, and soon revolt broke out. After over a year of indecisive civil war, the two rival leaders effected a compromise whereby Flores agreed to acquiesce in Rocafuerte's election as his successor in 1835. Four years later (1839) Flores returned as president, but soon had difficulties with congress, and after further disorders accepted exile in 1845, going to Spain, where he involved himself in plans for restoration of Spanish control. In 1851 he made an unsuccessful attempt to return to power.

Meanwhile president had followed president, with only the exceptional one serving his full term. In Jan. 1860, while Ecuador was torn by internal dissensions, Peruvian warships blockaded Guayaquil and forced acceptance of a treaty recognizing Peru's boundary claims. This treaty was repudiated shortly, however, when the government signing was overthrown in Sept., 1860, by a revolution headed by Gabriel García Moreno, son in law of Flores, and one of the most distinctive figures in Ecuadorian history.

Gabriel García Moreno (1821-1875) whose length of service amounted to 10 years and nearly 5 months (two terms), held power longer than any other president. He was starting a third term when he was assassinated on Aug. 5, 1875, thus having the second distinction of being the only president to die by assassination while in office. His period of power brought the church party to its zenith in Ecuador, so much so that García Moreno's presidency was often referred to as a Jesuit government. He perhaps did more for Ecuador than any other president, for he gave it a strong government and peace. He caused the Roman Catholic Church to send out from Europe a number of Jesuit priests, eminent in science, to become teachers. Among these were Theodor Wolf, the geologist, Sodiro, the botanist, Menten, the astronomer, Dressel, the chemist and Kolberg, mathematician. He was a great patron of science, a man of extraordinary energy and a strict ruler. The reaction from his policy carried successive governments to greater and greater "liberalism" and finally to the deprivation of the Catholic clergy of their extensive landed properties, to the establishment of civil marriage and to freedom of worship.

The years following García Moreno's death were marked, mutually, by a reaction against the extreme elements of his time, but not for long. The issue of separation of church and state continued to be bitterly fought, amid nearly constant internal disturbance. Not until the rise to power of Eloy Alfaro in 1895 did order and relative stability return to Ecuador. During his presidency (1895-1901) various restrictions upon clerical activity were enacted into law, comparable in most respects to those exercised by Spain during the colonial regime. His successor, Leónidas Plaza Gutiérrez, went further, and under him civil marriage and divorce were legalized and control of education taken from the hands of the church.

In 1906, former President Alfaro returned to power, and was elected president for a second constitutional term. Under him a new constitution was promulgated. It made the government more centralized, forbade immediate re-election of a president, and set forth various liberal reforms. This constitution, the country's 12th in 86 years, lasted for 2 years, longer than had any of its predecessors. Under Alfaro, too, the railway from Guayaquil to Quito, first in the country, was completed (1906). In 1911, during a revolution against Alfaro's successor, the former president was arrested, and a few months later was dragged from his prison and murdered by a mob in Jan. 1912.

At the outbreak of World War I, Ecuador proclaimed its neutrality, but after entrance of the United States into the conflict, relations with Germany were broken off and German shipping in Ecuadorian harbors seized.

A coup d'état in 1925 ushered in a period of excessive political instability which was not terminated until the election of Pres. Galo Plaza Lasso in 1928. The coup of 1925 brought into power a junta which dissolved congress. Subsequently a military board assumed control and made Isidro Ayora president. In 1929 constitutional forms were resumed and Ayora's authority was confirmed by election. His administration, however, lost its army support by its budgetary policy and in 1931 Ayora resigned. Factional strife and minor uprisings, partly the results of economic depression, prevailed thereafter. In Aug. 1935, Pres. José María Velasco Ibarra was deposed by the army, and a junta was set up with Federico Páez as nominal head. The new government sternly repressed adverse criticism, but, as internal unrest continued, Páez was forced to resign (Oct. 24, 1937), being succeeded by his war minister, Gen. Alberto Enriquez Gallo. Enriquez Gallo served until a constituent assembly, meeting Aug. 10, 1938, chose Manuel María Borrero and subsequently (Dec. 1) Alberto Mosquera Narváez.

Narvaez, fourth president in 14 months, was able to retain his position only by force, crushing a revolution with artillery after two days' fighting, and died in office Nov. 17, 1939. His successor, Carlos Alberto Arroyo del Río, resigned in favour of Andrés B. Córdova (Dec. 11) to run in the Jan. 1940 presidential elections. Elected, he took office Sept. 1940.

On May 28, 1944, Pres. Arroyo del Río was overthrown in one of Ecuador's most violent revolutions. The insurgents delivered the government to former President Velasco Ibarra, who remained in office until Aug. 23, 1947. His ouster at that time inaugurated a month of chaotic instability characterized by frequently changing administrations. Pres. Carlos Manchego, who had deposed Velasco Ibarra, was himself overthrown on Sept. 2, 1947, and his successor, Pres. Mariano Suárez Veintimilla, presented his own resignation, effective Sept. 17, 1947, to congress. That body thereupon chose Carlos Julo Arosemena to serve out the unexpired portion of Velasco Ibarra's term. Arosemena was successful in achieving sufficiently orderly conditions to permit a relatively free presidential election to be held on June 6, 1948. Galo Plaza Lasso, the victor in that electoral contest, embarked on Sept. 1, 1948, on a four-year presidential term.

(J H Sr., L W Br., G I B.)

POPULATION, GOVERNMENT, ETC.

Population.—The first national population census ever conducted in Ecuador was taken in conjunction with the over all 1950 census of the Americas. Figures published at that time set the population of Ecuador at 3,076,933. Indians accounted for about 60% of this figure, mestizos 25% to 30%, and whites at most 15%. There are a few Negroes on the coast. Guayas is the most populous province, with Pichincha, Manabí, Azuay, Loja and Cumborazo following in order. The language of the whites and mestizos is Spanish, that of most of the Indians is Quechua, although some speak Spanish in the forest region to the east of the Andes. The Jivaro language is spoken among many of the Indians.

Some attempts to attract European immigration were made, but with little success. During World War II, war refugees were invited to settle in the country, and, throughout the Hitlerian era, about 1,000 Europeans, many of them Jews, came to Ecuador as immigrants. All in all, however, there was probably a smaller proportion of new blood brought into Ecuador after independence than into any other country of South America.

Government.—Under the constitution of Dec. 31, 1946—the republic's 15th constitution—Ecuador was declared a unitary or cen-

Army, Navy and Aviation.—At mid-20th century the army consisted of approximately 10,000 with 40,000 reserves. Military service was compulsory for men on reaching the age of 18. Lots were drawn to determine who was to undergo special training at that time. All men from 18 to 50 years of age are part of the reserves. The Ecuadorian government maintained at the aviation base at Guayaquil a school of aviation where young Ecuadorians were trained as pilots and in the mechanics of ground air service. It was there that numbers of men became proficient in the various branches of air service. The navy maintained a naval school at Salinas.

Religion.—Of the pre-Inca religions the only one remaining is possibly that of the Jivaro Indians of eastern Ecuador, which Rafael Karsten says is wholly unaffected by Christianity. In this there is no notion whatsoever of a supreme being and creator of the universe, but it is by no means a pure demonology. The Inca religion has apparently entirely disappeared (see Inca).

The Spaniards made the conquest of Peru not only a territorial extension of their power but a means of conversion of the aborigines to the Roman Catholic religion. The capitulation of July 26, 1532, made Hernando de Luque bishop of Peru, and Francisco Pizarro, when he returned from Spain after having made this contract, took with him a number of Dominican priests, among them, Fray Vicente de Valverde. Soon more priests, this time Mercedarians, arrived and the campaign to convert the Indians was well started. Luque never went to Tumbez to take over his charge, but Valverde was made bishop at Cuzco over all of Peru. González Suárez states that by the end of the 17th century there were in Ecuador alone 42 convents belonging to the Dominicans, Franciscans, Augustinians, Mercedarians, Jesuits and barefooted Carmelites. The number of priests was very large, Quito alone having, as he states, about 1,000 priests. Great social regress and "great damage was caused to the moral advancement of the people by the bad example not only in lack of virtue among the priests, but by their lack of good manners." González Suárez concludes, however, that the convents were the cradle of culture. It is certain that by the end of the 17th century, no part of the Andean region remained unvisited by the missionaries. In 1767 the Jesuits were expelled from all the Spanish dominions in America.

The opposition to the official religion was intended to restrict clerical influence in political affairs. The growth of liberalism resulted in 1889 in the church tithes (10% of the value of the production of the farms) being abolished, a tax of 3 per mill on the value of the farms was substituted. In 1904 civil marriage was permitted and in 1904 the church was placed under state control, the foundation of new religious orders was forbidden and new religious communities were denied entrance. In addition all members of the episcopate had to be Ecuadorians. The state took over the landed property of the religious orders and administered it under a board of charities which gave a pension to the friars. The excuse for this latter action was stated to be the great wealth of the church, gained largely through participation in legacies and by labour which received no earthly pay.

A few Protestant missionaries penetrated the country, among the Indians east of the Andes (Tena and Macas). Freedom of religion, provided for in the constitutions of 1906 and 1929, was limited by the 1946 constitution.

The Catholic Church has an archbishop at Quito and bishops in Ibarra, Robamba, Cuenca, Guayaquil and Puerto Viejo.

Education.—The ministry of public instruction exercises supervision over all educational institutions. Higher education is provided at the Central University of Quito, the University of Cuenca, the University of Guayaquil, and the Junta Universitaria of Loja, all of them government supported. The Central university has faculties of law and social sciences, physical and natural sciences, philosophy and letters, and medicine. The national veterinary school, a school for nurses and a vaccination institute come under the last, a school of agronomy under the faculty of physical and natural sciences, and a section of pedagogy under that of philosophy and letters. The University of Cuenca has faculties of medicine and of law and political and social science, along with a school of painting and art and the superior school of mining engineering. Faculties of law and social science, medicine, pharmacy, odontology, physical sciences and mathematics and a school for nurses are part of the University of Guayaquil. The Junta Universitaria has only a faculty of law and political and social sciences. Teacher training is provided in four normal schools, two in Quito and one each in Cuenca and Guayaquil. In addition, short elementary normal courses have been established in seven cities.

A committee consisting of experts in educational methods, school architecture, public health, etc., known as the National Council on Education, was appointed by the government in 1935 to reorganize primary and secondary education along modern lines, by issuing pamphlets to interpret the ideals of the new type of school, by building experimental schools, organizing demonstration schools for Indians and establishing welfare centres for underprivileged children of preschool age.

At mid-20th century there were about 3,500 public and private elementary schools with about 265,000 pupils, and 135 secondary schools with enrolment of 18,000. To provide necessary funds for education the government required municipal governments to increase their contributions toward defrayment of school costs. Revolutionary changes in secondary school requirements were made, with radical changes in the curriculums which broke down the rigidity of the old system and its

of 64 members elected for two-year terms theoretically on the basis

Charters

There are 17 provinces, 86 cantons and 651 parishes. Each province is ruled by a governor, each canton by a *jefe político*, and each parish by a *teniente político*. The Galápagos Islands are administered through the ministry of national defense and are, technically, a naval command. The Oriente is divided into the two provinces of Napo-Pastaza and Santiago-Zamora.

excessive precautions and through enlargement of the number of elective courses made for flexibility. Further efforts at school improvement were made by encouraging teachers to improve themselves. In 1916, in an attempt to improve the government, it attempted to impose a fine upon landowners for each illiterate person over 15 years old working on the property.

Despite these efforts, however, illiteracy was still estimated at 60% in 1924.

In addition to the National library at Quito are municipal libraries at Quito, Guayaquil and Riobamba.

TRANSPORTATION AND FINANCE

Transportation—Guayaquil, situated on the Guayas river about 40 mi. from the coast, is the chief port. Almost all of the country's foreign commerce flows through it. The Guayas is navigable for 40 mi. above Guayaquil. Several other small rivers are navigable as is the Marañon (the upper Amazon) in the eastern part of the country.

Railways—Approximately 700 mi. of railway were in operation at mid century, the most important being the Guayaquil and Quito line, 227 mi. in length connecting the capital with the coast. Its construction completed in 1908, was regarded as having been one of the most difficult ever attempted. Its cost was in excess of \$19,000,000, averaging \$68.15 per mile. Originally a private enterprise, it was subsequently nationalized, and was all other railway truckline in the country.

Highways—New highway construction and rehabilitation of old roads was pushed extensively in the first half of the 20th century. In the single year 1916, the automobile highway mileage increased from 24.8 mi. to 270 mi. or 12%. Highway mileage at mid-century was approaching 3,000 mi., including the Ecuadorian section of the Pan American highway.

Aviation—Ecuador has external communication by air with all parts of the Americas, to the north through Colombia, and to the south through Peru. Air facilities were materially improved when Quito became a regular port of call for north south airlines.

Revenues—The ordinary budget for 1952 was estimated to balance at 465,000,000 sucres, the equivalent of \$36,000,000 U.S. Decline of the sucre in international exchange was partially responsible for the increase in terms of sucres.

In the average fiscal year, revenues are apportioned among the following sources: taxes on state monopolies, 25%; import duties, 24%; consular fees, 6%; petroleum taxes 5%; substitute for sales tax, 5%; income tax, 5%; port duties, 4%; post office, 4%; stamp tax, 3%; rural property tax, 3%; or 12%. Highway mileage at mid-century was approaching 3,000 mi., including the Ecuadorian section of the Pan American highway.

The public debt of Ecuador (foreign) was \$41,341,000 on Nov. 1, 1950, the internal debt totalling 121,548,000 sucres on that date.

Currency Exchange—Ecuador was on a gold standard, adopted in 1908, until 1912, when payments in gold were stopped by decree. Although the bank-note circulation increased to a considerable extent after 1914, the exchange rate was maintained with very slight fluctuations at about the legal parity of \$0.4867 to the sucre, until in the middle of 1918 it declined in value to 35 cents U.S. This situation was due to the effects of World War I and to the passage of the "Law of the inconvertibility of bank notes" which was really a moratorium. This law probably saved the banks, particularly the Banco Comercial y Agrícola de Guayaquil, as it allowed them from paying gold for their notes, but certainly did great injury to the country at large. In Nov. 1918, the sucre suddenly rose in value to 15 cents and held this to the beginning of 1920 when it was quoted at 47½ cents. The exchange market then broke suddenly, and the sucre depreciated in value until it reached 18½ cents, when, by executive decree of Nov. 16, 1924, the government took over the monopoly and complete control of all foreign bills of exchange, fixing the rate of exchange at about 47 cents. This official rate was subsequently reduced to approximately 35 cents and eventually to 25 cents, remaining at the latter level until official control was abolished in Oct. 1924.

Meanwhile, in the open market, the sucre had fallen as low as 17 cents, following abolition, however, it rose as high as 25½ cents before beginning a decline which carried it to as low as 6 cents in 1952.

Production and Commerce—Ecuador's chief product is cacao, in which it is third in world production. Cacao was exported to Europe as early as the 16th century, and until the 20th century Ecuador was the world's leading producer. By the second decade of the 20th century, however, it had been exceeded by Brazil and subsequently by the Gold Coast of Africa as well. This relative decline was due not only to increased production elsewhere, but to local difficulties as well, especially the ravages of the famous witchbroom disease and of the monilia disease. By 1916 production had fallen from a former high of 26% of world output to 27%. Nevertheless, in 1950 cacao amounted to 20% of the country's exports, and the country's prosperity still depended primarily on this product.

Coffee ordinarily ranks close to first among exports of the country, accounting in 1950 for 20% of all exports. Bananas were first ex-

ported in 1931, and comprised 15% of the total exports in 1950. A government decree of July 8, 1938, restricted the holdings of a single foreign company to 50,000 bbl. and required the sale of any excess to Ecuadorian citizens within five years.

Another industry of Ecuador is the production of tagua, or vegetable ivory, a palm fern whose fruit is used as a substitute for elephant tusk product. The tagua, or Panama hat, so called because exports enter world trade through Panama, is made from the straw of a native plant (*Carludovica palmata*).

Mineral Production—Gold production was stimulated by the decline of the sucre, but remained small. In 1949 it aggregated 99,741 troy ounces.

Development of petroleum resources began in 1925. In that year 144,000 bbl. of crude petroleum were produced, and the output steadily increased until it was between 2,000,000 bbl. and 3,000,000 bbl. annually (2,617,000 bbl. in 1949). Around 95% of the production is in the hands of one British company.

Foreign Commerce—Quoted in either Ecuadorian sucres or United States dollars, Ecuador's foreign commerce increased rapidly after World War II, but in part this reflected both the fall of the sucre and inflation in the United States.

Ecuadorian export and import figures for 1936, 1939 and 1951 were as follows:

| | 1936 (U.S. \$) | 1939 (U.S. \$) | 1951 (U.S. \$) |
|---------|-------------------|-------------------|-------------------|
| Exports | 13,493,000 | 11,347,000 | 63,000,000 |
| Imports | 10,857,000 | 10,173,000 | 47,000,000 |

The United States has long been both the largest buyer of Ecuador's exports and the principal supplier of her imports. U.S. Ecuadorian commerce, expressed in terms of the major commodities traded, was as follows at mid century:

| Chief exports to U.S. | First 9 months of 1951 (U.S. \$) | Per cent increase over same period 1950 | Chief imports from U.S. | First 9 months of 1951 (U.S. \$) | Per cent increase over same period 1950 |
|-----------------------|-------------------------------------|---|-------------------------|-------------------------------------|---|
| Cacao | 9,500,000 | 12 | Autom. and parts | 2,800,000 | 60 |
| Bananas | 6,200,000 | 31 | Grains and preparations | 2,000,000 | 44 |
| Coffee | 5,600,000 | 33 | Textile materials | 1,800,000 | 35 |
| Panama hats | 2,700,000 | 4 | Drugs | 1,800,000 | 35 |
| | | | Industrial machinery | 1,200,000 | 20 |

(G. I. B. '51)

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ECZEMA, a common and important inflammation of the skin originating without visible external irritation, and characterized in some stage of its evolution by a serous exudation. For an attack of eczema two conditions are necessary, a predisposition or special irritability of the skin, and a directly exciting cause. The first condition is usually inherited or depends on some underlying constitutional state. The number of such states incalculable and their diversity are expressions of our ignorance of the real causation, but there is an undoubted relationship between eczema and certain forms of functional neurosis, particularly asthma. Sufferers from rheumatism and gout are also prone to eczema, though the exact relationship is much disputed. Eczema is not contagious, though when complicated by pyogenic micro organisms (impetigo), it is both auto-inoculable and contagious. Females (except when menstruation is becoming established, and at the menopause) are less liable to be attacked than males. In old age the sex influence is lost.

An attack of eczema is usually described as acute or chronic, but the only distinction lies in its greater or less intensity at the time of description, it has nothing to do with the length of time that the disease has lasted. It usually begins with local itching and burning and an erythematous blush, on which numerous tiny vesicles form. The vesicles grow larger, run together, and either burst or are broken by the patient's scratching, a clear fluid exuding which stiffens linen. The discharge does not dry up at once, but continues to exude—hence the name of "weeping eczema" when this is a prominent symptom. In some cases papules predominate, in others, especially when the face is attacked, erythema is more marked. The general health seldom suffers appreciably, unless the itching is so bad as to make sleep impossible. The irritation and local heat may be out of all proportion to visible changes in the skin, and in neurotic patients the nervous excitement may be extreme. The attack may affect any part of the body, but it usually begins at one of the following sites: the bends of the elbows or knees, the groins, between the buttocks, the groove behind the ears, the scalp, the palms or the soles, and the breasts of women. According to its position the form of the eczema is somewhat modified. On the front of the legs and arms, there is uniform redness. On the scalp it is generally seborrhoeic, and in children, especially when pediculi are present, it will become pustular. On the palms and soles it brings about thickening of the epidermis and the formation of cracks.

Treatment is unsatisfactory. Some cases are benefited by X-rays, others by alkaline bicarbonates or calomel, but the condition seems to wax and wane, or even disappear in an arbitrary way and the last treatment employed is given the credit. The only safe statements are (a) that the inflamed area should be protected from air and irritation and (b) that highly seasoned foods should be avoided.

EDAM, a town in the province of North Holland, close to the Zunder Zee, about 13 mi NNE of Amsterdam. It is connected with the Zunder Zee by a fine canal protected by a large sea-lock (1828). Pop. (1940) 8,947. Germany occupied Edam in 1940.

Edam took its name and origin from the dam built on the Ye, which joined the Purmer lake close by. Free access to the Zunder Zee was obtained by the construction of a new dock in 1357, when the town also received civic rights from William V of Bavaria, count of Holland. Owing to the danger of the extension of the Purmer and Beemster lakes, Philip II of Spain caused a sluice

to be built into the dock in 1567. In the next century Edam was a great shipbuilding centre, and nearly the whole of de Ruyter's fleet was built here, then the harbour began to get silted up, and commercial and industrial activity slowly waned. The Great Church (St Nicholas) probably 14th century, was largely rebuilt after a fire in 1602, which destroyed nearly the whole town. It contains some fine stained glass and carved woodwork of this period. The Little Church (15th century) was demolished in 1883, except for a portion of the nave and the old tower and steeple. The town hall dates from 1737, and there is a museum founded in 1895. Cheese making is important and Edam gives its name to the "sweet milk cheese" (*soetemelks kaas*) made throughout North Holland.

EDDA, the title given to two very remarkable collections of old Icelandic literature. Of these one bears that title from the middle ages, the other is called *Edda* by a comparatively modern misnomer. The word is first met with in *Rígsþula*, a fragmentary poem dating from the first half of the 10th century, where it is introduced as the name or title of a great-grandmother. From the 14th to the 17th century, this word—but no one has formed a reasonable conjecture why—was used as a synonym for the technical laws of the Norwegian Court-metre, *Eddu regla*, and "never to have heard or seen Edda" signified "never to have learned the art of poetry." The only known work by the name in the middle ages was the miscellaneous group of writings composed by Snorri Sturluson (qv, 1179-1241), the greatest name in old Scandinavian literature. It is believed that the *Edda*, as he left it, was completed about 1222. Whether he gave this name to the work is doubtful, the title first occurs in the *Uppsala Codex*, transcribed about 50 years after his death. The collection of Snorri is now known as the *Prose* or *Younger Edda*, the title of *Elder Edda* being given to a collection of mythological and heroic poems, discovered by the Icelandic bishop of Skálholt, Brynjólfur Sveinsson, in 1643 and erroneously named by him the *Edda* of Saemundr.

The *Prose Edda*—Properly known as *Edda Snorra Sturlusonar*, this was undoubtedly written by Snorri Sturluson. It is divided into five parts, the Preface or *Formátt*, *Gylfaginning*, *Brágarœður*, *Skáldskaparmál* and *Háttatal*. The Preface bears a very modern character and simply gives a résumé of the biblical story of the creation and the flood, with a brief account of the rise and spread of paganism. *Gylfaginning*, or the Delusion of Gylfi, on the other hand, is the most precious compendium which we possess of the mythological system of the ancient inhabitants of Scandinavia. The *Brágarœður*, or sayings of Bragi, are further legends of the deities, attributed to Bragi, the god of poetry. The *Skáldskaparmál*, or Art of Poetry, commonly called *Skálda*, contains the instructions given by Bragi to Aegir, and consists of the rules and theories of ancient verse, exemplified in copious extracts from Eyvindr Skáldaspillir and other eminent Icelandic poets. The fifth section of the *Edda*, the *Háttatal*, or Number of Metres, is a running technical commentary on the text of Snorri's three poems written in honour of Hákon, king of Norway. Affixed to some mss of the *Younger Edda* are a list of poets and a number of philological treatises and grammatical studies. These belong, however, to a later period than the life of Snorri Sturluson.

The three oldest mss of the *Prose Edda* all belong to the beginning of the 14th century. The Wurm ms was sent to Ole Wurm in 1628, the *Codex Regius* was discovered by the indefatigable bishop Brynjólfur Sveinsson in 1643. The most important, however, of these mss is the *Uppsala Codex*, an octavo volume written probably about the year 1300. There have been several good editions of the *Edda Snorra Sturlusonar*, of which, perhaps, the best is the edit. n published by the Arnamagnæan Society in Copenhagen in 1848-52, edited by a group of scholars under the direction of Jón Sigurðsson, and the more recent Danish (1900) and Icelandic (1907) editions of Finnur Jónsson. There are English translations by T. Percy, *Northern Antiquities*, from the French of P. H. Mallet (1770), by G. Webbe Dasent (Stockholm, 1842), by R. B. Anderson (Chicago, 1900), by A. G. Brodeur (1916). The last-named version contains the whole of the *Prose Edda*, with the exception of the very technical and

practically untranslatable *Hattatal*

The Elder Edda, *Poetic Edda* or *Saemund's Edda* *hins fróða* was entirely unknown until about 1643, when it came into the hands of Brynjólfir Sveinsson, who, puzzled to classify it, gave it the title of *Edda Saemundis multiscus* Stremund Sigfusson, who was thus credited with the collection of these poems, came of an old and distinguished Icelandic family, and lived from about 1056 to 1133. The poems themselves are many of them only fragments of longer heroic chants now otherwise entirely lost. They treat of mythical and heroic legends of an early Scandinavian civilization, and are composed of the simplest and most archaic forms of Norse verse. They present many difficult problems upon which scholars have expended an inexhaustible but not always conclusive erudition.

It may be said with some confidence, however, that the 34 poems usually included in the *Edda* were composed between the 9th and 12th centuries, and that they were the composition of poets, whose very names are unknown, but who were certainly Norwegian by birth or descent and shared the same religious and poetic convention. These poets were not uncultured, they were affected by the beliefs of the Christianized peoples of western Europe, they used as material for their art Danish and German legends, they were influenced by the Anglo-Saxon and Irish literatures. Irish influence is marked in *Kræfilla*, to what extent it affected the *Edda* as a whole is debatable. The honour of having been the home land of the *Edda* has been claimed in turn for Norway, Iceland, the British Isles and Denmark. The two *Athi* poems can be assigned with certainty to Greenland, *Grimmsund* appears from internal evidence to have been composed in Norway, and *Grípisská* in Iceland. *Risepula* may have been composed in Ireland or in northern England. The meaning of the title 'Edda' is still in doubt, it has been variously explained by scholars as "Tales of a Grandmother," "Poetics," "The Book of Oddi"—Saemundur resided at Oddi—"Poems of Death and Destruction," from the Irish word *athle*, signifying "deaths." The poems appear to have been collected from oral tradition and committed to writing in the 12th century, probably in Iceland and possibly by Saemundur.

The most remarkable of the poems in this priceless collection is the *Völuspá*, or prophecy of the *Völva* or *Sibyl*. In this chant we listen to an inspired prophetess, "seated on her high seat, and addressing Odin, while the gods listen to her words." She sings of the world before the gods were made, of the coming and the meeting of the Aesir, of the origin of the giants, dwarfs and men, of the happy beginning of all things, and the sad ending that shall be in the chaos of Ragnarok. The melodies of the verse, exquisite in their extreme and severe simplicity, are wholly rhythmical and alliterative, and return upon themselves like a solemn incantation.

Hávamál, the Lesson of the High One, or Odin, follows, this contains proverbs and wise saws, and a series of stories, some of them comical, told by Odin against himself.

In *Hyndludýdd*, the Lay of Hyndla, the goddess Freyja rides to question the *völva* Hyndla with regard to the ancestry of her young paramour, Ottar. With this poem, the first or wholly mythological portion of the collection closes. What follows is heroic and pseudo-historic. *The Volundarkvæði*, or Song of Volund, is engaged with the adventures of Volund, the smith Lung, during his stay with Nidud, king of Sweden. Volund, identical with the Anglo-Saxon Wieland and the German Wieland (O.H.G. *Wilelmus*), is sometimes confused with Odin, the master smith. This poem contains the beautiful figure of Svanhvit, the swan-maiden, who stays seven winters with Volund, and then yearning for her fatherland, flies away home through the dark forest. *Helgakvæði Hjörvarðssonar*, the Song of Helgi, the Son of Hjörvarð, celebrates the wooing of Helgi of Svava, who like Atalanta, ends by loving the man with whom she has fought in battle. The two Songs of Helgi the Hunting's Bane, *Helgakvæði Hundingsbana*, open the long and very important series of lays relating to the heroic families of the Volsungs and the Nibelungs. A very curious poem is the Song of the Sun, *Sólarijóð*, which forms a kind of appendix to the *Poetic Edda*. In this the

spirit of a dead father addresses his living son, and exhorts him, with maxims that resemble those of *Hávamál*, to righteousness of life. Though found only in the 17th century copies of the *Edda*, *Sólarijóð* appears from internal evidence to have been written in the 11th century, and to have been the composition of a Christian mystic who had not completely shed heathen modes of thought and expression.

The principal ms of this *Edda* is the Codex Regius in the royal library of Copenhagen, written continuously, without regard to prose or verse, on 45 vellum leaves. This is that found by Bishop Brynjólfir. Another valuable fragment exists in the Árnamagnæus collection in the University of Copenhagen, consisting of four sheets, 22 leaves in all. These are the only mss older than the 17th century which contain a collection of the ancient mytho-heroic lays, but fragments occur in various other works, and especially in the *Edda* of Snorri. The text of the *Poetic Edda* has been edited by Möbius, Sophus Bugge, Hildebrand, Symons and Gerner, Finnur Jónsson, Neckel, Dittus and Heinezel (1903), and Severs (1923). Twelve poems from the *Poetic Edda* were translated into English verse by Amos Cottle in 1797, the poet Gray produced a version of the *Völuspá* in 1797, but the first translation of the whole was that published by Benjamin Thorpe in 1866. The most recent English versions are those of Olive Bray (1906) and H. A. Bullows (1923).

The Ldric poems were rearranged, on a system of their own which differs entirely from that of the early mss by Gudbrand Vigfusson and E. V. York Powell, in their *Corpus poetarum boreale* (1885). This is a collection not of *Edda* only, but of all existing fragments of the vast literary literature of ancient Iceland.

(X, R P Co)

EDDINGTON, SIR ARTHUR STANLEY (1882-1944)

British astronomer. He was born at Kendal, England, Dec. 28, 1882. He was educated at Owen's college, Manchester and Trinity college, Cambridge, where he was Senior Wrangler in 1904 and Smith's Prize in 1907. In the latter year he was elected fellow of his college. From 1906 to 1913 he held the post of chief assistant at the Royal observatory at Greenwich, and in 1913 he became Plumian professor of astronomy at Cambridge. In 1914 he was made director of the observatory at Cambridge, and in the same year was elected fellow of the Royal Society.

He was a member of many British and foreign scientific societies and was awarded the Hopkins prize of the Cambridge Philosophical society (1918-21), the Pontecoulte prize of the French academy (1919), the gold medal of the Royal Astronomical society (1924), the Bruce medal of the Astronomical Society of the Pacific (1924), and others. He was knighted in 1930 and was awarded the Order of Merit in 1938.

Eddington's principal researches were on the motions of stars, stellar evolution and relativity. His first published paper in 1906 was on the systematic motion of stars, this was followed during the next nine years by a series of papers on the structure of the heavens. "The Systematic Motions of the Stars of Professor Boss's Preliminary General Catalogue" appeared in 1910, in this paper Eddington analyzed this catalogue of 6,188 stars and some of his later researches were based on this analysis. In 1916-17 he published papers on "the radiative equilibrium of the stars," dealing with the interior of a star. Eddington grasped the significance of the theory of relativity at an early stage of its development, and, by means of articles, books and lectures, gave a clear exposition of the theory.

Eddington died Nov. 22, 1944.

His published works include *Stellar Movement and the Structure of the Universe* (1914), *Report on the Relativity Theory of Gravitation* (1918), *Space, Time and Gravitation* (1920), *The Mathematical Theory of Relativity* (1923), *Stars and Atoms* (1927), *The Expanding Universe* (1933), *New Pathways in Science* (1935), *Relativity Theory of Protons and Electrons* (1936) and *The Philosophy of Physical Science* (1940). (See RELATIVITY.)

EDDIUS or **ÆDDI**, a Kentish choirmaster, was employed by Wilfrid (c. 634-709), bishop of York, to organize services in Northumbria. His *Life of Wilfrid* is the earliest extant work of an Anglo-Saxon author. It is invaluable for its period, though strongly partisan in feeling, and was used by Bede for his *History*.

See Eddius, *Vita Wilfridi* (Räike, *Historians of Church of York*, London, 1879-84, 14), ed. with trans. and notes by B. Colgrave (Cambridge, 1917), Bede, *Hist. Eccl.* (ed. Plummer, Oxford, 1896), II, 2.

EDDY, MARY BAKER (1821-1910), the founder and leader of the Christian Science movement, was born on July 16, 1821, at Bow, near Concord, New Hampshire, USA. She was the youngest of the six children of Mark Baker and Abigail Ambrose Baker. Her father was a man of local prominence, first at Bow and later at Tilton, New Hampshire, a landowner, a justice of the peace, a member of the committee having charge of the public schools and a deacon of the Congregational Church. Her mother was the daughter of Deacon Nathaniel Ambrose, of Pembroke, New Hampshire, who also represented the same type of citizenship.

In 1843 Mary Baker married Major George W. Glover, a native of Concord, New Hampshire, but a resident of Charleston, S.C. By occupation a contractor and builder, he had an honorary title "by appointment to the staff of the governor of South Carolina." Major Glover died six months after their marriage while they were at Wilmington, N.C. Her only child (also named George W. Glover) was born three months later, after she had returned to New Hampshire. During the next nine years she lived at Tilton, New Hampshire, with her father, or with her sister Mrs. Abigail Tilton, and occupied herself to the extent allowed by delicate health in caring for her child and in teaching. For a time she conducted a private school for young children, at other times she was an extra teacher in a New Hampshire Conference Seminary.

In 1853 Mrs. Glover married Dr. Daniel Patterson, of Fanklin, N.H., a dentist. This marriage proved to be extremely unfortunate. After ten years of alternate care and neglect, he finally deserted her at Lynn, Mass., whither they had removed from New Hampshire. Ten years later (at Lynn, in 1873) she obtained a divorce from him for desertion following after adultery. In 1877 Mrs. Glover (Mrs. Patterson having resumed this name) married Asa Gilbert Eddy, of Lynn, an ardent Christian Scientist and the first of her followers to engage in the public practice of Christian Science. After his death (at Lynn, in 1882) Mrs. Eddy continued as a widow until she died at Chestnut Hill, Mass., near Boston, on Dec. 3, 1910.

Considering that educational facilities for women were limited when Mrs. Eddy was young and that her attendance at school was interrupted by delicate health, the education she obtained was exceptionally liberal. In addition to attending ordinary schools, she attended the Academy at Tilton and received instruction from tutors. An extensive reader of good literature, she also wrote acceptable poetry and prose which appeared frequently in New England publications long before her discovery of Christian Science. After her discovery of Christian Science, she contributed the principal literature of this subject, employing for this purpose a distinctive literary style, as well as a notable ability to elucidate metaphysical and religious topics.

As a child and as a young woman, Mrs. Eddy showed an exceptional interest in religious subjects. In the development of this interest she was aided by her devout and intelligent mother, as well as by the Congregational pastors at Bow and Tilton and by other ministers whom her parents frequently entertained. At the age of 12, she had the courage and independence to dispute a point in theology when she was examined for church membership. Between then and her first marriage, she often discussed religious topics with her parents and with ministers, exhibiting a comprehension which they regarded as remarkable. Shortly before her first marriage, one of her pastors who also tutored her for six or seven years (Rev. Enoch Corser) predicted for Mrs. Eddy a great future and spoke of her as "an intellectual and spiritual genius."

The beginning of Mrs. Eddy's interest in religious or spiritual healing can be traced to an incident which occurred when she was 12 years old, immediately before her examination for admission to the Congregational Church. During a fever her mother commended prayer to God. Then, as Mrs. Eddy has related, "I prayed, and a soft glow of ineffable joy came over me. The fever was gone, and I rose and dressed myself, in a normal condition of health" (*Retrospection and Introspection*, p. 13). This incident, together with others of an extraordinary nature, is believed to have contributed to the observation and study which resulted

ultimately in Mrs. Eddy's discovery of Christian Science.

Mrs. Eddy regarded her discovery of Christian Science as resulting directly and immediately from an incident which occurred at Lynn in 1836. While returning from an meeting of Good Templars, she fell on an icy street and was injured severely. Carried to a nearby residence, she was attended by a physician and cared for during the night. The next day she was removed to her home, as a local newspaper reported at the time, "in a very critical condition." On the third day after this injury, having obtained little or no relief, Mrs. Eddy asked for her Bible, opened it so that she read an account of Christian healing (Matt. 9:2) and again experienced an immediate recovery.

Concerning the study which then ensued, Mrs. Eddy has written "The Bible was my textbook. It answered my questions as to how I was healed, but the Scriptures had to me a new meaning, a new tongue. Their spiritual significance appeared, and I apprehended for the first time, in their spiritual meaning, Jesus' teaching and demonstration, and the Principle and rule of spiritual Science and metaphysical healing,—in a word, Christian Science."

Mrs. Eddy's published works on Christian Science began with a pamphlet copyrighted in 1870, entitled *The Science of Man*, of which only one small edition was printed. In this pamphlet she said, "In the nineteenth century I affix for all time the word Science to Christianity, and error to personal sense, and call the world to battle on this issue." Her principal work, the Christian Science textbook, first entitled *Science and Health* but after ward entitled *Science and Health with Keys to the Scriptures*, was issued in 1875. Occasionally revised by the author, "only to give a clever and fuller expression of its original meaning," and finally revised in 1907, this book continues to be the fundamental and standard statement of Christian Science. Other published works by Mrs. Eddy include *The People's Idea of God* (1886), *Christian Healing* (1886), *Unity of Good* (1891), *Rudimentary Divine Science* (1891), *Retrospection and Introspection* (1891), *No and Yes* (1891), *Church Manual* (1895-1910), *Miscellaneous Writings* (1896), *Christ and Christmas* (1897), *Christian Science versus Pantheism* (1898), *Pulpit and Press* (1898), *Messages to The Mother Church* (1900, 1901, 1902), *The First Church of Christ, Scientist, and Miscellany* (1913).

Naturally, Mrs. Eddy was the first practitioner and the first teacher of her religion. As a practitioner, she demonstrated her religion by healings in many cases, until duties which could not be left to others required all of her time. As a teacher, she taught students until she was obliged to leave class teaching to students whom she selected for this work. She began to organize the Christian Science movement in 1876 when she and a few of her students formed the Christian Science Association. After three years she and a selected number of her followers organized the Church of Christ, Scientist, into which the earlier Association was merged. In 1892, she and a selected number of her followers organized the Christian Science mother church, the First Church of Christ, Scientist, in Boston, which succeeded the earlier church The Mother Church, together with the branch churches or local congregations throughout the world, constitutes the present organization. In 1892 Mrs. Eddy also founded the Christian Science Publishing Society as an agency of her Church.

Next to what Mrs. Eddy did as the discoverer and founder of Christian Science, her greatest work was done as the leader of the Christian Science movement. Although living a rather secluded life (at Lynn until 1882, in Boston from then until 1889, at Pleasant View, near Concord, N.H., from then until 1903, and afterward at Chestnut Hill, near Boston), she initiated and either directed or supervised every important activity of her Church, and she formulated the plan, set forth in the *Church Manual*, by which its affairs are to be conducted permanently. From the general point of view, Mrs. Eddy was a remarkable woman, for it was no light task to propose a new system of religious philosophy which was at the time and is even now so radically at variance with much of prevailing orthodox beliefs. She was 57 when she founded the Church of Christ, Scientist, which in half a century extended its branches throughout the world totalling (1928) 2,370 churches and societies. She followed this with the founding of the *Chris-*

tion Science Journal, a monthly magazine which she edited for 11 yrs., and 15 yrs later she founded the *Christian Science Sentinel*, a weekly. In 1908, when Mrs Eddy was 87, she established the *Christian Science Monitor*, a successful daily news paper, giving news free from sensation and scandal. Nor did Mrs Eddy, at these times, relinquish her other activities. Her own life illustrated and demonstrated her proposition that "prayer, watching and working combined with self immolation, were God's gracious means for accomplishing whatever has been successfully done for the Christianization and health of mankind" (*Science and Health*, p. 1). See CHRISTIAN SCIENCE (C P S).

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EDE, a town in the province of Gelderland, the Netherlands, on the railway Utrecht-Arnhem. Pop. (1940) 34,567. Ede is the seat of the important Dutch Enka rayon silk industry. At 3 mi. distance is the castle of St Hubertus, containing the modern art collection of Krollier Muller, which gained special fame for its outstanding collection of paintings by Vincent Van Gogh.

EDELINCK, GERARD (1649-1707), Flemish copper plate engraver, was born in Antwerp on Oct. 20, 1649. He learned the rudiments of the art in his native town under Gaspard Huybrecht. He then went to Paris in 1665 and worked under de Poilly. On the recommendation of Le Brun, he was appointed teacher at the academy established at the Gobelins to train workers in tapestry.

Edelinck with Nanteuil and Masson formed the great triumvirate of the best period of French portrait engraving. He excelled in rendering light and shade, colour and the texture of surfaces. He was the first to execute prints in the lozenge shape. Among his works, which number 341, are a "Holy Family," after Raphael, a "Penitent Magdalen," after Charles Le Brun, "Alexander at the Tent of Darius," after Le Brun, a "Combat of Four Knights" after Leonardo da Vinci, "Christ Surrounded by Angels," "St. Louis Praying," and "St. Charles Borromeo before a Crucifix"—the last three after Le Brun. Edelinck engraved portraits of Louis XIV, Le Brun, Rigaud, Philippe de Champaigne (which the engraver thought his best), Santeuil, La Fontaine, Colbert, John Dryden, Descartes, etc. He died in Paris on April 2, 1707. His two brothers, Jean and Gaspard François, and his son Nicolas, were also engravers, but did not attain to his excellence.

See H. Delaborde, *Gérard Edelinck* (1886), Robert Duménil, *Le graveur français*, vol. vii (1835-71).

EDELWEISS (*Leontopodium alpinum*), a perennial plant of the composite family (*Compositae*), native of the Alps and

the Andes. It is a small herb reaching about 6 in. high, with narrow white woolly leaves and terminal flowerheads enveloped in woolly bracts. The woolly covering is assumed to protect the plant, in the exposed situations in which it is found, by preventing its drying up through excessive loss of moisture. It is much sought after by some visitors to the Alps but although rather sporadic in its distribution it is not rare and grows readily in gardens under lowland conditions.

EDEN, SIR ASHLEY

(1831-1894), Anglo-Indian official and diplomatist, third son of Robert John Eden, third Lord Auckland and bishop of Bath and Wells, was born on Nov. 13, 1831, and entered the Indian civil service in 1852. In 1855 he helped to suppress the "mutiny" and from 1860 to 1871 was secretary to the Bengal government with an office in the legislative council. Eden was (1871) the first civilian governor



EDELWEISS A HANDSOME WOOLLY PLANT FOUND IN THE ALPS OF CENTRAL EUROPE. OFTEN GROWN IN ROCK GARDENS.

of British Burma, in 1877 he became lieutenant-governor of Bengal. He returned to England on his appointment (1882) to the council of the secretary of state for India, of which he remained a member till his death on July 9, 1887.

EDEN, though often used as the name of the garden in which, according to Gen. 11 and 12, lived the first man created, is strictly the name of the region in which that garden was situated. The garden contained beautiful fruit trees providing food for the man whom God had appointed to till it. In it, too, were "the tree of the knowledge of good and evil" and "the tree of life," magical trees conferring upon those who ate of their fruit wisdom and immortality. The man and his wife were expelled from the garden because, having tasted, contrary to the divine command, of the fruit of the former, God feared that they might eat also of the other tree's fruit. The story blends many mythological conceptions which belong to the primitive age of Semitic religion. Close study of the story reveals that it is compounded of at least two traditions, one concerned with the tree of knowledge, the other with the tree of life. Prof. H. T. Obbink of Utrecht has suggested that the narrative has been generally misunderstood. His view is that the tree of life was really intended to furnish divine food by which the first man maintained his immortality, and that he was evicted from the garden to cut him off from this nourishment.

Many speculations have been made as to the site of the garden, which seems to be thought of as an oasis in a barren region. According to Gen. 11:8 it was "eastward" verses 10-14 describe a river as flowing forth from it, and dividing into four streams. One of these is the Euphrates, and another, "Hiddekel," almost certainly the Tigris. This would suggest a site north of Babylon. It is true that the Euphrates and the Tigris near Baghdad approach so closely together that the former discharges water through canals into the latter. But even if it be supposed that these two rivers might be regarded as coming from a common source no satisfactory explanation of the two remaining rivers is offered. To define the site from these details is impossible, it is obvious, moreover, that verses 10-14 are a learned note introduced into the simple story. The attempt to locate a mythological garden is bound to be attended by considerable difficulty, and all that can be safely said is that the story in its present form combines two traditions, one of which placed the garden in the far east, the other in the far north, where, according to Babylonian tradition, the garden of the gods was to be found. Yet another tradition as to the garden, which underlies Ezek. xxxiii 12-19, connects it with the mountain of God, placed by Isa. xiv 13 in the "sides of the north" (W. L. W.).

EDENBRIDGE, a market town in the Sevenoaks parliamentary division of Kent, England, 2½ mi. SSE of London on the Southern railway, and 10 mi. W of Tonbridge on the line to Redhill. Pop. of civil parish (1931) 3,254. It is pleasantly situated on the river Eden, an affluent of the Medway, in a valley between the Ragstone hills and the Forest ridges, on the Surrey border. The church of St. Peter and St. Paul is principally Perpendicular. The town has considerable agricultural trade and a chalybeate spring which is little used. Hever castle, 2 mi. SW, is a beautiful moated mansion of the 15th and 16th centuries, but occupying the site of an earlier structure. This was rebuilt by Sir Geoffrey Boleyn, whose grandson, Sir Thomas, was father of Anne, second wife of Henry VIII, who here spent much of her life before her marriage and was visited by the king. There is a chapel of her family in the fine parish church of Hever. Not far distant is the modern Chiddingfold castle, on an ancient site. A block of sandstone in the park is called the "chiding stone," tradition asserting it to be a prehistoric seat of judgment.

EDEN HALL, LUCK OF, an old painted or enamelled glass drinking goblet preserved at Eden Hall, Cumberland, the seat of the Musgrave family, perhaps of the 18th century. It has the letters LHS on the top. Round the vase is the verse given below. In the grounds of Eden Hall is a spring called St. Cuthbert's Well, and the story is that one of the early Musgraves survived the faeries making merry at the well, and seized the goblet from the fairy king, who eventually acknowledged his

defeat and gave him the cup, but warned him

When this cup shall break or fall,
Farewell the luck of Eden Hall

Possessed of the cup, the knight of Musgrave is said to have at once prospered in a love suit. There is a poem on the cup called 'The Drinking Match at Eden Hall,' by Philip, duke of Wharton, a parody on the ballad of Chevy Chase, reprinted in Edward Walford's *Tales of Great Families* (1877, vol. x), as "The witty Duke of Wharton."

EDENKOBEN, a town of Germany, in the Bavarian palatinate, 6 mi. N from Landau, on the railway to Wessensberg. Population 5,218. It has a sulphur spring. Its industries comprise ironworks, and the manufacture of machinery, furniture and cigars. It has also a large trade in wine and is frequented for the grape-cure.

EDENTATA, an order of Mammalia (*q.v.*) comprising the sloths, anteaters and armadillos restricted to the warmer parts of America. But this name, meaning toothless, applies only to the anteaters. The teeth of sloths and armadillos, however, are abnormal in being of persistent growth, seldom differentiated, without enamel and invariably absent in the front of both jaws. A character distinctive of the order is the presence of accessory articular processes on some of the vertebrae. From this the name *Xenarthra* has been given to these groups to distinguish them from the pangolins and aardvarks of the old world which were formerly associated with the American edentates as *Nomarthra* on account of the normal construction of the vertebrae. There is, however, no evidence of kinship between the anteaters of the old and new worlds, such resemblances as they exhibit being superficial adaptations to diet. The pangolins and aardvark are therefore dealt with separately in this article.

The existing edentates are divided into two suborders, the Pilosa or Acanodonta and the Loricata or Eicanodonta.

Pilosa—In the Pilosa the anus and external genitalia are close together on a common eminence or enclosed in a fold of skin, both the clitoris and penis being quite short, and there is no exoskeleton of dermal bones. There are two well defined groups, the Tardigrada or sloths and the Vermilingua or anteaters. In the Tardigrada the jaws are short, strong, and the wide mouth is provided with teeth and a short flat tongue, the tail is short or absent and the limbs are long and slender, the fore and hind feet are similar in being long and narrow and in having the two or three digits compactly united and furnished with long, curved, equal claws. In the skull the zygomatic arch is branched.

The existing sloths feed upon leaves and are entirely arboreal. Their limbs are especially modified to enable them to climb or hang back downwards on branches, and their long coarse hair harbours microscopic green algae which serve to conceal them in the trees.

The sloths are referred to two subfamilies, the Bradypodinae and Choloepinae. In the Bradypodinae, or three-toed sloths, all the feet are furnished with three digits, and the soles are almost entirely hairy, there is a distinct tail, the hair on the head grows forward, forming a fringe round the face, the nostrils are small and the ears very simple. Sometimes known as aye-ayes, they are found in the tropical forests of South and Central America. The few known species are referred to two genera, *Bradypus* and *Scaevops*.

The Choloepinae or two-toed sloths, also known as unau, have only two digits on the forefoot, the soles are quite naked, there is no external tail, the hair on the head grows backwards, the nostrils have a thickened margin and the ear is provided with a valvular flap. The single genus *Choloepus*, represented by a few species, ranges from Nicaragua to Brazil.

In the Myrmecophagidae or anteaters the snout is elongated and down curved, the mouth has a very short gape, a long worm-like tongue and no teeth, the fore and hind feet are dissimilar and the digits of the forefoot are unequal in size, the third being the largest and armed with a great falcate claw and the tail is very long. In the skull the jaws are weak and the zygomatic arch is slender and unbranched. The anteaters are assigned to two subfamilies, the Cyclopedinae and Myrmecophaginae.

In the Cyclopedinae, containing only *Cyclopes didactylus*, the silky or two-toed anteater, the limbs are adapted essentially for climbing. The forefoot has only two digits with strong claws which close upon a large cushion-like pad, the hind foot has four fused digits, each with a long claw, and capable of folding down on to the heel for grasping, the tail is prehensile and naked at the tip beneath but otherwise covered, like the head and body, with long silky hairs which on the head conceal the simple ears. The jaws and other parts of the skull are less specialized than in the next family. This little arboreal anteater, which is no bigger than a rat, is found in tropical South and Central America.

The Myrmecophaginae contain two very distinct forms, the great anteater (*Myrmecophaga jubata*) and lesser anteater or tamandua (*Tamandua tetradactyla*). The feet are adapted for progression on the ground although in the tamandua they also serve for climbing. The forefoot has four clawed toes, and on its outer side a large supporting pad, the hind foot has five toes with short claws, and is plantigrade, the hair is not silky and on the head is quite short so that the better developed ears are prominent. The skull differs from that of *Cyclopes* in having a weaker mandible and in the fusion of the pterygoids to prolong the nasal passages. In the tamandua the tail is prehensile and covered mostly with small scales and short hairs, the hair of the body is short and smooth and the forefoot has a large carpal pad confluent with the ambulatory pad. This anteater, which is about the size of a cat, lives in the forests of tropical America.

The great anteater (*Myrmecophaga jubata*), standing over two feet high, is purely terrestrial in habits. The hair on the body and tail is long, shaggy and coarse, the tail is rigid and non-prehensile, the forefoot has a very large ambulatory pad and a small isolated carpal pad and the snout is much longer than in the tamandua. It lives in the swampy savannahs and forests of tropical America, feeding, like the other anteaters, mainly on termites, the nests of which it rips open with the great falcate claws of the fore feet.

Loricata—In the Loricata the external genitalia are long and not associated with the anus, as in the Pilosa, there is a dermal bony exoskeleton and the hairy covering is usually scanty. The armadillos which constitute this suborder are divisible into several subfamilies.

In the Dasypodinae the bony exoskeleton consists of a head-shield, one or more free bands on the neck, a large compact scapular shield enclosing the fore quarters, followed by from 6 to 13 free dorsal bands and a large solid pelvic shield over the hind quarters, the scutes of these areas being tolerably alike in size and shape, the flexible tail tapers to a point and its bony rings never consist of more than two rows of scutes, the skin of the lower surface is scanty hairy and tubercular, the legs are scaly above and there are five toes on each foot, those of the fore foot being provided with fossorial claws, the fourth toe being the longest, while on the hind foot the third and fourth are subequal and all the claws are smaller, the ears are large, situated on the sides of the head some distance behind the eyes.

There are two tribes, the Dasypodini and the Cabassomini. The Dasypodini have from six to eight dorsal bands, one neck band, the scutes are coarsely sculptured, and the tail has jointed rings. To this subfamily belong the six-banded armadillo (*Dasypus sexcinctus*) of Paraguay and Brazil, and many related species. A remarkable Brazilian species (*Scalops brimleyi*) has the dermal scutes defective, especially on the back. These armadillos are active animals of small or medium size, ranging in length of head and body from about six inches in the pichi to a foot or rather more in the six-banded armadillo.

In the Cabassomini there are from 11 to 13 dorsal and from three to four neck bands, the scutes are often polished, the scutes of the tail are not arranged in distinct rings and may be defective, and the forefeet are more fossorial, the claws of the third or third and fourth being specially enlarged. To this group belong the tatouay (*Cabassous unicinctus*) of Brazil and Surinam, and the giant armadillo (*Protonotus gigas*) of Brazil, which may reach a length of three feet.

The subfamily Tatuninae contains the nine-banded arma-

dillo (*Tatu* or *Tatusia*) which differs from the Dasypodinae in having the ears set close together on the top of the head no bands on the neck, the scutes of the dorsal bands larger and differently shaped from the small scutes of the scapular and pelvic shields, the bands on the long tail are composed of three rows of scutes, in the fore foot the fifth toe is absent and the third is as large as or larger than the fourth, and the five toes of the hind foot are symmetrically arranged, the third being median. The genus ranges from Texas to the Argentine and is represented by a few species of which the best known is *Tatu novemcincta*. A rare species, the hairy peba (*T. pilosa*), is remarkable for having a coat of long hair concealing the scutes. It has been referred to a distinct genus *Cryptopractus*.

To the subfamily Tolypetinae belong the apais or bill armadillos, so called from their power to roll up into a compact sphere. In adaptation to this protective habit there is beneath the very large pelvic and scapular shields a deep recess into which the limbs can be withdrawn. The tail is very short and rigid. They also differ from the Dasypodinae in having from two to four dorsal bands and in being more digitigrade, the second, third and fourth toes of the hind foot which have broad hoof like claws, and the tips of the long claws of the third and fourth digits of the fore foot resting on the ground during progression. The toes vary from five to three. A few species of the genus *Tolypetes* are admitted. The best known is the common three-banded armadillo (*T. tricinctus*) from the Argentine.

The little silky armadillo or pichiciego (*Chlamyphorus truncatus*) the type of the subfamily Chlamyphorinae, differs from all existing armadillos in having a continuous series of scutes, forming transverse bands, extending from the head shield to the pelvic shield, the latter forming a vertical semicircular disc giving a truncated appearance to the hinder end of the body, in having the dorsal bands attached to the body along the middle of the back and overlapping its sides, which, like the ventral surface and legs, are clothed with silky hair, like a cloak, in the reduction of the ear to a tiny lobe close to the eye and in having the tail spatulate. The feet nearly resemble those of the Dasypodinae but have larger falcate claws. This armadillo, which is found in the sandy deserts of the Argentine, is an expert digger and largely subterranean in habits. A related genus, *Burmeisteria*, found in Bolivia, differs in having the shell adherent to the sides of the body and the bony scutes of the pelvic shield defective.

Extinct Edentates.—The fossil remains of edentates, found in abundance in Tertiary deposits of North and South America, show that the existing sloths, anteaters and armadillos are the widely divergent survivors of a great, and now vanishing group represented in the past by large numbers of highly diversified genera, some of the species of which were colossal in bulk. Some of these fossils serve to link in a measure, not only the sloths with the anteaters, but the armadillos with both these groups.

Taking first the Pilosa the discovery of sloths and anteaters differs, but little from existing ones in Pleistocene deposits of South America needs only passing reference. Of former interest is the ground sloth, the *Gravigradus* standing between the *Trigigrada* and the *Vermivora* with skull and teeth as in the former and the rest of the skeleton more as in the latter. The two genera are grouped round three main types, *Megatherium*, *Myodon* and *Megalonyx*.

Megatherium had a longish, very strong tail, broad hips and very stout hind limbs with a huge heel and only three toes the third alone being armed with a large claw, the fore limbs were long and strong and four toed the second third and fourth toes being armed with claws, that of the third being exceptionally large, there were well developed collar bones the skull had anteriorly protruding massive jaws, with a thick brain case, agonistic arch. There is no doubt that this great bear, measuring 18 ft long, the skull being about two feet long upon outline and wings which he reached by rearing up against a tree trunk supported on his hind legs and tail, and using his fore legs to pull down the branches, and a long flexible tongue to gather the leaves into his mouth. It also seems clear that in standing and walking on the ground he rested on the outer side of both fore and hind feet. The remains

of *Megatherium* itself are found in Pleistocene deposits of the southern United States and South America. Related forms occur in the Pliocene of Argentina, and considerably smaller forms, regarded as ancestral, occur in Miocene beds of Patagonia.

Myodon, although smaller, with the skull about a foot and a half long, closely resembled *Megatherium* in general form, but had weaker, short jaws, differently shaped, smaller teeth, and five toes on the fore foot and four on the hind, but evidently walked on the outer side of both feet, like *Megatherium*. Its remains are found in Pleistocene beds of North and South America. There are many related genera, also Pleistocene. Of particular interest was *Glossotherium* on account of the presence of bones in the skin beneath the hair, recalling the exoskeleton of the armadillos. Supposedly ancestral forms of *Myodon* and its allies are found in Miocene deposits of Patagonia.

Megalonyx, with the skull a foot or more in length, found in Pleistocene and Pliocene deposits of North America, is distinguished from the preceding genera by having the first of the five upper teeth large, tusk like and isolated. A large number of related genera from Miocene deposits in Patagonia are smaller and less specialized.

It is amongst the earlier Miocene forms of Gravigrada that we find evidence of convergence between the sloths and anteaters. Not only are they smaller than the later evolved forms but also their limbs are more slender and their feet more normal, in the number and size of the digits, and in the hind feet being plantigrade, as in the great anteater.

With regard to the Loricae, many existing genera occur in the Pleistocene of Argentina and Brazil, and Pleistocene and Pliocene beds have yielded remains of a huge armadillo (*Chlamydotherrium*), comparable to a rhinoceros in size and with teeth less simplified than in surviving species. A large number of genera approximating to existing forms have also been found in Miocene and earlier deposits in Patagonia. One of these, *Stegotherium*, is of particular moment from possessing long, narrow jaws with a few minute, simple teeth at the back of the mouth, thus approaching the long jawed toothless anteaters. But excelling all in interest are the Glyptodonts, a group of extinct, highly specialized armadillos distinguished by having the entire body encased in an unjointed bony carapace, in the fusion of the vertebrae of the back, the peculiar jointing of the neck so that the head could be withdrawn into the shell, and in the structure of the skull which was remarkably like that of *Megatherium*, in general appearance. To support the great weight of the carapace the feet were short and broad with hoof like nails especially on the hind feet, and the long tapering tail was jointed, with bony rings in its basal portion and encased in an unjointed sheath at the end. Some of these armadillos, like *Glyptodon* and *Panochthus*, from the Pleistocene of South America, were eight or nine feet long and about four feet high and they moved about slowly, grazing on herbage like huge tortoises. They died out in the Pleistocene, but the group is traceable through the Pliocene back to Miocene deposits of Patagonia.

Another group of extinct mammals, shown by the structure of the vertebral column to belong to the edentate stock, is the Taeniodonta or Gnomodonts whose remains occur in Lower and Middle Eocene deposits in North America. In the structure of the skull and of the maxillary limbs this order shows considerable resemblance to the *Gravigrads*, but although the median incisor teeth, both above and below, seem to be missing, the rest of the dentition is quite unlike that of typical eomastates in being heterodont, with large canines and cusped, usually rooted cheek teeth, all more or less covered with enamel. The best known forms are *Conoryctes*, *Pastacetrurus* and *Hem gnus*.

The Lower Eocene of North America has yielded yet another group, the Palaeodontata (*Palaeomodon*, *Metachromys*), which has been claimed to be ancestral to the edentates. It is said to resemble the Loricae in the structure of the feet and other respects, such as the absence of incisor teeth, but differed in the absence of dermal bones and of cheek-teeth and the presence of large cutting canines. Since, moreover, the vertebrae were normally constructed and there was no union between the poste-

rior part of the pelvis and the anterior vertebrae of the tail such as is found in all typical Edentata, it is difficult to justify this classification.

PHOLIDOTA

The pangolins (*q v*) or scaly anteaters of Africa and tropical Asia were at one time associated with the Edentata mainly on account of their likeness to the South American anteaters in the absence of teeth, the weakness of the jaws, the enlargement of the salivary glands, and the length of the vermiform, extensible tongue, and to the armadillos in the possession of a hard dermal exoskeleton. But the resemblances to the former group are adaptive and due to similarity of diet and the exoskeleton is of a totally different type from that of the armadillos, since it consists of large, erectile, overlapping horny scales, composed of cemented hairs, there being no trace of bony matter in the skin. They show, indeed, no resemblances to the edentates of any systematic importance and differ from them fundamentally in many characters, such as the absence of extra articular processes in the spinal column, the presence of a bicornuate, instead of a globular, uterus, of a diffused, non deciduate, instead of a dome-shaped deciduate, placenta, etc.

The head is short and conical, with functionless facial vibrissae and a moist normal rhinarium as in *Myrmecophaga*, the ear sometimes has a distinct pinna but may be represented by a vertical slit only. The legs are short but the feet vary in structure according to habit. The fore foot has five toes of which the second, third and fourth are always armed with large claws, the largest being on the third, the first and fifth digits are very variable in size and are usually small clawed. The hind foot also has five toes which vary in size and in the size of the claws. The tail is also variable, sometimes being excessively long and prehensile, sometimes comparatively short and forming, with the hind legs, a kind of tripod support, at other times it is intermediate in structure. The anus and external genitalia are situated close together on an eminence formed mainly by the enlarged anal glands, and the anus is sunk in a depression into which the ducts of the glands open, both the penis and clitoris are quite small.

Pangolins range in Asia from north India and south China to Ceylon and Borneo and in Africa from Sierra Leone and Uganda to the Cape. There are several different kinds. Some are almost entirely arboreal, some purely terrestrial, while others which live in the main on the ground also climb trees as well. Otherwise their habits are very similar. They feed mostly on termites, ripping open the nests of these insects with the strong claws of the fore feet. Their means of defence are the emission of a repulsive odour from the large anal glands and rolling into a compact ball with the hard, often sharp, erected scales presented to the enemy and protecting the soft skinned hairy underside of the body from injury.

There are several species and genera, all referred to the family Manidae. But this is divisible into three sub-families. In the Asiatic species, the Maninae, the hinder end of the sternum or breast-bone is shaped like the blade of a spade, having a convex posterior edge and two forwardly directed spiniform angles. To this group belong the north Indian and Chinese eared pangolin (*Mans pentadactyla*), the Indian and Ceylonese thick tailed pangolin (*Phatagius crassicaudata*) and the Javanese and Bornean pangolin (*Paramanus javanica*), which differ in many external characters.

In the African pangolins the end of the breast-bone is prolonged into two long rods running back to the posterior ribs. There are two well defined sub-families differing in habitat and correlated structural characters. The Smutsinae, containing the genus *Smutsia* with the two species *temminckii* and *gigantea*, are terrestrial with the feet and tail adapted for ground life, and the Phataginae, containing the two small west African pangolins, *Phatagius tricuspis* and *Uromastix longicaudata*, which differ from all other pangolins in being adapted to arboreal life, their tails being exceedingly long and prehensile, and the feet with only four functional toes, the upper side of the fore foot being without scales.

Extinct Pangolins.—Bones of a large pangolin, indistinguishable from the African giant pangolin, have been found in a cave in Madras, in Lower Pliocene deposits of Samos occur *Palaeomastomys* and earlier still are *Leptomastomys* and *Necromastomys* from the Upper Eocene phosphorites of Quercy.

TUBULIDENTATA

To the order Tubulidentata belongs the aardvark (*q v*) or African antbear, *Orycteropus*, representing the family Orycteropodidae, which was formerly associated with the American edentates and the scaly anteaters because, feeding on termites, it has a longish snout, a long, extensible tongue, a small gape, no teeth in the fore part of the jaws and cheek teeth defective in enamel and of persistent growth. In no other respects does it resemble the edentates, and although it is like the scaly anteaters (Pholidota) in having normally articulated vertebrae and a bicornuate uterus, these are characters common to many orders of mammals. The aardvark is a burrowing, heavily built animal, about six feet long, scantily covered with hair, with a long narrow head carrying huge rabbit like ears and ending in a swollen mobile snout with terminal valvular nostrils closed with long hair. The tongue, although long, is not vermiform. The feet are powerful and very much alike except that the fore foot has no first toe, the toes are long, armed with huge flattened claws, and the second and third, which are the longest, are united by a deep and wide web, the fore foot is plantigrade, the hind digitigrade. The tail is long, stout and tapering, and the external genital organs are situated on a pleural eminence containing a pair of scent glands opening at the sides of the short penis and of the vulva, which is provided with a cordate flap-like clitoris. The teeth of the permanent set are unlike those of other mammals in being traversed by many tubules radiating from a central pulp cavity. They represent molars and premolars, the latter having milk predecessors, but in the newly born young traces of incisors and canines which never cut the gum have been discovered. There is evidence indeed that the ancestor of *Orycteropus*, before degeneration of the teeth set in, had no fewer than three incisors, one canine, five premolars and five or six molars on each side above and below, a larger number than is found in any order of mammals with typical heterodont dentition.

Aardvarks are found in Africa south of the Sahara both in deep forest and in the open. It is doubtful if more than one species is still in existence.

Extinct Aardvarks.—A species, *O. gaudryi*, nearly allied to the living forms, occurs in Lower Pliocene deposits of Bessarabia and Samos, and a distinct genus, *Palaeorycteropus*, has been recorded from the Upper Eocene phosphorites of Quercy. Finally, it may be added, certain bones from the Miocene of Europe have been claimed to indicate a common ancestry for the armadillos, scaly anteaters and aardvarks, but the indications are too doubtful to be trusted. (R. I. P., X.)

EDENTON, a city of northeastern North Carolina, U. S., on an inlet of Albemarle sound, near the mouth of the Chowan river, the county seat of Chowan county. It is served by the Norfolk Southern railroad and by bus and river transportation. The railroad bridge across Albemarle sound is 4.8 mi long. Pop. (1950) 4,454, (1940) 3,835. Shad and herring fisheries are an important industry, and there is a U. S. fish hatchery near by. The city is a large peanut and watermelon market. Edenton has some fine old homesteads and many historical associations. It was settled about 1658, and through the 18th century was a place of considerable social and political importance. The legislative assembly met here occasionally, and here lived the royal governors and various prominent citizens of the province, including Joseph Hewes, James Iredell, father and son, and Samuel Johnston. St. Paul's church was built in 1736, the court-house in 1867. In a house facing the court house the "Edenton Tea Party" was held on Oct. 24, 1774, by 51 ladies, who signed resolutions that they would refrain from using tea or anything manufactured in England until the tax on tea should be repealed. On May 5, 1864, a naval engagement was fought near Edenton between the Confederate ram "Albemarle" and the Union "Sassacus," a wooden side wheeler, resulting in favour of the Confederate ironclad.

EDESSA, the ancient capital of Macedonia (an older name is *Aegae*), situated 46 m W of Thessalonica on a beautiful stream in the centre of the kingdom, commanding the approaches from the coast to the interior. It was the original residence of the Macedonian kings, and after the seat of government was removed by Philip II to the more accessible Pella, it continued to be the royal burial place. At the celebration of his daughter's marriage here, Philip II was murdered by Pausanias in 336 B.C. Though Alexander was buried at Alexandria the bodies of Eurydice and her husband Arrhidæus were removed by Cassander to the ancestral sepulchre. On the occupation of the town by Pyrrhus the royal tombs were plundered by Gallic mercenaries. Owing to its position commanding the Via Egnatia the town retained its importance during the Roman and Byzantine periods. For its present condition, see *VOYAGE*.

EDESSA, the Greek name of an ancient city of N.W. Mesopotamia (in 37° 21' N lat. and 39° 6' E. long.), suggested perhaps by a comparison of its site, or its water supply, with that of its Macedonian namesake. It still bears its earlier name, *Urbai*, modified since the 15th century (by the Turks?) to *Urfa*.

The oldest certain form is the Aramaic *Urhāi* ("Western" pronunciation *Urhāi*), which appears in Greek as an adjective as *Opponeus*, -ου (perhaps also as a fortress with spring, as *Oppā*), and in Latin as *Opphā*, and (in the inscription on Abgar's grave) *Opphānour* (n). The Syriac Chronicle ascribed to Dionysius of Tell-mahrē derives the name from a first king *Urhāi*, son of *Hewyā* (i.e. "Snake"), but neither this nor any other derivation hitherto suggested is satisfactory. The distinct name *Osroēnē* (for *Opponeus*) is in Syriac Bēth *Urhāyē*. The Arabs pronounced the name *er-Ruhā*, and that form prevailed till it gave place to *Urfa* in the 15th century.

According to Pliny, v. 86, Edessa was also called Antioch, and coins of Antiochus IV. Epiphanes with the legend "Antioch on the Callirhoe" may imply that he rebuilt and renamed the place. (so Ed Meyer in Pauly-Wissowa, *Realencyclopädie*, col. 1933, 66). Pliny indeed seems to call the city itself Callirhoe, but K. Regling (*Klio*, i. 459, n. 1) may be right in his emendation which applies the title in Pliny to the sacred spring.

History—Edessa *Urhāi* is important mainly as the earliest seat of Syriac-speaking Christianity. About 132 B.C., when the Hellenistic empire of the Seleucids was breaking up, a native non-Greek dynasty succeeded in establishing a more or less independent State with Edessa as its capital on what came to be the frontier between the Roman and the Parthian dominions. The names of some 30 local kings survive, but little is known of its history, and the true tale of the planting of Christianity in this region is lost in the mists of legend. In A.D. 114 king Abgar VII. entertained Trajan on his way back to Syria (Dio Cass. xviii. 21), but in 116 after a general rising the Consul L. Quietus sacked the city and made the State tributary. Hadrian, however, restored the dynasty of Edessa, but made it a dependency of Rome. When L. Verus (163-165) recovered Mesopotamia from Parthia, it was not Edessa but Harrān that was chosen as the site of a Roman colony and made the metropolis by Marcus Aurelius (172). The fact that these decisive events have left no trace in the Christian traditions suggests that Christianity had not yet arrived at Edessa. The native religion of Edessa, according to Christian tradition, was connected with the Planets. In the *Doctrine of Addai* 24 Venus appears to be called Bath Nīkal, a name for Ishtar of Babylonian derivation ("daughter of Nin Gal" see C. Winckworth in *J. Th. St.* xxv. 402). One or both of the pools below the citadel containing sacred fish may have been sacred to Atargatis (q.v.), an Ishtar-Venus deity. In the citadel itself are still standing two pillars—there may once have been more—both 50 ft high, on one of them is a pre-Christian Syriac inscription, which states that it was set up for Shalmat the queen, daughter of Ma'nu.

—*See* Appian, *Syr.* 57; cf. Steph. Byz., s.v. *Ἐδεσσα*. *Did. rhp. rān* *ἰδὲ ἰδὲ ἰδὲ*

pliny Steph. Byz., s.v. *Ἐδεσσα*.

Dio. passim

Isidore Charac. i. (Müller, *Geog. Gr. Min.* i. 246)

Several times in Pliny, Nat. Hist.

Cic. vi. 1797

the viceroy (*pagraba*), together with a bas relief or statue, now effaced. The fact that this inscription is in Syriac is a testimony to the Semitic tone of the culture of the little state, "Syriac," in fact, is the dialect of Aramaic then spoken in Edessa and its neighbourhood.

Before Christianity arrived at Edessa the more important parts of the Old Testament had been translated into Syriac by Jews, either at Edessa itself or in Adiabene under the encouragement of the then reigning house (Josephus, *Bell. Jud.* ii. 19, 4). This translation, slightly revised and supplemented, is still used by the Syriac speaking churches and is known as the *Peshita* (i.e. the *Simple* version). Tradition connects the founding of Christianity in Edessa with Addai, a missionary sent by St. Thomas himself, who converted Abgar the king and many of the inhabitants. As, however, he is also said to have brought the Gospel in the form of the Diatessaron, and we know from Epiphanius (*Haer.* 46) that Tatian, the author of the Gospel Harmony called *Diatessaron*, returned to his Mesopotamian fatherland about 170 as a missionary, it seems reasonable to identify "Addai" with Tatian himself (see *J. Th. St.* xv. 128-130). About the end of the 2nd century Edessene Christianity seems to have made a fresh beginning, the ordination of Palbot by Serapion of Antioch may mean that things ecclesiastical took a westward trend, and it is possible that a complete version of the Four Gospels (the "Old Syriac") was now introduced. Mention should here be made of Bardaisan (q.v., Bardesanes) known as the Aramaean philosopher. He became a Christian, and is famous for his cosmological speculations (see C. W. Mitchell, *Ephraim's Refutations*, p. cxxii ff.), but was reckoned heretical. He was a contemporary of Abgar IX., at whose court Iulius Africanus stayed for a while. A Syriac official record from this reign, preserved in the *Edessene Chronicle*, gives a somewhat detailed account of a violent flood (Nov. 201) of the Dāsān river which did much damage, destroying amongst other things "the palace of Abgar the Great," rebuilt as a summer palace by Abgar IX., and "the nave of the church of the Christians." The form of this last statement shows that at the time of writing (206) the rulers had not adopted Christianity themselves. Abgar IX. is now commonly supposed to be the ruler to whom the famous legend was first attached (see *ABGAR*), but though he visited Rome there is no proof that he ever became a Christian (Comper, in *Archäologisch-epigraphische Mittheilungen aus Österreich-Ungarn*, xiv. 154-157). It was at Edessa that Caracalla, who made it a military colony (Colonia Marcia Edesseonorum), spent the winter of 216-17, and near there that he was murdered. The religious philosophical treatise known as the *Book of the Laws of Countries* was produced at this time by a pupil of Bardesanes. The *Acts of Thomas* in its original form may have followed not long after: this work contains the finest Syriac poem extant, commonly called the "Hymn of the Soul." Bardesanes has been conjectured to have been its author on insufficient grounds (see Mitchell, *op. cit.*, p. cxxix).

Sassanian Period—In 226 the Parthian empire gave place to the new kingdom of the Sassanidae, whose claim to the ancient Achaemenian empire led to constant struggle with Rome in which Edessa naturally suffered. The native State was restored by Gordian in 242, but in 244 it became again directly subject to Rome. The legendary Edessan martyrs Sharbēl and Barsamāyā may have perished in the Decian persecution. In 260 the city was besieged by the Persians under Shapur I., and Valerian was defeated and made prisoner by its gates. Odaenathus of Palmyra (d. 267), however, wrested Mesopotamia from the Persians, but Aurelian defeated his successor Zenobia at Emesa (273), and Carus, who died in 283 in an expedition against the Persians, and Galerius (297) carried the frontier again to the Tigris. During the Diocletian persecution Shmōna and Garra (Nov. 15, 309) and Habbib (Sept. 2, 310), the "Confessors of Edessa" were martyred; but the bishop Qōna, who laid the foundations of "the great church" by the sacred pool, somehow escaped. Edessa can claim no share in "the Persian Sage" Aphrahāt (Aphraates), but Ephrem, after bewailing in Nigbīs the sufferings of the great Persian war under Constantius and Julian, when Jovian in 363 ceded most of Mesopotamia to Shapur II., the persecutor of the

Christians, settled in Edessa, which as the seat of his famous school (called "the Persian") grew in importance, and attracted scholars from elsewhere. He taught and wrote vigorously against the Arians and other heretics, and although just after his death (373) the emperor Valens banished the orthodox from Edessa, they returned on the emperor's death in 378. Rabbula, bishop of Edessa from 411 to 435, was a great organizer, but he won from the Nestorians the title of the Tyrant of Edessa. In particular he exerted himself to stamp out the use of the Diatessaron in favour of the four Gospels, of which he issued a revised Syriac translation, which is the final form of the Peshitta. The sojourn in Edessa of the "Man of God" (Alexis) belongs to Rabbula's episcopate, and the oldest surviving dated Syriac ms was written in the year he became bishop. When Nestorianism was condemned at Ephesus (431) it began to gravitate eastwards, Nisibis becoming its eventual headquarters, but Edessa and the western Syrians refused to bow to the Council of Chalcedon (451) when it condemned Monophysitism.¹ Zeno's edict (489) ordered the closing of the school of the Persians at Edessa, and East and West drifted apart more and more, Narsai, the leading Nestorian teacher, fled to Nisibis about 489. Till about this time Syriac influence was strong in Armenia, and some Syriac works have survived only in Armenian translations. In the opening years of the 6th century the Persian-Roman War (502-506) found a chronicler in the anonymous Edessene history known till recently as the Chronicle of Joshua Stylites. Whether Edessa received from the emperor Justin I the additional name of Justinopolis may be uncertain (see Hallier, *op cit* p 128), but it seems to have been renewed and fortified after the "fourth" flood in 525 (Procop. *Pers* II 27, *De aedific* II 7). About this time, according to Noldeke, an anonymous Edessene wrote the Romance of Julian the Apostate, which so many Arab writers use as a history. Chosroes I Anushirvan succeeded in 540, according to the last entry in the Edessene Chronicle, in exacting a large tribute from Edessa, but in 544 he besieged it in vain. A few years later Jacob Burd'ara (Baradaeus), with Edessa as his nominal bishopric, was carrying on the propaganda of Monophysitism which won for the adherents of that creed the name of Jacobites (see JACOBITE CHURCH). The valuable Syriac Chronicle just referred to probably was compiled in the latter half of this century.

Islam—In the first decade of the next century Edessa was taken by Chosroes II, and a large part of the population transported to eastern Persia. Within a score of years it was recovered by the emperor Heraclius, who reviewed a large army under its walls. The prophet of Islam was now, however, building up his power in Arabia, and a few years later (637) Heraclius's attempts from Edessa as a centre, to effect an organized opposition to the victorious Arabs were defeated by Said, and he fell back on Samosata. The terms on which Edessa definitely passed into the hands of the Moslems (638) under Riyad are not certain (Baladhuri). As it now ceased to be a frontier city it lost its importance. In 668 occurred another destructive flood (Theophanes, p 537), and in 678 an earthquake which destroyed part of the "old church," which the caliph Mo'awiya I is said to have repaired. To the latter part of the century belongs the activity of Edessa's bishop Jacob, whose chronicle is unfortunately lost. It may have been the impulse given by the final supremacy of the caliphate to the long process which eventually substituted Arabic for Aramaic (which had now prevailed for a millennium and a half), that led Jacob to adopt Greek vowel signs for use in Syriac. Yet a century later Theophilus of Edessa (d 785), author of a lost history, translated into Syriac "the two books of the poet Homer on the conquest of the city of Ilium." When the Baghdad caliphs lost control, Edessa shared the fortunes of western Mesopotamia, changing with the rise and fall of Egyptian dynasties and Arab chieftains. In the 10th century al-Mas'udi, writing in the very year in which it happened, tells how the Mohammedan ruler of Edessa, with the permission of the caliph, purchased peace of the emperor Romanus Leapenus by surrendering to him the napkin of Jesus of Nazareth, wherewith he had dried himself

after his baptism. The translation of the Holy Icon of Christ from Edessa is commemorated on Aug 16 (Cal Byzant). A few years later Ibn Haukal (978) estimates the number of churches in the city at more than 300, and al Mo'addasi (985) describes its cathedral, with vaulted ceiling covered with mosaics, as one of the four wonders of the world. In 1031 the emperor recovered Edessa, but in 1040 it fell into the hands of the Seljuks, whose progress had added a large element of Armenian refugees to the population of Orshoene. Maqrizi tells us that the Armenian minister Badr al Gama' employed architects from Edessa to build three of the fine city gates of Cairo (1087-91). The empire soon recovered Edessa, but the resident made himself independent. In 1098, in the First Crusade, Baldwin, brother and successor of Godfrey of Bouillon took possession of the town and made it the capital of a Burgundian countship, which included Samosata and Sarug, and was for half a century the eastern bulwark of the kingdom of Jerusalem.² The local Armenian historian, however, Matthew of Edessa, tells of oppression, decrease of population, ruin of churches, neglect of agriculture. With the campaign of Maudud in 1110 fortune began to favour the Moslems. Edessa had to endure siege after siege. Finally, in 1144 it was stormed, Matthew being among the slain, by Imad ud Din Zengi, ruler of Mosul, an achievement celebrated as "the conquest of conquests," for which an Edessan monk, John, bishop of Harran (d 1165) laid the responsibility not on God but on the absence of the Frankish troops. Edessa suffered still more in 1146 after an attempt to recover it. Churches were now turned into mosques. The consternation produced in Europe by the news of its fate led to "the second Crusade." In 1182 it fell to Saladin, whose nephew recovered it when it had temporarily passed (1234) to the sultan of Rum, but the "Eye of Mesopotamia" never recovered the brilliance of earlier days. The names it contributed to Arabic literature are unimportant. By timely surrender (1268) it escaped the sufferings inflicted by Hula'ku and his Mongols on Sarug (Barhebraeus, *Chron Arab*, Beirut ed, 486). Mostaufi describes a great cupola of finely worked stone still standing by a court over a hundred yards square (1340). Ali b Yazid in his account of the campaigns of Timur, who reduced Mesopotamia in 1393, still calls the city (1425) Ruhu. In 1637, when Amurath IV conquered Baghdad and annexed Mesopotamia, it passed finally into the hands of the Turks, by whom it is called Urfa.

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Modern City—The city occupies an important position as one of a line of frontier forts which hold the entrance from the foothills to the plain. It is in addition an important point of transit along the northern and safer route from Mosul to Aleppo, being now on the railway. At this point the land routes westwards divide, one going south to Aleppo, another west to Adana. It is the centre of a wheat district but is not concerned in any industry. The population is uncertain, it probably numbers about 40,000 and includes Kurds, Turks and Armenians.

The town itself is of considerable interest. It is surrounded by a wall, with square towers at intervals. On the western part of the town lies the old citadel, with two great Corinthian columns, known as the "throne of Nimrod." Between the citadel and the town are the springs, from which it probably derived its name of *Callirhoe*. The water from these springs forms two ponds, on the edge of the larger of which is the great Mosque of Abraham. The largest mosque however is in the middle of the town, probably on the site of the once famous Christian church. The Kara Kuyun (*Expius*) runs in a moat round the town, and this and the other streams serve to irrigate the gardens, vineyards and mulberry orchards. In addition to its stormy history in earlier times Edessa towards the end of the last century incurred an unfor-

¹The oldest surviving dated ms of a portion of the Bible in any language was written at Amid (Diarbekr) in A.D. 464.

²The counts were Baldwin I (1098), Baldwin II (1100), Joscelin I (1110), Joscelin II (1131-47).

fortunate reputation as the seat of Armenian massacres

EDFU, in Coptic *Athab*, a town of Upper Egypt, 484 m S S E of Cairo by rail, on the W bank of the Nile, the railway station being on the opposite side of the river. The inhabitants manufacture earthenware, which finds ready sale all through Egypt. The ancient *Athab* (*Apollinopolis Magna*) was capital of the second nome of Upper Egypt. The great Ptolemaic sandstone temple is practically complete. The central part of the building, begun by Ptolemy III. Evergetes in 237 B.C., was finished by his successor in 212, the portico, court, pylons and surrounding wall were added by Ptolemy Euergetis II., Soter II. and Alexander I., but the decoration was not finished till c. 100 in the reign of Ptolemy XIII. Neos Dionysus. The god of *Athab* was a form of Horus (Apollo) as the sun god, his most characteristic representation is as the disk of the sun with outspread wings. Population 15,000.

EDGAR (EADGAR), king of the English (941–975), was the younger son of Edmund the Magnificent and Aelfifu. As early as 955 he signed a charter of his uncle Eadred, and in 957 the Mercian nobles, discontented with the rule of his elder brother Eadwig, made him king of England north of the Thames. On the death of his brother in Oct. 959 Edgar became king of a united England. Immediately on his accession to the throne of Mercia Edgar recalled St. Dunstan from exile and made him first bishop of Worcester, and then of London. In 961 Dunstan was translated to Canterbury, and throughout Edgar's reign he was his chief adviser, and to him must be attributed much of the peace and prosperity of this time.

The reign of Edgar was somewhat uneventful, but two things stand out clearly: his ecclesiastical policy and his imperial position in Britain. Edgar and Dunstan were alike determined to reform the great monastic houses, to restore them to their true owners, and to remove them from the lax discipline of the secular priests or *canonici*. The priests of the old and new monasteries at Winchester, Chertsey and Milton Abbas were replaced by monks, and the old rule of St. Benedict was strictly enforced.

The coronation of Edgar, delayed for some unexplained reason till 973, took place with much ceremony at Bath, and was followed shortly after by the submission of eight kings, including the kings of Scotland and Strathclyde, to Edgar at Chester. In 967 an outbreak against Edgar in Northumbria was put down by Thored, the son of Gunner, steward of the king's household.

Edgar's death took place in the year 975, and he was buried at Glastonbury. By his vigorous rule and his statesmanlike policy Edgar won the approval of his people, the only fault ascribed to him is a too great love for foreigners and for foreign customs. Edgar strengthened the hands of the provincial administration, and allowed the northern Danes a certain degree of self government.

Edgar is said to have formed an irregular union in 961 with Wulfthryth, an inmate of the convent at Wilton, who bore him a daughter Eadgyth but refused to marry him. He married Aethelflaed, "the white duck," daughter of Earl Ordmaer, who bore him a son, known as Edward the Martyr. Finally he was united (964) to Aelfthryth, daughter of Earl Ordgar, who became the mother of the Aetheling Edmund (d. 971) and of Aethelred the Unready.

See *The Anglo-Saxon Chronicle* (ed. Plummer, 1892–99), *sub ann.*, *Vita Sancti Oswaldi* (*Historians of the Church of York*, ed. Raine, Rolls Series), William of Malmesbury, *Gesta regum* (ed. Stubbs, Rolls Series), Birch, *Cartularium Saxonicum*, vol. II, Nos. 1047–1310, F. Liebermann, *A-S Laws*, i, 192–216, "Florence of Worcester" (*Mon. Hist. Brit.*), E. W. Robertson, *Historical Essays*, pp. 189–215.

EDGAR or **EADGAR** (c. 1050–c. 1130), called the Aetheling, was the son of Edward (the exile), a son of the English king Edmund Ironside, by his wife Agatha, a kinswoman of the emperor Henry II., and was born probably in Hungary some time before 1057, the year of his father's death. After the death of Harold in 1066, Eadwine and Morkere desired to make him king, but on the advance of William I., Edgar and his supporters made their submission. He took part in two unsuccessful risings in the north (1068 and 1069), afterwards taking refuge in Scotland, where his sister Margaret married the Scottish king, Malcolm Canmore. In 1074 he went to Normandy and made peace with William. In 1097 he made a successful attempt to set his nephew

Edgar on the throne of Scotland, and in 1099 went to the crusade. He returned to England in Henry I.'s reign, but sided with Robert of Normandy against the king in their last war, and was taken prisoner at the battle of Tinchebrai in 1106. He was soon released, and lived in obscurity until his death, the date of which is uncertain.

EDGECEUMBE or **EDGECOMBE**, the name of a celebrated west of England family, taken from the manor of Edgecombe in Cornwall. One of its earlier members was Sir Richard Edgecombe (d. 1489), who was descended from a Richard Edgecombe who flourished during the reign of Edward I. Richard was a member of parliament in 1467, afterwards he joined Henry, earl of Richmond, in Brittany, returned with the earl to England, and fought at Bosworth, where he was knighted. He was richly rewarded and sent by Henry VII. on errands to Scotland, Ireland and Brittany, he died at Morlaix on Sept. 8, 1489. His son and successor, Sir Piers Edgecombe (d. 1539) went to France with Henry VIII. in 1513. His son Sir Richard Edgecombe (1499–1562), a cultured and hospitable man, is celebrated through Richard Carew's *Friendly Remembrance of Sir Richard Edgecombe*. Sir Richard's eldest son, Piers or Peter Edgecombe (1536–1607), was a member of parliament under Elizabeth for about 30 years.

Another famous member of this family was Richard, 1st baron Edgecombe (1680–1758), a son of Sir Richard Edgecombe. Educated at Trinity College, Cambridge, he was successively member of parliament for St. Germans, Plympton and Lostwithiel from 1701 to 1742, on two occasions served as a lord of the treasury, and from 1724 to 1742 was paymaster general for Ireland, becoming chancellor of the duchy of Lancaster in 1743. He managed the elections for the Cornish boroughs in the interests of Sir Robert Walpole and his elevation to the peerage, which took place in 1742, was designed to prevent him from giving evidence about Walpole's expenditure of the secret service money. His son and successor, Richard, the 2nd baron (1716–61), was comptroller of the royal household, a member of parliament, and a major general in the army.

Richard's brother George (1721–95), was a naval officer during the Seven Years' War. Succeeding to the barony on the 2nd baron's death in 1761 he became an admiral and treasurer of the royal household, was created Viscount Mount Edgecombe in 1781, and earl of Mount-Edgecombe in 1789.

EDGE HILL, an elevated ridge in Warwickshire, England, near the border of Oxfordshire. The north western face is an abrupt escarpment of the Lias, and the summit of the ridge is almost level for nearly 2 m., at a height somewhat exceeding 700 ft. The escarpment overlooks a rich lowland watered by streams tributary to the Avon, the gentle eastern slope sends its waters to the Cherwell, and the ridge thus forms part of the divide between the basins of the Severn and the Thames. Edge Hill gave name to the first battle of the Great Rebellion (q.v.), fought on the 23rd of October 1642.

EDGE TOOLS. A general term which includes cutting and scraping tools, as distinguished from those of percussive type, as hammers, and of lever type, as spanners. Edge tools date from the remote palaeolithic age when rough axes were chipped from flints, to be improved by neolithic men who ground and polished their celts. The true chisel, thrust by hand, appears to have been developed in the bronze age. The basic difference between an axe and a chisel is that the one is doubly bevelled, the other singly. The result is that the axe does not possess good guidance on the wood, while the flat face of the chisel acts as a guide, helping to cut true surfaces. An adze is of the chisel class, and is used by the carpenter and shipwright to true baulks and other large areas. The carpenter's plane gives still better control by means of the sole sliding along the wood, while in machine tools for wood and metal the guidance becomes perfect.

The keenness of an edge tool, or its "cutting angle" is nearest to that of the razor in the woodworker's chisel, gouges, carving-tools and plane irons, as well as in certain machine knives. Hard or tough wood tends to turn over a fine edge or break it, consequently the angle of the two faces meeting at the edge must be

increased. The same rule applies to cold chisels for metals. In the tools used in metal working machines, as the lathe, drill, planer, shaper and slotter and the milling and sawing machines, the edges must be ground more keenly for the fibrous metals and alloys, as wrought-iron, mild steel and copper, but less keenly for the crystalline kinds, as hard steel, cast iron and brass. Chilled cast iron, for the rolls of rolling mills, is very difficult to turn, and the tool faces meet at an angle of near 90°, the action being merely slow scraping. Nevertheless this tool is a wedge, in principle, just as much as the finest chisel for soft wood, penetrating and forcing aside the metal (See also FILE, MACHINE KNIVES, MACHINE TOOLS, MILLING CUTTERS, PUNCHING AND SHEARING MACHINES, SAWS, and general article Tool.)

EDGEWORTH, MARIA (1767-1849), Irish novelist, second child and eldest daughter of Richard Lovell Edgeworth (qv) and his first wife, Anna Maria Elers, was born in the house of her maternal grandparents at Black Bourton, Oxfordshire, on Jan. 1, 1767. She had ample opportunities for society among her father's neighbours in Ireland, among whom were the second Lord Longford, whose daughter, "Kitty" Pakenham, became later duchess of Wellington, Lady Moura at Castle Forbes, and Maria's aunt, Margaret Ruxton, at Black Castle. She gained a first-hand experience of the Irish peasantry by acting as her father's assistant in the management of the estate. The Edgeworths were in Ireland from 1793 onwards through that dangerous period, and Maria's letters, always gay and natural, make very light of their anxieties and their real perils.

It has been the fashion to regard Mr Edgeworth's influence over Maria's work as altogether deplorable, but she undoubtedly derived a stimulus from his powerful mind. Her first publication was a plea for the education of women, *Letters to Literary Ladies* (1795), and in 1796 appeared *The Parent's Assistant* (2nd ed., 6 vols., 1800), a collection of stories which had been submitted as they were written to the juvenile critics of the Edgeworth nursery. They were therefore children's stories for children, even though the morals were Mr Edgeworth's *Practical Education* (2 vols., 1798) was written in conjunction with her father, who also collaborated with her in the *Essay on Irish Bulls* (1802). Miss Edgeworth's first novel, *Castle Rackrent*, appeared anonymously in 1800. It is the story of an Irish estate and its owners, the Rackrents, as told by Thady, the steward. Its success was immediate, and a second edition soon appeared with the author's name. The personages appear to be drawn immediately from the natives of Edgeworthstown, though Miss Edgeworth asserts that only Thady himself was an actual portrait. The book influenced Scott. In the "Postscript, which should have been a preface," in the original edition of *Waverley*, Scott describes his aim as being "in some distant degree to emulate the admirable Irish portraits of Miss Edgeworth, so different from the 'Teagues' and 'dear joys' who so long, with the most perfect family resemblance to each other, occupied the drama and the novel." *Belinda* (1801) is a society novel, and one of her best books. Saintsbury thinks that Miss Austen's heroines owe something of their naturalness to *Belinda*, who was one of the earliest to break with the tradition of fainting and blushing. *Moral Tales for Young People* (5 vols.) and *Early Lessons*, which included "Harry and Lucy," "Rosamond" and "Frank," appeared in 1801.

In 1802 the Edgeworths went abroad, first to Brussels and then to Paris. They had already connections in Paris through their kinsman, the abbé Edgeworth de Firmont, who was, however, then in exile. They met all the notabilities in Paris, and Maria refused an offer of marriage from a Swedish count named Edelcrantz. Although *Leonora*, not published until four years later, is said to have been written to meet his taste, she apparently remained then and always heart whole, but her stepmother thought otherwise and maintained that she suffered severely for her decision (*Memoir*, i. 144). Returning to Edgeworthstown, Miss Edgeworth resumed her writing, which was always done in the rooms commonly used by the whole family. *Popular Tales* was published in 1804, and *The Modern Griselda* in the same year, *Leonora* in 1806, and in 1809 the first series of *Tales of Fashionable Life*, three volumes containing "Ennui," "Madame

de Fleury," "Almeria," "The Dun" and "Manoeuvring," the second series (3 vols., 1812) included "The Absentee," one of her best tales, which was originally designed as a play, "Vivian" and the clever study of emigre life, "Emile de Coulinges." In 1813 Maria and her parents spent a considerable time in London, and her society was much sought after. When *Waverley* was published, Miss Edgeworth received a copy from the publishers, and at once recognized the authorship. She wrote a long letter of appreciation (Oct. 23, 1814) to "the author of *Waverley*," which she began with the phrase *aut Scotus, aut diaboli*, but the letter was merely acknowledged by the publishers. *Patronage* (4 vols., 1814), the longest of her novels, and *Harrington, a tale*, and *Ormond, a tale* (3 vols., 1817) complete the list of the works which received what her father called his *imprimatur*.

After his death in 1817 Miss Edgeworth occupied herself with completing his *Memoirs*, which were published in 1820. In 1820 she was again in Paris, and in 1823 she spent a fortnight with the Scotts at Abbotsford. In 1825 Scott went to Edgeworthstown, and their relations were always cordial. Miss Edgeworth's production was less after her father's death. Sequels to "Rosamond," "Frank," "Harry and Lucy" in the *Early Lessons* were published in 1822-1825. *Comic Dramas* appeared in 1817, and *Helen* in 1834. In 1846 she worked strenuously for the relief of the famine-stricken Irish peasants. She died on May 22, 1849.

Miss Edgeworth's novels are distinguished by good sense, humour and vivacious dialogue. She expressly calls some of her stories "Moral Tales," but the freshness of her stories, her insight into character, lively dialogues, originality of invention and delightfully clear style render it quite possible to read her works in succession without any sense of weariness.

See *A Memoir of Maria Edgeworth, with a Selection from her Letters* (1867), by her stepmother, F. A. Edgeworth, privately printed. A selection from this was made by Augustus J. C. Hare, and printed under the title of *The Life and Letters of Maria Edgeworth* (2 vols., 1804). See also *Maria Edgeworth* (1883), by Helen Zimmern, in the "Eminent Women" series, Grace A. Oliver, *A Study of Maria Edgeworth* (3rd ed., Boston, U.S.A., 1882), and *Maria Edgeworth* (1904), by the Hon. Emily Lawless in the "English Men of Letters" series. Also George Saintsbury in *Macmillan's Magazine* (July 1895), the preface supplied by Lady Thackeray Ritchie to Macmillan's edition of the novels (1895), C. Hill, *Maria Edgeworth and her circle* (1909), *The Black Book of Edgeworths Town* (1858-1817), ed. H. J. and H. E. Butler (1928).

EDGEWORTH, RICHARD LOVELL (1744-1817), British writer, was born at Bath. The greater part of his life was spent at Edgeworthstown, or Edgeworthstown, in the county of Longford, Ireland. He was educated at various schools in England and Ireland, and entered Trinity college, Dublin, in April 1761, but was transferred to Corpus Christi college, Oxford, in October of the same year. While still at college, he made a runaway match, marrying at Gretna Green, Anna Maria, one of the daughters of Paul Elers of Black Bourton, Oxon, an old friend of his father. Edgeworth devoted much of his time to scientific reading and experiments, and he made an attempt to establish telegraphic communication (*Memoirs*, 2nd ed., i. 144). In the pursuit of his mechanical inventions he visited Erasmus Darwin at Lichfield, where he met Anna Seward, and her cousin, Honora Sneyd. He kept terms at the Temple, and formed the greatest friendship of his life with Thomas Day, the author of *Sandford and Merton*, which was written at Edgeworth's suggestion. In 1769, on the death of his father, he gave up the study of law, and spent a considerable time in England and France, mainly in Day's company. He was summoned to England by the death of his wife (March 1773), with whom he had been far from happy. Edgeworth hurried to Lichfield, to Dr. Erasmus Darwin's, and at once declared his passion for Honora Sneyd, which had been the cause of his flight to France two years before. Miss Sneyd had been the object of attention from Thomas Day, but her views on marriage were not submissive enough to please him. She had other suitors, among them the unfortunate Major Andre. She married Edgeworth (July 1773), and after residing at Edgeworthstown for three years, they settled at Northchurch, in Hertfordshire. Honora Edgeworth died in April 1780, recommending her husband to marry her sister Elizabeth, and they

were actually married on Christmas day, 1780. She died in 1797.

Practical Education (1798) was written in collaboration with his daughter Maria, and embodied the experience of the authors in dealing with children. This book, generally regarded as old-fashioned, has a real value in the history of education. Their views had been inspired by Rousseau, and by Thomas Day. The Edgeworths brought a scientific method to their work. The second Mrs Edgeworth (Honora Sneyd) began the collection of actual examples of conversations between the children and their elders. This was continued by the writers of the book, and their reasonings were thus founded on an accurate record of childish methods of thought. They deprecated especially any measures that interrupted the child's own chain of reasoning. The chapters on special subjects of study, chronology, geometry, etc., were written by Richard Lovell Edgeworth, those on toys, on rewards and punishments, on temper, etc., by his daughter.

In 1798 Edgeworth married Miss Beaufort, and was elected M.P. for the borough of St John's Town, Longford. During the formidable rebellion of that year the Edgeworths took refuge in Longford. The winter of 1802 they spent in Paris. In 1804 the government accepted his telegraphic apparatus, but the installation was left incomplete when the fear of invasion was past. In 1806 Edgeworth was elected a member of the board of commissioners to enquire into Irish education. From 1807 till 1809 much of his time was spent on mechanical experiments and in writing the story of his life. He died on June 13, 1817, and was buried in the family vault in Edgeworthstown churchyard. Edgeworth's works include *Poetry Explained for Young People* (1802), *Professional Education* (1808), *Readings in Poetry* (1816).

See *Memoirs of Richard Lovell Edgeworth*, *sq.*, begun by himself and revised by his daughter, Maria Edgeworth (4 vols, 1820, 3rd and 4th ed., 1844). *Richard Lovell Edgeworth* (1860), edit Mrs Lionel Tollemache, is a selection from the *Memoirs*. See also *The Black Book of Edgeworthstown* (1885-1817), edit H. J. and H. E. Butler (1928).

EDGEWORTH DE FIRMONT, HENRY ESSEX (1745-1807), last confessor to Louis XVI, was the son of Robert Edgeworth, rector of Edgeworthstown in Ireland, his mother being a granddaughter of Archbishop Usher. His father resigned his living and emigrated to Toulouse, where the boy was brought up by the Jesuits. On taking orders he assumed the additional surname of de Firmont, from the family estate of Firmount near Edgeworthstown. In 1791 he became confessor to the princess Elizabeth, sister of Louis XVI, and then to Louis himself. After Louis' condemnation he obtained permission to celebrate mass for him and attend him on the scaffold, where he recommended the king to allow his hands to be tied, with the words "Sire, in this new outrage I see only the last trait of resemblance between your Majesty and the God who will be your reward." The abbé himself denied that at the moment of the execution he uttered the celebrated words "Son of St. Louis, ascend to heaven." Edgeworth continued to correspond with Madame Elizabeth. In 1795, his mother having meanwhile died in prison, where his sister was also confined, he escaped to England, carrying with him Elizabeth's last message to her brother, the future King Charles X. He afterwards went with some papers to Monsieur (Louis XVIII), then at Blankenburg in Brunswick, and was induced to accompany him to Mittau, where, on May 22, 1807, he died of a fever contracted while attending some French prisoners.

EDGREN-LEFFLER, ANNE CHARLOTTE, duchess of Cajanello (1849-1892), Swedish author, daughter of the mathematician Prof. C. O. Leffler, was born on Oct. 1, 1849. Her first volume of stories appeared in 1869, but the first to which she attached her name was *Ur Lifvet* ("From Life," 1882), a series of realistic sketches of the upper circles of Swedish society, followed by three other collections with the same title. Her earliest plays, *Skädespölskan* ("The Actress," 1873), and its successors, were produced anonymously in Stockholm, but in 1883 her reputation was established by the success of her comedies *Sanna Kumor* ("True Women") and *En Riddande engel* ("An Angel of Deliverance"). *Sanna Kumor* is directed against false femininity, and was well received in Germany as well as in Sweden.

Anne Leffler had married in 1872 G. Edgren, but about 1884 she was separated from her husband, who did not share her advanced views. She spent some time in England, and in 1885 produced her play *Hur man gör godt* ("How Men do Good"), followed in 1888 by *Kampen för Lyckan* ("The Struggle for Happiness"), a drama in which she had the help of Sophie Kovalevsky. Another volume of the *Ur Lifvet* series appeared in 1889, (both volumes were reprinted in 1915, and *Familejlycka* ("Domestic Happiness," 1891), a drama in 3 acts, was produced in the year after her second marriage, with the Italian mathematician, Pasquale del Pezzo, duca di Cajanello. She died at Naples on Oct. 21, 1892. The masculine directness, freedom from prejudice, and frankness of her work gave her a high place in Sweden. Her last book was a biography (1892) of her friend Sophie (Sonya) Kovalevsky, by way of introduction to Sonya's autobiography. An English translation (1895) by A. de Fumhjel and A. M. Clive Bayley contains a biographical note on Fru Edgren Leffler by Lily Wolfstom, based on private sources.

See also Ellen Key, *Anne Charlotte Leffler* (1893), O. J. Leventin, *Swedish National Literature, 1500-1900*, vol. 18 (1907).

EDIBLE BIRD'S-NEST, the nest of a species of swift of the genus *Columba*, composed chiefly of the saliva of birds. They are to be found in the East Indies and Australia and are valued by the Chinese for the making of soup. The most important species is *C. fuciphaga*. See SWIFT.

EDICT, in order or proclamation issued under authority and having the force of law. The word is especially used of the promulgations of the Roman praetor (*q. v.*), of the Roman emperors, and also of the kings of France (see ROMAN LAW).

EDINBURGH (Ed'n bur'), the capital city of Scotland, county of a city, royal and parliamentary burgh and the county town of Midlothian or Edinburghshire south of the Firth of Forth, 393 mi. by rail N.N.W. of London. The old Royal observatory on Calton Hill stands in 55° 57' 23" N. and 3° 10' 46" W. Edinburgh occupies a group of hills and valleys. In the centre is a bold rock, crowned by the castle, between which and the new town lies a ravine that once contained the Nor Loch, but is now covered with the gardens of Princes street. To the east rises Calton Hill (355 ft.) with St. Andrew's house and the Calton cemetery. On the southeast is the hill of Arthur's Seat (822 ft.). Toward the north the site of the city slopes to the Firth of Forth and includes the port of Leith, while to the south, Liberton Brae, Blackford Hill, Braid Hills and Craiglockhart Hills roughly mark the city bounds, as Corstorphine Hill and the Water of Leith do the western limits. Its situation, general plan and literary associations gave Edinburgh the name of "the modern Athens," but it has a homelier nickname of "Auld Reekie," from the cloud of smoke (reek) over the low-lying quarters.

Chief Buildings—In the castle, the oldest building is St. Margaret's chapel, believed to be the chapel where Queen Margaret, wife of Malcolm Canmore, worshipped, and belonging at latest to the reign of her youngest son, David I. (1124-1153). Near it the parliament and banqueting hall contains a fine collection of Scottish armour, weapons and regimental colours. The heraldic bearings of royal and other figures distinguished in national history are emblazoned in the windows. Other buildings in the palace yard include the apartments occupied by the regent, Mary of Guise, and her daughter Mary, queen of Scots, and the room in which James VI was born. Here also are deposited the Scottish regalia ("The Honours of Scotland"), with the sword of state presented to James IV by Pope Julius II, and the jewels restored to Scotland on the death (1807) of Cardinal York, the last of the Stuarts. The remains of King David's tower, the ancient keep, were hidden by the Half Moon battery, but were revealed in 1912. In the armoury is a collection of arms of various dates, and on the Argyll battery stands a huge piece of ancient artillery, called Mons Meg, of which repeated mention is made in Scottish history. The large arsenal on the west side of the rock is modern, but the castle garrison was withdrawn in 1923. A war memorial, a shrine and gallery of honour, was opened in Crown square in 1927. (See under MONUMENTS below.)

The palace of Holyrood house was originally an abbey of

canons regular of the rule of St Augustine, founded by David I in 1128, and the ruined nave of the abbey church still shows parts of the original structure. Connected with this is a part of the royal palace erected by James IV and James V, including the apartments occupied by Queen Mary, the scene of the murder of Rizzio in 1566. The abbey was sacked and burned by the English under the earl of Hertford in 1544, and again in 1547. Modern excavation revealed much of the early foundations. In a map of 1544 the present northwest tower of the palace is shown standing apart, and joined to the abbey by a cloister. Beyond this was an irregular group of buildings replaced later by additions more in accordance with a royal residence. The whole of this latter structure was destroyed by fire in 1650 while in occupation by the soldiers of Cromwell, and the more modern parts were begun during the Protectorate, and completed in the reign of Charles II by Robert Mylne, after the designs of Sir William Bruce of Kinross. They include the picture gallery, with 106 mythical portraits of Scottish kings, and a triptych (c 1484) containing portraits of James III and his queen, believed to have formed the altar piece of the collegiate church of the Holy Trinity, founded by the widowed queen of James II in 1462, demolished in 1848, and afterwards rebuilt, stone for stone, in Jeffrey street. The picture gallery is associated with the festive scenes that occurred during the short residence of Prince Charles in 1745, and in it the election of representative peers for Scotland takes place. Escaping from France at the revolution of 1789, the comte d'Artois, afterwards Charles X of France, had apartments granted for the use of himself and his suite, who continued to reside in the palace till Aug 1799. When driven from the French throne by the revolution of 1830, Charles once more found a home in the palace. The state apartments were redecorated under the guidance of Queen Mary, wife of George V. A fountain, after the original design of that in the quadrangle of Linlithgow palace, was erected in front of the entrance by the prince consort. Iron gates enclosing the forecourt, and a statue of Edward VII, form the national memorial to that king. The royal vault in the Chapel Royal, which was dilapidated, has been put in order. Clockmill house and grounds have been added to the area of the parade ground, and the abbey precincts generally and the approaches to the King's park have been improved. With the abolition of imprisonment for debt in 1882 the old privileges of sanctuary came to an end.

Parliament house, begun in 1632 and completed in 1640, in which the later assemblies of the Scottish estates took place until the dissolution of the parliament by the Act of Union of 1707, has since been the meeting-place of the supreme courts of law. The great hall, with its fine open-timbered oak roof, is adorned with a splendid stained-glass window and several statues, including one by Louis François Roubiliac of Duncan Forbes of Culloden, lord president of the court of session (1685-1747), and now forms the ante room for lawyers and their clients. The surrounding buildings, including the court rooms and the buildings for the Signet and the old Advocates' libraries, are modern. The Advocates' library was founded in 1682 by Sir George Mackenzie of Rosehaugh. It was presented to the nation by the faculty of advocates in 1924 and was endowed by Sir A. Grant with £100,000 for maintenance. It is one of the five entitled by the Copyright Act to receive a copy of every work published in Great Britain. The library is now the National Library of Scotland.

The General Register house for Scotland, begun in 1774 from designs by Robert Adam, stands at the east end of Princes street. It contains, in addition to the ancient national records, accommodation in fireproof chambers for all Scottish title deeds, entails, contracts and mortgages, and for general statistics, including those of births, deaths and marriages.

The Royal Institution, in the Doric style, surmounted by a colossal stone statue of Queen Victoria by Sir John Steell, formerly accommodated the board of trustees for manufactures and the board of fishery, the school of art, the Royal Society of Edinburgh (founded in 1783) and the Society of Antiquaries of Scotland (founded in 1780). In 1910 it was renamed and appropriated to the uses of the Royal Scottish Academy of Painting, Sculpture and Architecture, instituted in 1826, and incorporated

by royal charter in 1838, on the model of the Royal Academy in London. It is situated on the Mound close to the National Gallery (1850). These collections are especially rich in Raeburn's works and include also Alexander Nasmyth's portrait of Robert Burns and Gainsborough's "The Hon Mrs Graham." The National Portrait gallery and Museum of Antiquities are housed in Queen street. St Giles's church, usually styled cathedral, restored (1872-83) by the liberality of Dr William Chambers, the publisher, has many associations. The regent Moray, the marquess of Montrose, and Napier of Merchiston were buried within its walls and are commemorated by monuments, and among the memorial tablets is one to R. L. Stevenson. The choir (restored in 1873 by public subscription) is a fine example of 15th-century architecture, and the Gothic crown surmounting the central tower is a feature in many views of the city. Just inside the church in Parliament square, the supposed grave of John Knox is indicated by a stone set in the pavement bearing his initials, and in the pavement to the west a heart indicates the site of the old Tolbooth, which figures prominently in Scott's *Heart of Midlothian*. The original Tolbooth was completed in 1501, but a new one took its place in 1563-1564. At first occupied by the parliament and courts of justice, it served later as a prison, and was removed in 1817. Other churches having historical associations are Greyfriars church, which formerly occupied the two halves of one building but were united in 1937, Tron church, the scene of midnight hilarity at the new year, St Cuthbert's church, St Andrew's church in George street, whence set out, on a memorable day in 1843, that long procession of ministers and elders to Tanfield hall which ended in the founding of the Free Church, St George's church in Charlotte square, a good example of the work of Robert Adam. The finest building belonging to the Scottish Episcopal Church is St Mary's cathedral (1879). The mansion of East Coates (17th cent.), stands in the close, and is occupied by functionaries of the cathedral. The Catholic Apostolic church at the foot of Broughton street has a set of mural paintings by Mrs Traquair. The Central hall at Tollcross testifies to Methodist energy. A house at the east end of the High street, said to have been John Knox's, is kept in repair, and contains articles of his furniture. The Canongate Tolbooth adjoins the parish church, in the burial ground of which is the tombstone raised by Burns to the memory of Robert Ferguson, here Dugald Stewart, Adam Smith and other men of note were buried. Almost opposite to it stands Moray house, from the balcony of which the 8th earl of Argyll watched Montrose led to execution (1650). The jail, a castellated structure on the black rock of Calton Hill, was demolished to make way for St Andrew's house, the Scottish government building, opened in 1939. This was designed by T. S. Tait in a classical style and incorporates the south wall of the jail, which rises sheer from the cliffside, and the governor's house Usher hall (1914), a large public hall in Lothian road was built on the bequest of £100,000 by Andrew Usher (1826-98). The Sheriff Court buildings stand on George IV bridge, and facing them is Andrew Carnegie's free library (1887-1889). At the corner of the High street and George IV bridge stand the County buildings. The *Scotsman*, the principal daily newspaper, is housed in an ornate office in North Bridge street. Ramsay gardens, a student's quarter fostered by Prof. Sir Patrick Geddes (1854-1932), grew out of the "goose-pie" house where Allan Ramsay lived. The Outlook tower on Castle Hill houses collections, partly illustrating town-planning, by Prof. Geddes. The old City Cross (restored at the cost of W. E. Gladstone) stands in the High street, adjoining St Giles's. Several quaint groups of buildings have been carefully restored, such as the White Horse Close in the Canongate, the mass of alleys on the north side of the Lawnmarket, from Paterson's close to James's court have been connected, and here Lord Rosebery acquired and restored the 17th century dwelling called Lady Stuart's house, which figures in the legend of *My Aunt Margaret's Mirror*. It is used as a branch museum. Another model restoration of a historic close is found in Kiddle's close, which contains a students' settlement. The changes in the Old Town (many of a drastic nature) have been carried out with due regard to the character of their environment.

Monuments—The National World War I memorial designed by Sir Robert Lorimer, is on the north side of Crown square, atop the castle rock. The exterior is rather severe, but the interior is of surpassing beauty. It was opened in 1927. An arched entrance porch, over which, in a deep recess, is a figure symbolic of immortality, leads to the Hall of Honour of 12 bays, containing memorials of the 12 Scottish infantry regiments and embellished with the arms of counties and burghs. Facing the entrance is an octagonal shrine with stained glass windows by Douglas Strachan and a bronze frieze by Morris Meredith Williams. The altar bearing the steel casket containing rolls of honour is a great block of marble resting on an outcrop of living rock rising through the floor. The Scott monument in East Princes street gardens was designed by George Meikle Kemp (1795-1844). A column surmounted by a colossal figure of Viscount Melville, Pitt's first lord of the admiralty, rises from the centre of St Andrews square. Burns's monument, in the style of a Greek temple, occupies a prominent position on the Regent road, on the southern brow of the lower terrace of Calton Hill. On Calton Hill is the national monument to the victory of Waterloo, originally intended to be a reproduction of the Parthenon. The plan was abandoned for lack of funds, after 12 out of the 24 Greek pillars had been erected. The Nelson monument, an elongated turreted structure, stands on the highest cliff of the hill. Close by is the monument to Dugald Stewart, a copy of the choragic monument of Lysicrates. Sir John Steell's equestrian statue of the duke of Wellington stands in front of the Register house, and in Princes street gardens are statues of Livingstone, Christopher North, Allan Ramsay, Adam Black and Sir J. Y. Simpson, and a memorial to the Scots Greys who fell in the Boer War. In George street are Chantry's figures of Pitt and George IV, and a statue of Dr Chalmers, the 5th duke of Buccleuch stands beside St Giles's. Charles II surveys the spot where Knox was burned, the reformer himself is in the quadrangle of New college. The statue of Sir David Brewster has been moved from the quadrangle of the university to the new buildings at West Mains, that of Dr William Chambers is in Chambers street, and Frederick, duke of York (1763-1827), and the 4th earl of Hopetoun are also commemorated. The Gladstone memorial in St Andrews square was unveiled in 1917. In the west part of Princes street gardens is the Scottish-American war memorial (1927), raised by U.S. subscriptions and designed by Professor R. T. MacKenzie of Philadelphia. It consists mainly of a killed soldier in bronze.

Cemeteries—In Greyfriars' churchyard the Solemn League and Covenant was signed, and among its many monuments are the Martyrs' monument, recording the merits of the murdered covenanters, and the tomb of "Bluidy" Mackenzie. There are interesting memorials in the churchyards of St. Cuthbert's and the Canongate.

In the Calton burying-ground are the Roman tomb of David Hume, the obelisk raised in 1844 to the memory of Maurice Margarot, and the graves of Thomas Muir (1765-1798), Thomas Ryshe Palmer (1747-1802), William Skirving and Joseph Gerald (1765-1796), the political martyrs convicted in 1793-94 for advocating parliamentary reform.

The Scottish dead in the American Civil War are commemorated in a monument bearing a life-sized figure of Abraham Lincoln and a freed slave.

Parks and Open Spaces—The older open spaces are Princes street gardens, Calton Hill, the Meadows and the Bruntsfield links. On the southern side is Blackford Hill with the Royal observatory. Harrison park is in the congested district of Fountainbridge. The park at Saughton hall was opened in 1905, for the western district of the city, and Hillend park on the Pentland slopes, in 1924. The Scottish Zoological park lies beyond Murrayfield, on the slopes of Corstorphine Hill. To the north of the Water of Leith lie Inverleith park, the Arboretum and the Royal Botanical garden which includes a herbarium, hot houses, and a museum of economic botany. Near it is the Stevenson Memorial house in Howard place. The most extensive open spaces surround Arthur's Seat (822 ft.). This is a basaltic hill, separated from the narrow valley in which lie the Canongate and Holyrood pal-

ace by Salisbury Crags. Adjoining Holyrood palace is the King's park. Facing the crags on the southwest are the spots familiar to readers of *The Heart of Midlothian*, where stood Jeanie Deans's cottage, and between the crags and Arthur's Seat lies Hunter's Bog, used as a shooting range. Near here too are three small lakes, Duddingston, Dunsappie and St. Margaret's, the last overlooked by the ruins of St. Anthony's chapel. On the Braid hills two golf links have been laid out and there are 140 ac. of playing fields.

Environns—Leith (q.v.), the port of Edinburgh, was incorporated with the city in 1920. Newhaven, so called from the harbour constructed in the reign of James IV, had a shipbuilding yard of some repute in former times. The village has always been a fishing place of importance. To the west lies Granton, where the 5th duke of Buccleuch constructed a fine harbour. Still farther west lies the village of Cramond, at the mouth of the river Almond, where Roman remains have often been found. Lauriston castle is situated in the parish of Cramond. Brig was the scene of one of the "roving" adventures of James V, when the life of the "Gudeman of Ballengeich" was saved by Jack Howieson of the Braehead. Here are Craigcrook castle, where Lord Jeffrey spent many years, and Ravelston house, the home of the Keiths. To the south of the metropolis are Colinton, on the Water of Leith, and Currie, which was a Roman station and near which are Curriehill castle (held by the rebels against Queen Mary), the ruins of Lennox tower, and Riccarton. At Dalmahoy castle, near Ratho (pop. 1,672), the seat of the earl of Morton, are preserved the only extant copy of the Bible of the Scottish parliament and the original warrant for committing Queen Mary to Lochleven castle in Kinross shire. Craigmillar has a picturesque castle, part of which probably dates from the 12th century. Duddingston, once a quiet village, has become a centre of the distilling and brewing industries. Duddingston house was a seat of the duke of Abercorn. Restalrig, between Duddingston and Leith, was the home of the Logans, from whom the superiority of Leith was purchased in 1553 by the queen regent. Sir Robert Logan (d. 1606) was alleged to have been one of the Gowrie conspirators and to have arranged to imprison the king in Fast castle. This charge was made three years after his death, when his bones were exhumed for trial. He was found guilty of high treason and sentence of forfeiture was pronounced. A small chapel adjoining the old church covers the healing well of St. Triduana Liberton, a name that possibly recalls the previous existence of a leper's hospital, is situated on the rising ground south of Edinburgh, the parish church being a conspicuous landmark. Portobello is a popular seaside resort in the city, 3 mi. from the centre. Its beautiful sands are flanked by a promenade extending to Joppa. The town dates from the middle of the 18th century, when a cottage was built by a sailor and named Portobello in commemoration of Admiral Vernon's victory in 1739. The place does a considerable trade in the making of bricks, bottles, earthenware, tiles and paper and a large electric power station was opened in 1923. Joppa, which adjoins it, has salt works, but is chiefly residential. Lasswade, partly in the Pentlands, famous for its oatmeal, was often the summer resort of Edinburgh worthies. Melville castle and Auchendunny are in the neighbourhood. Most famous among the environs of Edinburgh are Rosslyn and Hawthornden. Rosslyn castle, on the beautifully wooded precipitous banks of the Esk, dates from the 12th century. The fine chapel, higher up the bank, founded in 1446 by William St. Clair, 3rd earl of Orkney, is believed to be the chapel of what was intended to be a large church, it suffered at the hands of revolutionary fanatics in 1688. The Gothic details, especially the wreathed "Prentice's pillar," are finely carved. The walk to Hawthornden, about 1½ mi. distant by the river-side, leads to the mansion of the Drummonds, on a lofty cliff falling sheer to the stream. The caverns in the sides of the precipice are said to have afforded Wallace and others refuge in time of trouble, but the old house is most memorable as the home of the poet William Drummond. The Pentland range contains many points of interest and beauty, Habbie's Howe is some 2 mi. from Carlisle, and Rulion Glen is noted as the field on which the Covenanters were defeated in 1666. Penicuik has paper mills and stone quarries.

ADMINISTRATION AND EDUCATION

Communications—Both LMSR (Princes St station) and LNER (Waverley station) serve Edinburgh. Besides Leith, Granton and Grangemouth serve as passenger seaports for Edinburgh. Tramways connect all parts of the city, including Leith, Newhaven, Portobello and Joppa, and a suburban railway, starting from Waverley station, returns by way of Restalrig, Portobello, Duddingston, Newington, Morningside and Haymarket. In summer, steamers ply between Leith and Aberdeen and other pleasure resorts, and there is also a service to Alloa and Stirling.

Population—In 1801 the number of inhabitants was 67,288, in 1881 it was 228,357, in 1931 the figure was 439,010, and was estimated in 1938 at 469,448. The area is 50.6 sq mi, having been enlarged by successive extensions. In 1896 portions of the parishes of Liberton and Duddingston and the police burgh of Portobello were incorporated and in 1900 a further addition was made including Granton, Restalrig, and parts of South Leith and Duddingston. In 1920 Leith and the parishes of Corstorphine, Craigmond, Liberton and Colinton, including many villages to the south and west of the city, were incorporated with it.

Government—By the Redistribution act of 1918 the city with Musselburgh, was divided for parliamentary purposes into five divisions, each returning one member. Leith also returns a member. The town council, which has its headquarters in the Municipal buildings in the Royal Exchange, consists of 70 members, a lord provost, 10 bailies, a dean of guild, a treasurer, a convener of trades, 10 judges of police, 9 of whom are councillors, and 46 other councillors. The corporation has acquired the gas-works, the transport undertakings, the electric lighting of the streets, and the water supply from the Pentlands.

May Meetings—During the establishment of Episcopacy in Scotland, Edinburgh was the seat of a bishop, and the collegiate church of St. Giles became a cathedral. But the annual meeting of the General Assembly of the Church of Scotland at Edinburgh is now the public manifestation of the predominance of Presbyterianism as the national church. In May each year the sovereign appoints a representative as lord high commissioner to the General Assembly of the Established Church, who takes up his abode usually in the palace of Holyrood, and thence proceeds to the High Church, and so to the assembly hall on the Castle Hill when the lord provost and magistrates offer to him the keys of the city. The General Assembly of the United Free Church is usually held at the same time.

University—Edinburgh university, the youngest of the Scottish universities, was founded in 1583 by a royal charter, dated 1582, granted by James VI. In 1621 an act of the Scottish parliament accorded to the university all rights and privileges enjoyed by other universities in the kingdom, and these were renewed under fresh guarantees in the treaty of union between England and Scotland, and in the Act of Security. Important changes were made in the constitution by acts passed in 1858 and 1889. In the latter year, women were admitted to graduation and in 1916 three hostels for women were built. The students numbered 3,407 in 1942-43. As a corporation it consists of a chancellor, vice-chancellor, lord rector (elected by the students every three years), principal, professors, registered graduates and matriculated students. With St. Andrews, Glasgow and Aberdeen it sends three members to parliament. While the college, as such, bears the name of the College of King James, or King's college, and James VI is spoken of as its founder, it really originated in the liberality of the citizens of Edinburgh. William Little of Craigmillar, and his brother Clement Little, advocate, along with James Lawson, the colleague and successor of John Knox, may justly be regarded as true founders. In 1580 Clement Little gave all his books, three hundred volumes, for the beginning of a library, and this was augmented by other valuable benefactions, one of the most interesting of which was the library of Drummond of Hawthornden. The older buildings of the university occupy the site of the ancient collegiate church of St. Mary in the Fields (the "Kirk o' Field"), the scene of the murder of Darnley. The present Old college, designed by Robert Adam, dates from 1789. The Royal Scottish museum is structurally united to the univer-

sity and Minto House college and Heriot-Watt college are practically adjuncts of the university. The medical school stands in Teviot row, adjoining George square and the Meadows. The magnificent McEwan hall is used for academic and public functions. Closely associated with the medical school, and separated from it by the Middle Meadow Walk, is the Royal infirmary, designed by David Bryce, R.S.A. (1803-1876), removed from Infirmary street. Its wards are lodged in a series of turret pavilions, and cover a large space of ground on the margin of the Meadows, from which, to make room for it, George Watson's college—the most important of the Merchant Company schools—was removed to a site farther west, while the Sick Children's hospital was moved to the southern side of the Meadows. George Watson's college was moved again (to Colinton road) in 1932 to make room for a further large extension, a maternity wing, to the Royal infirmary. This hospital is one of the largest in Great Britain. After 1930 chairs of psychology, geography and child life and health were established, also five chairs in the faculty of divinity and a chair of organization of industry and commerce. In 1919 the university acquired 115 ac of land at Liberton, and the new King's buildings of the university, containing chemical laboratories, etc., were opened at West Mains in 1924, and the department of animal genetics. In the same colony new laboratories for engineering and geology were opened in 1932. Considerable improvements were subsequently carried out in the Old college.

Scientific Institutions—The old observatory, on Calton Hill, overlooks the district at the head of Leith Walk. The City observatory stands close by, and on Blackford Hill is the newer building of the Royal observatory. The museum and lecture-rooms of the Royal College of Surgeons occupy a classical building in Nicolson street. The college is an ancient corporate body, with a charter of the year 1505, and exercises the powers of instructing in surgery and of giving degrees. Its extra-academic courses are recognized, under certain restrictions, by the University Court, as qualifying for the degree of doctor of medicine. The Royal College of Physicians is another learned body organized, with special privileges, by a charter of incorporation granted by Charles II in 1681. In their hall in Queen street are a valuable library and a museum of materia medica. But the college as such takes no part in the educational work of the university.

Other Educational Institutions—After the Disruption in 1843, and the formation of the Free Church, New college was founded in connection with it for training students in theology. After the amalgamation of the United Presbyterian and the Free Churches, under the designation of the United Free Church of Scotland, New college was utilized by both bodies. The Royal high school, the burgh school *par excellence*, is an ancient foundation, and the Grecian buildings (1829) on the south of Calton Hill, are its third habitation. Edinburgh academy was opened in 1825. Fettes college and Merchiston Castle school are organized on the model of the great English public schools. For many generations the charitable foundations for the teaching and training of youth were a conspicuous feature in the economy of the city. Foremost among them was the hospital founded for the maintenance and teaching of poor fatherless sons of freemen by George Heriot—the "Jingling Goardie" of Scott's *Fortunes of Nigel*—the goldsmith and hanker of James VI. The quadrangular building in Lauriston, sometimes ascribed to Inigo Jones, is one of the noblest in the city. Even earlier than Heriot's hospital was the Merchant Maiden hospital, founded in 1605, which gave to the daughters of merchants similar advantages to those which Heriot's secured for burghesses' sons. In 1738 George Watson's hospital for boys was founded, then followed the Trades' Maiden hospital for burghesses' daughters, John Watson's, Daniel Stewart's, the Orphans', Gillespie's, Donaldson's hospitals, and other institutions founded by successful merchants of the city, in which poor children of various classes were lodged, boarded and educated. The Merchant Maiden, George Watson and Daniel Stewart hospitals were converted to day schools in 1870 and called colleges, the name of the first being changed to Edinburgh Ladies' college. In 1871 a fourth school was opened under the name George Watson's Ladies' college. All four are administered by the Edinburgh

Merchant company education board. As the New Town expanded, the Heriot Trust—whose revenues were greatly benefited thereby—erected day schools in different districts, in which children received a free education, and, in cases of extreme poverty, a money grant towards maintenance. Public opinion as to the "hospital" system of board and education, however, underwent a revolutionary change after the Education act of 1872 introduced school boards. The governing body was reconstituted in 1885, and the income of the trust was applied for the upkeep of a day school at Heriot's hospital, and of the Heriot Watt college as a technical school, and for the provision of scholarships here and elsewhere. The college is affiliated to the university. The Church of Scotland has a training college, there is a large training college for teachers in Holyrood road, and a Roman Catholic college (1920) in Colinton road.

Besides the Royal infirmary there are a considerable number of more or less specialized institutions, two of the most important being situated at Craiglockhart. Thro' Trinity hospital, the oldest charity in the city, no longer exists as a hospital with resident pensioners, the trustees disburse annually pensions to certain poor burghesses and their wives and children, and the trust controlling the benevolent branch of the Gillespie hospital endowment is similarly administered.

Industries.—Edinburgh is residential rather than manufacturing or commercial, but from 1507, when Walter Chapman set up the first press, to the present day, printing has enjoyed a career of almost continuous vitality. Publishing, on the other hand, has drifted away, only a few leading houses—such as those of Blackwood, Chambers and Nelson—still making the city their headquarters. Mapmakers, typefounders, bookbinders and lithographers all contribute their share to the prosperity of the city. Brewing is a strong industry, Edinburgh ale being proverbially good. The manufactures of paper machinery, gas and water meters, iron and wire fencing, indiarubber goods, etc., are important, and mention can be made of biscuit and confectionery making, whisky blending and the arts and crafts associated with furniture work. Stone quarrying is carried on, but the vast quarry at Craigleith, from which the stone for much of the New Town was obtained, was abandoned. Owing to the great changes effected during the latter part of the 19th century, some of the old markets were demolished and the system of centralizing trade was not wholly revived. The Waverley market deals in vegetables and fruit and is used for meetings and concerts. Slaughter-houses, cattle markets and grain markets were opened at Gorgie in 1910, thus obviating the driving of flocks and herds through the streets.

HISTORY

A fort or camp set up on the rock on which Edinburgh castle now stands was probably the nucleus around which, in prehistoric time, grew a considerable village. Under the protection of the hill fort, a settlement was established on the ridge running down to the valley at the foot of Salisbury Crags, and another hamlet, according to William Maitland (1693-1757), the earliest historian of Edinburgh, was founded in the area at the north-western base of the rock, a district that afterwards became the parish of St. Cuthbert, the oldest in the city. The Romans occupied the country for more than three hundred years. When they withdrew, the British tribes reasserted their sway. The southern Picts ultimately subdued the Britons, and the castle became their chief stronghold until they were overthrown in 617 (or 629) by the Saxons under Edwin, king of Northumbria from whom the name of Edinburgh is derived. Simeon of Durham (854) calls it *Edin-burgh*, and includes the church of St. Cuthbert within the bishopric of Lindisfarne. Its Gaelic name was *Dunedin*. In the 16th century the latinized form *Edina* was invented. Long after Edwin's conquest the lowland continued to be a debatable territory held by uncertain tenure but at length it was to a large extent settled anew by Anglo-Saxon and Norman colonists under Malcolm Canmore and his sons.

In the reign of Malcolm Canmore the castle included the king's palace. There his queen, Margaret, grandmother of Edward the Confessor, died in 1093. It continued to be a royal residence dur-

ing the reigns of her three sons, and hence the first rapid growth of the upper town may be referred to the 12th century. The parish church of St. Giles is believed to have been founded in the reign of Alexander I. about 1110, and the Norman keep of the castle, built by his younger brother, David I., continued to be known as David's Tower till its destruction in the siege of 1572. Soon after his accession to the Scottish throne David I. founded the abbey of Holyrood (1128), which from an early date received the court as its guests. But the royal palace continued for centuries to be within the fortress, and there both the Celtic and Stuart kings frequently resided. Edinburgh was long an exposed frontier town within a territory only ceded to Malcolm II. about 1020, and even under the earlier Stuart kings it was still regarded as a border stronghold. Hence, though the village of Canongate grew up beside the abbey of David I., and Edinburgh was a place of sufficient importance to be reckoned one of the four principal burghs as a judicatory for all commercial matters, nevertheless, even so late as 1450, when it became for the first time a walled town, it did not extend beyond the upper part of the ridge which slopes eastwards from the castle. So long, however, as its walls formed the boundary, and space therefore was limited, the citizens had to provide house-room by building dwellings of many stories. These tall tenements on both sides of what is now High Street and Canongate are still prominent in the Old Town. The streets were mostly very narrow, the main street from the castle to Holyrood palace and the Cowgate alone permitting the passage of wheeled carriages. In the narrow "wynds" the nobility and gentry paid their visits in sedan chairs.

The other three royal burghs associated with Edinburgh were Stirling, Roxburgh and Berwick, and their enactments form the earliest existing collected body of Scots law. The determination of Edinburgh as the national capital, and as the most frequent scene of parliamentary assemblies, dates from the death of James I. in 1436. Of the 13 parliaments summoned by that sovereign, only one, the last, was held at Edinburgh, but his assassination in the Blackfriars' monastery at Perth led to the transfer of the court and capital from the Tay to the Forth. The coronation of James II. was celebrated in Holyrood abbey instead of at Scone, and the widowed queen took up her residence, with the young king, in the castle. Notwithstanding the favour shown for Stirling as a royal residence in the following reign, every one of the parliaments of James III. was held at Edinburgh. James II. conferred on the city various privileges relating to the holding of fairs and markets, and the levying of customs, and by a royal charter of 1452 he gave it pre-eminence over the other burghs. Further immunities and privileges were granted by James III., and by a precept of 1482, known as the Golden Charter, he bestowed on the provost and magistrates the hereditary office of sheriff, with power to hold courts, to levy fines, and to impose duties on all merchandise landed at the port of Leith. Those privileges were renewed and extended by various sovereigns, and especially by a general charter granted by James VI. in 1603.

James III. was a great builder, and, in the prosperous era which followed his son's accession to the throne, the town reached the open valley to the south, with the Cowgate as its chief thoroughfare. After Flodden the citizens hastened to construct a second line of wall, enclosing the Cowgate and the heights beyond, since occupied by Greyfriars church and Heriot's hospital, but still excluding the Canongate, as pertaining to the abbey of Holyrood. In the 16th century the movements connected with John Knox and Mary, queen of Scots, caused much activity at Edinburgh castle. With the departure, however, of the sixth James to fill the English throne in 1603 the town lost its pre-eminence for a long period. Matters were not bettered by the Act of Union signed in a cellar in High Street in 1707 amidst the execrations of the people and it was not till the hopes of the Jacobites were blasted at Culloden (1746) that the townsfolk began to accept the inevitable. This epoch, when grass grew even in the High Street, long lingered in the popular memory as the "dark age."

By the accession of George III. (1760) Edinburgh showed signs of revived enterprise. In 1763 the first North bridge, connecting the Old Town with the sloping ground on which afterwards stood

the Register house and the theatre in Shakespere square, was opened, a little later the Nor' Loch was partially drained, and the bridging of the Cowgate in 1785 encouraged expansion southwards. Toward the end of the 18th century the New Town began to take shape on the grand, if formal, lines planned by James Craig (d 1795) and the erection of Regent bridge in Waterloo place (1819) gave access to Calton hill. The creation of Princes street led to further improvement. The earth and debris from the excavation of the sites for the houses in this and adjoining streets had been "dumped" in the centre of the drained Nor' Loch. This unsightly mass of rubbish lay for a while as an eyesore, until it was converted into a broad way joining the new road at Hanover street with the Old Town at the Lawnmarket. Upon this street, which received the title of the Mound, were erected the National gallery and the Royal Institution.

Speaking generally, the New Town was resorted to by professional men—lawyers, doctors and artists—and in its principal streets are found the head offices of the leading banks and insurance offices. Expansion of the city has been southward—from Liberton, and south from Morningside to the Braid hills and the lower slopes of the Pentlands. In addition, much slum clearance and rehousing were carried out and many historic buildings were cleaned and restored.

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EDINBURGSHIRE see MIDLOTHIAN

EDISON, THOMAS ALVA (1847-1931), U.S. inventor, born at Milan, O., Feb. 11, 1847, of Dutch ancestry on his father's side and Scottish on his mother's.

Edison's education was limited to three months in the public school of Port Huron, Mich. At 12 he became a railroad newsboy and after 15 earned his living as a telegraph operator in various cities, always studying and experimenting in his spare time. In 1868 he took out his first patent for an electrical vote recorder. During the next few years he devised stock tickers, duplex, quadruplex and automatic telegraph systems and the electric pen, which developed into the mimeograph, for the multiplication of typewriting. His invention (1877-78) of the carbon transmitter, in which compressed lamp-black buttons were used to obtain the necessary variable resistance in the circuit, marked a real advance in the art of telephony and aided materially in bringing the Bell telephone into practical use.

Most modern inventions result from the contributions of many minds, and it is often difficult for the courts to determine priority, but when Edison made application in 1877 for a "phonograph or speaking machine," the U.S. patent office could discover no previous record of his sort. The original model, costing \$18, was a cylinder covered with tinfoil and turned with a hand crank. Ten years afterward he developed a motor-driven machine with cylindrical wax records which speedily became popular. Later he invented a disk form reproducing with a diamond point for music, and the "Ediphone" for office dicta-

at Orange, N.J., Edison had been necessarily engaged in various forms of invention for more than 60 years and had taken out 1,033 patents up to April 1918. He died Oct. 18, 1931.

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EDMONTON, a municipal and parliamentary borough of Middlesex, Eng., $7\frac{1}{2}$ mi N of London bridge, with four stations on the Eastern Region railway system. Pop. (1951) 104,214. Area 6.09 sq. mi. Edmonton, consisting of Upper and Lower Edmonton, lies along the Old North road between Tottenham and Enfield, with the river Lea for its eastern boundary. It has grown very rapidly as an industrial area because of its numerous factories, including gas meter and gas stove works. Market gardening is also carried on there. The Church of All Saints, extensively restored, retains Perpendicular and earlier portions and some brasses of interest, in the churchyard is the memorial of Charles Lamb, who lived and died (1834) at Edmonton, and his sister, William Cowper and John Keats were also residents, and the Bell Inn is famed through Cowper's poem *John Gilpin*. Open spaces in Edmonton include Pymmes park (53 ac) and others. Among buildings are the town hall and public libraries, a technical institute (1912-13), Latimer's school (1924) and the county school (1911). Edmonton was incorporated in 1937 and returns one member to parliament.

have their counterpart in the line to Grande Prairie and the Peace river settlements, and that to the navigable Athabasca river at Ft. McMurray. Precipitation is heavier at Edmonton than in southern Alberta, and it is the centre of an important mixed farming area, extending as far north as the Peace river country. Both the provincial parliament buildings and the University of Alberta are situated there, the latter including departments in arts, agriculture, medicine and mining. The city is the centre of an important coal mining district but for domestic use the prevalent fuel is natural gas supplied from the immense deposits in the Viking, Kinsella and Fabian fields to the east. With the rapid increase in the city's population, and that of its vast hinterland, manufacturing developed to a marked degree, particularly in packing plants, which reached the largest output of any city in Canada.

Adjacent to Edmonton on the Athabasca river at Ft. McMurray are large tar sand deposits. Industries include milling, lumbering, furniture and bedding, men's and women's garments, egg powdering plant, cereals and biscuits, oil refining. It is a large distributing centre both for the surrounding agricultural area and the extensive mining developments to the north, where the range of ore discoveries is remarkable, including precious metals and radium. The mid 20th century discoveries of oil in near-by areas, in quantities rivaling Turner valley, created a great boom. Several railways radiate from this city, and two transcontinental lines, together with lines serving the north country, including the Alaska highway. The city owns all its utilities including the production and distribution of electricity, waterworks, street railway and telephone systems. Edmonton with its strategic location on the great coast route to the orient has long been to the forefront in the matter of aviation, and was the first city in Canada to establish a municipal airport. Flights operate daily in every direction, including Alaska, Northwest Territories, transcontinental and the U.S. With the advent of World War II and the completion of the Alaska highway and other large northern projects, air traffic stepped up greatly.

EDMUND, SAINT [EDMUND RICHY? (c. 1175-1240), English saint and archbishop of Canterbury, was born at Abingdon, near Oxford. His father was a merchant who retired, with his wife's

consent, to the monastery of Eynsham, leaving in her hands the education of their family. Edmund began his education in a grammar school at Oxford, and at the age of twelve took a vow of perpetual chastity in the Virgin's church at Oxford. After graduating at Paris, for six years he lectured in the liberal arts, partly in Paris and partly in Oxford where he was the first to lecture on Aristotle. He then returned to Paris for his theological studies. He again lectured at Oxford on theology until c. 1222 when he accepted the treasurership of Salisbury cathedral. Little is known of his life for the next ten years. But he attracted the notice of the Roman court, and was appointed in 1227 to preach the crusade in England.

In 1233 he was elected archbishop of Canterbury at the express suggestion of Gregory IX, after the monks of Canterbury had in vain suggested three other candidates for the pope's approval. Edmund at once leaped into prominence by the outspoken manner in which he rebuked the king for following the advice of foreign favourites. In common with the baronial opposition he treated Henry III as responsible for the tragic fate of Richard Marshal, earl of Pembroke, and threatened the king with excommunication. The king bowed before the storm, dismissed the foreign counselors, made peace with Marshal's adherents, and was publicly reconciled with the barons. But it was with the object of emancipating himself from Edmund's control that the king asked the pope to send him a legate (1236). On the arrival of Cardinal Otho (1237) the archbishop found himself thwarted at every point. The marriage between Simon de Montfort and the Princess Eleanor, which Edmund had pronounced invalid, was ratified at Rome upon appeal. The king and legate upheld the monks of Canterbury in their opposition to the archbishop's authority. On all public occasions the legate took precedence of the archbishop. By the advice of his suffragans Edmund laid a protest before the king, and excommunicated in general terms all who had infringed the liberties of Canterbury. These measures led to no result, and after the papal encroachments of 1240, when the English clergy were required to pay a subsidy of a fifth for the war against Frederick II, and simultaneously three hundred Romans were "provided" with English benefices in return for their political services to the Holy See, Edmund withdrew to Pontigny. The state of his health drove him later to Souisy (near Provins), where he died on Nov. 16, 1240.

His canonization was at once demanded by his admirers, and only delayed (till 1247) through the opposition of Henry III. Edmund is one of the most saintly and attractive figures of the English church. As archbishop he showed no great capacity, but the purity of his motives and the loftiness of his ideals commanded universal respect. It was his misfortune to be placed at the head of the national hierarchy in a crisis for which he had not been prepared by practical experience.

Edmund's *Le Merue de Sainte Eglise* was last edited by H. W. Robbins (Leipzig, 1925). See the life printed by Martene and Durand in the *Thesaurus novus anecdotorum* (1717). Other lives exist in ms. at the Brit. Museum, in Cambridge univ. library and in that of St. John's college, Cambridge. The last named is printed by W. Wallace in his *Life of St. Edmund* (1893). See also B. Ward, *St. Edmund* (1903), Baroness Paravicini, *St. Edmund of Abingdon* (1898), and the *Eng. Hist. Review*, xxx.

EDMUND, king of East Angles (c. 840-870), succeeded to the East Anglian throne in 855 while yet a boy. According to tradition he was born at Nuremberg, and was the son of King Alkmund and Queen Scilvare. Offa, king of the East Angles, visited Alkmund on his way to the Holy Land, and adopted Edmund as his heir. Edmund succeeded him in 855, landing at Hunstanton. His coronation took place in the next year at "Burna" (i.e., probably Bures St. Mary, Suffolk), which was then the royal capital.

Of the life of St. Edmund during the next 14 years we know nothing. In 870 the Danes, who had been wintering at York, marched through Mercia into East Angles and took up their quarters at Thetford. Edmund engaged them fiercely in battle at Hrome, but the Danes under their leaders, Ubba and Ingvar, were victorious. The king himself was slain, whether on the actual field of battle or in later martyrdom is not certain, but

the version of the story which makes him fall a martyr to the Danish arrows when he had refused to renounce his faith or hold his kingdom as a vassal from the heathen overlords, may be true. The king's body was ultimately interred at Beadonnesworth, the modern Bury St. Edmunds. The shrine of Edmund soon became one of the most famous in England, and the reputation of the saint was European. The date of his canonization is unknown, but churches dedicated to his memory are found all over England.

See *Aver's Life of Alfred* ed. W. H. Stevenson, *Annals of St. Neots*, *Saxon Chronicle*, *Memorials of St. Edmund's Abbey* (Rolls Series), including the *Passio Sancti Edmundi* of Pbilio of Fleury, and the *Corolla Sancti Edmundi*, ed. Lord Francis Hervey (1907).

EDMUND I, king of the English (d. 946), was the son of Eadigifu, third wife of Edward the Elder, and half brother to his predecessor Aethelstan. He succeeded to the throne in 940, but had already played an active part in the previous reign, and fought with Aethelstan in the great battle of Brunanburh.

In the first year of Edmund's reign Olaf or Anlaf Sihtricsson, called Cuaran, who had crossed from Ireland, had been chosen king by the Northumbrians. Anlaf took York, besieged Northampton and destroyed Tamworth, but was met by Edmund at Leicester. A peaceful settlement was made by the good offices of Odo of Canterbury and Wulfstan of York. Simeon of Durham's statement that the kingdom was now divided between Anlaf and Edmund and his story of the reconquest of Northern Mercia by Edmund probably refer to the compact with Anlaf, made as a result of the campaign. All Mercia south of a line from Dore (near Sheffield), through Whitwell to the Humber, was now in Edmund's hands, and the five Danish boroughs, which had for some time been exposed to raids from the Norwegian kings of Northumbria, were now freed from that fear. The peace was confirmed by the baptism of King Anlaf and Raegenald, Edmund standing as sponsor, but in 944 or 945 the peace was broken and Edmund expelled Anlaf and Raegenald from Northumbria.

In 945 Edmund ravaged Strathclyde, and entrusted it to Malcolm, king of Scotland, "on condition that he should be his fellow worker by sea and land," the object of this policy being apparently to detach the king of Scots from any possible confederacy such as had been formed in 937.

On May 26, 946, Edmund's brief but energetic reign came to a tragic conclusion when he was stabbed at the royal villa of Pucklechurch, in Gloucestershire, by an exiled robber named Liofa. Edmund, the "deed doer" as the chronicle calls him, "Edmundus magnificus" as Florence of Worcester describes him, perhaps translating the Saxon epithet, was buried at Glastonbury, an abbey which he had entrusted in 943 to the famous Dunstan.

Edmund was twice married, first to Aelfgifu, the mother of Eadwig and Edgar, secondly to Aethelflaed "aet Damertrane" (i.e., of Damerham, Co. Wilts). Aelfgifu died in 944, according to Ethelwerd.

See *The Anglo-Saxon Chronicle* (ed. Plummer, 1892-99), *Simeon of Durham* (Rolls Series), *A. S. Laws*, ed. Liebermann, pp. 184-191, *Burch, Carolingian Saxonism*, Nos. 745-817, *Dictionary of National Biography*, v.

EDMUND or EADMUND (c. 980-1016), called IRONSIDE, king of the English, was the son of Aethelred II (the Unready) by his wife Emma, or Aelfgifu. When Canute invaded England in 1015, Edmund was betrayed and deserted by the caldormar, Edric, who went over to Canute, and Wessex submitted to the Danish king. Next year Canute and Edric together harried Mercia, while Edmund with infinite difficulty gathered an army. His attack on the invaded districts of Northumbria was brought to an end by Canute's northward march, and he was forced to return to London. The death of Aethelred on April 23, 1016, was followed by a double election to the English crown. The citizens of London chose Edmund, the rest of the Witan meeting at Southampton elected Canute. In the warfare which ensued Edmund fought at the severest disadvantage, for his armies, dispersed after every engagement, Canute besieged London, but the citizens successfully resisted all attacks. Edmund meanwhile received the submission of Wessex. At Pen in Somersetshire he engaged the Danes and defeated them. Canute now raised the siege of London and,

after being defeated by Edmund at Pen, came into conflict with him again at Sberston in Wiltshire. The battle was indecisive, but Canute left Edmund in possession of Wessex. Edmund hastened after him and relieved London, which Canute was besieging. He defeated the Danes at Brentford and at Otford, and drove them into Sheppey. He was now joined by Edric, with whom he followed the Danes into Essex, overtaking them at Assandun (or Ashington). In the battle which ensued Edric again played the traitor, and the English were routed. Edmund retired into Gloucestershire, whether he was followed by Canute. Edric and the Witan then persuaded Edmund to accept a reconciliation, which took place at Olney. The kingdom was divided—Canute taking the north, Edmund the south. Soon afterwards Edmund died (Nov. 30, 1016), probably from natural causes, though later historians hint at foul play.

EDMUND (CROUCHBACK), king of Sicily and earl of Lancaster (1245-96), was the second son of Henry III of England by Eleanor of Provence. At ten years of age Edmund was invested by Pope Alexander IV with the kingdom of Sicily (April 1255), the pecuniary obligations which Henry III undertook on his son's behalf were among the causes which led to the Provisions of Oxford and the Barons' War. Alexander annulled his grant in 1258, but still pressed Henry for the discharge of unpaid arrears of subsidies. In 1265, after Montfort's fall, Edmund received the earldom of Lancaster, and two years later was created earl of Lancaster. He joined the crusade of his elder brother, the Lord Edward (1271-72), and supported him on his accession. In 1275, two years after the death of his first wife, Aveline de Foribus, Edmund married Blanche of Artois, the widow of Henry III of Navarre and Champagne. Although the county of Champagne was held by his wife in custody for her infant daughter, Joan, Edmund assumed the title "Count Palatine of Champagne and Brie." This he was compelled to renounce upon the marriage of Joan to Philip the Fair, the heir to the crown of France, but he retained the possession of his wife's dowlands in Champagne. He was employed by his brother as a mediator with Philip the Fair in 1293-94, but allowed himself to be tricked out of possession of the duchy, which Philip's court declared forfeit. He was appointed lieutenant of Gascony in 1296 but died in the same year, leaving a son, Thomas, to succeed him in his English possessions.

See W. E. Rhodes, "Edmund, Earl of Lancaster," *English Historical Review*, vol. 4 (London, 1895).

EDMUNDS, GEORGE FRANKLIN (1828-1919), U.S. lawyer and political leader, was born in Richmond, Va., on Feb. 1, 1828. He began the practice of law in 1849. He was a member of the Vermont house of representatives (1854-59), acting for the last two years as speaker, and was a member and president *pro tem* of the state senate (1861-62). In 1866 he became a member, as a Republican, of the U.S. senate, where he remained until 1891, when he resigned in order to have more time for the practice of his profession. He took an active part in the attempt to impeach Pres. Andrew Johnson. He was influential in establishing the electoral commission to decide the disputed presidential election of 1876, and became one of the commissioners. In the national Republican nominating conventions of 1880 and 1884 he was a candidate for the presidential nomination. From 1884 to 1885 he was president *pro tem* of the senate. As senator he was conspicuous for his cause of his legal and parliamentary attainments, his industry and his liberal opinions. He was the author of the so-called Edmunds act (1882) for the suppression of polygamy in Utah, and of the antitrust law of 1890, popularly known as the Sherman act. He died in Pasadena, Calif., on Feb. 27, 1919.

EDO, a group of African tribes closely related by language and culture, inhabiting a large part of the region to the west of the lower Niger. The Edo dialects are more closely allied to Ewe (especially the Popo dialect) than to the intervening Yoruba. Of the four main Edo speaking tribes—the Urbobo (Sobo) to the south, the Bini in the centre, the Ishan (Esa) to the east and the Kukuru (with numerous subtribes) to the north—the Bini, though numerically the smallest, are by far the most important, and indeed were formerly one of the most powerful of all African tribes, having the only great empire centred in the forest zone (see BENIN). The art, especially the bronzework, of Benin, which was at its apogee before the arrival of the first Portuguese in West Africa, is the most famous and sought after, but neither the most refined nor the most creative, of all African art styles. The ma-

terial culture of the other Edo tribes is little known by comparison. Edo culture, though strongly *animistic*, has adopted many Yoruba traits including some elements in their religion, such as the worship of the sea god *Olukun*, said to have been introduced from Yorubaland in the 14th century.

See H. Lang Roth, *Great Benin* (London, 1903); P. A. Talbot, *The Peoples of Southern Nigeria*, 4 vol. (Oxford, New York, 1926); J. W. Hubbard, *The Soba of the Niger Delta* (Zaria, 1952); Chief J. V. Egharevba, *A Short History of Benin* (Lagos, 1953). (W. B. Fu.)

EDOM (Greek *Idumaea*), the district situated to the south of Palestine, between the Dead sea and the Gulf of 'Akaba, the inhabitants of which were regarded by the Israelites as a "brother" people (see ESAU). On the east it touched Moab, the tribes of the great desert and the northern part of Arabia, on the west its boundaries were determined by the Sinaitic peninsula, Egypt and Israel. Both Kadesh and Mt. Hor (perhaps Jebel Madera) are represented as lying on its border (Num. xv 6, 22), and the modern Wadi el-Tikreh, in which the "Scorpion pass" was probably situated (Judg. 1 36, Num. xxiv 4), may have marked its limits from Jebel Madera northwest toward the southern extremity of the Dead sea. The precise borders, however, must have been determined by political conditions by the relations between Edom and its neighbours, Judah, the Philistine states, Moab and the restless desert tribes with which Edom was always very closely allied.

The early history of Edom is obscure, Egyptian references to it are few and do not give much light regarding the early inhabitants. In the early records of the Pentateuch, the country is often referred to by the name of Seir, the general name for the whole range of mountains on the east side of the Jordan-Araba depression south of the Dead sea. These mountains were occupied by a cave dwelling aboriginal race, the Horites. According to Old Testament tradition, the Edomites were a new race who drove out the Horites from Mt. Seir.

The occupants of Edom during practically the whole period of Biblical history were the Bedouin tribes which claimed descent through Esau from Abraham, and were acknowledged by the Israelites (Deut. xxiii 7) as kin. Among the peculiarities of the Edomites was government by certain officials known as *dukes*, which the English versions translate "dukes." The now naturalized word "sheikhs" would be the exact rendering. In addition to this Bedouin organization there was the curious institution of an elective monarchy. A list of eight kings, who reigned before the Israelite monarchy is preserved in Gen. xxxv. Saul the first king of Israel, conquered Edom (1 Sam. xiv 47), as did David, the second king.

After David's conquest, the Edomite prince Hadad escaped to Egypt, where he remained until the death of David II, as the narrative of Kings xi implies, he became a troublesome adversary to King Solomon, nothing is known of his achievements, and if Solomon's trading-journeys from Ezion-geber were maintained, Edom must have been weak. Edom was under the rule of Jehoshaphat of Judah, who, with Israel held Ezion-geber (1 Kings xxi 47 sqq., 2 Chron. xx 35 sqq.). Some catastrophe befell the fleet, and shortly afterwards Jehoshaphat's son Jehoram had to face a revolt in which Edom and the men of Libnah (the Philistines) were concerned. It was about this period that Israel had conquered Moab, thrusting it farther south towards Edom, and the subsequent success of Moab in throwing off the yoke, and the unsuccessful attempt of Jehoram of Israel to regain the position, may show that Edom was also in alliance with Moab. In the time of Adad-nirari of Assyria (811-783 B.C.) Edom is mentioned as an independent tributary with Beth-Omri (Israel) and Palastu (Philistia). The absence of Judah is noteworthy. Amariah of Judah had gained a signal victory over Edom in the valley of Salt (2 Kings xiv 7), but after his defeat by Jehoshaphat of Israel there is a gap and the situation is obscure. Consequently it is uncertain whether Edom was the vassal of the next great Israelite king, Jeroboam II, or whether the Assyrian evidence for its independent position belongs to this later time. However, Uzziah, a contemporary of Jeroboam II, and one of the most successful of Judean kings, overcame Edom and its natural allies (2 Chron. xxvi 6 sqq.) and at this stage Edomite history becomes more

prominent. It joined the great coalition in which Philistia and Israel were leagued against Assyria, and drove out the Judeans who had been in possession of Elath (2 Kings xvi 6). On the events that followed see *ARAZ*, *HEZKIAH*, *PHILISTINES*. In the middle of the 7th century both Edom and Moab suffered from the restlessness of the desert tribes, and later joined in the attempt made by Zedekiah of Judah to revolt against Nebuchadnezzar (Jer xxvii 3).

Edom in alliance with the tribes along the trade routes (Philistines, Moabites etc.) was responsible for many attacks upon Israel, carrying away prisoners as slaves for Gaza and Tyre (Am i 6 seq. 9). As in ally or vassal Edom was in touch with the wealth of Arabia (Ezek xxvii 16, read "Edom" for "Aram") and Judah and Israel as well as Gaza and Damascus enjoyed the fruits of its commerce. Edomite and allied tribes were famed for their wisdom (Ob 8 Jer xlix 7 seq., Baruch iii 22), and besides the possibility of Arabian influence upon Israelite culture, the influence of Midian and related tribes is certain from the traditions of Moses and of his work (see *JETHRO*, *KENTES*, *MOSES*), and the Edomite district was a traditional home of Yahweh him self (Deut xxviii 2, Judg v 4, Hab iii 3). It should be added however, that the Edomite names and other evidence point to the cult of other gods.

In the last years before the fall of Jerusalem many of the Jews found a refuge in Edom (Jer xl 11), although other traditions throw another light upon the attitude of Edom during these disasters. It is said that Edomites burned the temple after the destruction of Jerusalem (1 Esd iv 45, cf v 50), and naturally the weak state of Palestine invited attacks from the outlying tribes, but the tone of certain late writings implies a preliminary period of, at least, neutrality (cf Deut ii 4 seq., xxii 7 seq., the omission of Edom in xxiii 3, Neh xiii 1, and in Ezra ix 1—contrast 1 Esd viii 69). Edom is execrated for revengeful attacks upon the Jews, and its speedy destruction is foretold, but the passages appear to be later than the disaster of 586 a.c., and may even imply conditions after the restoration (Ob 10 seq., Ezek xxv 12-14, Jer xlix 7, Ps cxxxvii 7, Lam iv 21 seq., v 2 seq.). Eventually the constant westward pressure of the eastern Arabs forced the ancient Edomites across the Jordan Araba depression. With their name they migrated to the south of western Palestine. In 1 Maccabees v 65 they are at Hebron, and this is one of the first indications of the cis Jordanic Idumaea of Josephus and the Talmud. See for the later history, *HEROD*, *Jews*.

Josephus used the name Idumaea as including not only Gobaletis, the original Mt. Seir, but also Amalekites, the land of Amalek, west of this, and Akkrabatine, the ancient Acrababim, S.W. of the Dead Sea. Jerome describes Edom as extending from Beit Jibrin to Petra, and ascribes the cave graves at the former place to cave dwellers like the iborians of Homer. Ptolemy's account presents the last stage in which the name Edom is confined to restricted to the cis Jordanic Idumaea and the old trans Jordanic region is described as *Araby*.

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EDRED (*Æðred*), king of the English (d. 955), was the youngest son of Edward the Elder and his wife Ædifu. He succeeded his brother Edmund in the year 946 and received the formal submission of the Northumbrians and Scots. In the next year Ædred went to Tyn-heli in Yorkshire, where he received from Wulfstan, archbishop of York and the Northumbrian "witan" confirmation of their submission. Shortly after they threw their pledges to the winds and took the Norwegian Eric Bloodaxe, son of Harold Godwinson (Harald Hargrass), as their king. Ædred recklessly ravaged all Northumbria in revenge, burning Ripon during his march. On his return home Ædred's rear-guard was attacked at Casterford, and he once more turned to ravage Northumbria, which was only saved by its abandonment of Eric and by compensation made to Ædred. Archbishop Wulfstan seems to have been a centre of disaffection in the north and in 952 Ædred

caused him to be imprisoned in the castle of "Judunburh" while in the same year the king took revenge for the slaying of Abbot Eadelm, slew many of the citizens of Thetford. After the brief rule of Anlaf Curran in Northumbria, Eric was once more restored probably in 950 only to be expelled again in 953 or 954, when Ædred took the Northumbrian kingdom into his own hands. In the same year Wulfstan was liberated and appointed to the Mercurian bishopric of Dorchester. Ædred died on Nov. 23, 955 at Trome, in Somersetshire and was buried in the old minster at Winchester. During the whole of his life Ædred was troubled by ill health, a fact which may help to explain some of the more passionate acts of violence attributed to him. The king was throughout his life on terms of personal intimacy with St. Dunstan, and his public policy was largely guided by that prelate and by his mother Ædifu. It is not known that Ædred married.

Bibliography.—*The Saxon Chronicle* (ed. Earle and Plummer, 1892), *sub ann.*, *Memorials of St. Dunstan* (Rolls Series, ed. Stubbs), *Florence of Worcester*, Birch, *Cartularium Saxonicum*, vol. iii, Nos 815-834 and 860-931, *D.N.B.* art. *sub voce*. (A.M.)

EDRIC (or **EDRIC**), **STREONA** (d. 1017) ealdorman of the Mercians, was a man of ignoble birth who was advanced to high dignity through the favour of the English king Æthelred II. In 1007 he became ealdorman of the Mercians and in 1009 married Æthelred's daughter Eadgyth. In the struggle between the English and the Danes he appears in the character of an arch traitor. When Æthelred in 1009 proposed a great attack on the Danes, Eadric dissuaded him from carrying it into effect. At the "witan" held in Oxford in 1015 Eadric had Sigerth and Morkere slain by treachery. In the same year Canute invaded England. Eadric, who had joined Edmund Ironside, subsequently quarrelled with him and went over to Canute. After the battle of Otford he returned to Edmund, but only to secure the utter defeat of the national cause by his treachery at the battle of Assandun. After Edmund's death Canute restored to Eadric the earldom of Mercia but in 1017, fearing further treachery, he had him slain.

EDUCATION, ARTICLES ON The history of education from early times is treated in the main article *EDUCATION HISTORY* or

For the subject of curriculum see *SCHOOL* and *CURRICULUM*. For other articles of a general and particular character see *ADULT EDUCATION*, *ATYPICAL CHILDREN*, *BLIND*, *TRAINING* and *WELFARE OF THE*, *CLASSICAL EDUCATION*, *COEDUCATION*, *COMMERCIAL EDUCATION*, *DEAF* and *HARD OF HEARING*, *EDUCATION OF THE*, *ELEMENTARY EDUCATION*, *EXAMINATIONS*, *KINDERGARTEN*, *MENTAL DEFICIENCY*, *MONTESSEORI SYSTEM*, *NURSERY SCHOOLS*, *PHYSICAL EDUCATION*, *POLYTECHNIC*, *SECONDARY EDUCATION*, *TEACHERS*, *TRAINING OF*, *TECHNICAL EDUCATION*, *UNIVERSITIES*, etc. For specialized education, see *AGRICULTURAL EDUCATION*, *JOURNALISM SCHOOLS OF*, *LITERARY EDUCATION*, *MEDICAL EDUCATION*, etc.

EDUCATION, HISTORY OF In ancient Greece the supremacy of the state was generally unquestioned and especially in the earlier times, the good man was identified with the good citizen. The highest life as one of cultured leisure in which the energies were mainly concentrated on the pursuit of knowledge for its own sake. But this life was only for the select few; for the undistinguished many the fulfilment lay in each of the duties of his station, the more or less of the highest culture, the essential preliminary condition was the existence of such a state as would form the most favourable environment for their cultured life. Thus Greek thought was saturated with the conception of life as essentially a set of relations between the individual and the city state of which he formed an integral part. The first aim of education was to train the young citizens. (For the evolution of the school from early times see *SCHOOLS* *ANCIENT*.)

Each state, however, had its special character, and to this character the education given in it had to conform if it were to be an effective instrument for training the citizens. From these fundamental conceptions flowed the demands of Plato and Aristotle that education should be regulated in all its details by the state authority, should be compulsory for all free citizens, and

should be uniform—at any rate in its earlier stages—for all. In the *Republic* and the *Laws*, Plato shows to what extreme lengths theory may go when it neglects to take account of some of the most pertinent facts of life. For the guardian citizens of the ideal state family life and family ties are abolished. Aristotle, indeed did not go to these extreme lengths, he allowed the family to remain, but he seems to have regarded it as likely to affect children more for evil than for good. Neither philosopher, however was at variance with the accepted Greek theory on the subject although the actual practice of Greek states departed and often widely, from this ideal, for, especially in later centuries, the Greek always tended to live his own life. The nearest approach to the theory was found in Sparta, where the end of the state as a military organization was kept steadily in view, and where, after early childhood, the young citizens were trained directly by the state in a kind of barrack life—the boys to become warriors, the girls the mothers of warriors. It was this feature of Spartan education, together with the rude simplicity of life it enforced which attracted Plato, and, to a less extent, Aristotle. In Athens there had of old been state laws insisting on the attendance of the children of the free citizens at school, and in some degree, regulating the schools themselves. But at the time of Plato these had fallen into desuetude, and the state directly concerned itself only with the training of the ephebi (ἐφῆβι) in intellectual and physical pursuits. For children and youths under the ephebic age there was no practical regulation of schools or palaestra by the state. Yet there is no doubt that the education really given was in conformity with Athenian ideals of culture and life, and that it was generally received by the children of free citizens, though of course the sons of the wealthy, then as now, could and did continue their attendance at school to a later age than their poorer brethren. The education of girls was essentially a domestic training. What Plato and Aristotle, with the theorists' love of official systematic regulation, regarded as the greatest defect of Athenian education was in reality its strongest point. In practice, the harmony between individual liberty and social claims was much more nearly attained under a system of free working out of common thoughts and ideals than would have been the case under one of the irremissible imposition from without of a rigid mould.

The instruments of education everywhere found to be in harmony with the Greek conception of life and culture were essentially twofold—music (μουσική), or literary and artistic culture for the mind, and systematic gymnastic (γυμναστική) for the body. Plato, in the *Republic*, shows that the latter, as well as the former, affects the character, and doubtless, though not formulated, this was generally more or less vaguely felt. But Greek gymnastic was really an individual training, and therefore made only indirectly for the aim of cultivating the social bonds of citizenship. The musical training was essentially in the national literature and music of Greece, and this could obviously be carried to very different lengths. The essential purpose throughout was the development of the character of a loyal citizen of Athens. As Athenian culture advanced, increasing attention was paid to intellectual studies, especially in the ephebic age, with a corresponding decrease of attention to merely physical pursuits, hence the complaints of such satirists as Aristophanes of a growing luxury, effeminacy and corruption of youths, complaints apparently based on a comparison of the worst features of the actual present with an idealized and imaginative picture of the virtues of the past. But a disintegrating force was already at work in the educational system of Greece which Plato and Aristotle vainly opposed, this was the rhetorical training of the Sophists. In a democratic city state the orator easily became a demagogue, and oratory was the readiest path to influence and power. Thus oratory opened the way to personal ambition, and young men who were moved by that passion eagerly attended the Sophist schools where their dominant motive was strengthened.

Further, the closer relations between the Greek states, both in nearer and farther Hellas, led naturally to the diminution of differences between civic ideals, and as a consequence, to a more cosmopolitan conception of higher education. This process was completed by the loss of political independence of the city states

under the Macedonian domination. Henceforth, higher education became purely intellectual and its relation to political and social life increasingly remote. The University of Athens was the outcome of a fusion of the private philosophical schools with the state organization for the training of the ephebi, and there were other such centres of higher culture, especially in after years at Alexandria where the contact of Greek thought with the religions and philosophies of Egypt and the east gave birth in time to the more or less mystical philosophies which culminated in Neo-platonism. But at Athens itself education became more and more a mere training in unreal rhetoric, until the dissolution of the university by Justinian (A.D. 529).

Ancient Rome.—Thus when Rome conquered Greece, Greek education with which it came in contact was an education which had largely lost its life-springs. In the earlier centuries of the republic, Roman education was given entirely in family and public life. The father had unlimited power over his son's life and was open to public censure if he failed to train him in the ordinary moral, civic and religious duties. But it is doubtful if there were any schools, and it is certain there was no national literature to furnish an instrument of culture. A Roman boy learned to reverence the gods, to read to bear himself well in manly exercises and to know enough of the laws of his country to regulate his conduct. This last he acquired directly by hearing his father decide the cases of his clients every morning in his hall. The rules of courtesy he learned similarly by accompanying his father to the social gatherings to which he was invited. Thus early Roman education was essentially practical, civic and moral, but its intellectual outlook was extremely narrow.

When a wider culture was imported from Greece, the instrument of education first introduced was Greek literature, much of which was soon translated into Latin. In time the schools of the *grammatici*, teaching grammar and literature, were supplemented by schools of rhetoric and philosophy, though the philosophy taught in them was itself little more than rhetorical declamation. These furnished the means of higher culture for those youths who did not study at Alexandria or Athens, and were also preparatory to studies at those universities. Under the empire the rhetorical schools were gradually organized into a state system. This widening of culture affected both boys and girls, the domestic education of the latter being supplemented by a study of literature. But it is the higher training in rhetoric which is especially characteristic of Hellenized Roman education.

The conception of a rhetorical culture is seen at its best in Quintilian's *Institutio oratoria*, the most systematic treatise on education produced by the ancient world. With Quintilian the ideal of an orator was a widely cultured, wise and honourable man. And at first the teaching of rhetoric undoubtedly made for higher and true culture. But with the autocracy, soon passing into tyranny, of the empire, rhetoric ceased to be a preparation for real life. Nor was there anything in the general conditions of society to counterbalance the ill effects of such an unreal education. Quintilian lamented that, even in his time, the old Roman family education by example was corrupted, and the moral degradation of later times, though it has doubtless been exaggerated, was certainly real and widespread. The religious revival of paganism which synchronized with the early centuries of Christianity does not appear to have effected any reform in life. Alexandria, the birthplace of Neoplatonism and the intellectual centre of the later empire, was also a very sink of moral obliquity.

Christianity and Pagan Education.—It was into such a decaying civilization that Christianity brought new life. Of course, careful instruction in the Faith was given in catechetical schools, of which that at Alexandria was the most famous. But the question of the attitude of Christians toward the ordinary classical culture became of growing importance. The Greek fathers, especially Clement of Alexandria (150–217) and Origen (185–253), regarded Christianity as essentially the culmination of philosophy, to which the way must be found through liberal culture. Without a liberal education the Christian could live a life of faith and obedience but could not attain an intellectual understanding of the mysteries of the Faith. On the other hand,

Therullian (160-240) was very suspicious of pagan culture, though he granted the necessity of employing it as a means of education yet he did so with regret. Many of the cultivated Christians of the 3rd and 4th centuries were little more than nominal adherents to the Faith, and the intercourse between Christian and pagan was often close and friendly. The general attitude of Christians toward the traditional education is evidenced by the protest raised against the edict of Julian, which forbade them to teach in the public schools. The ultimate outcome seems to be fairly expressed in the writings of St. Augustine (354-430) and St. Jerome (346-420), who held that literary and rhetorical culture is good so long as it is kept subservient to the Christian life.

In another way Greek philosophy exercised a formative influence over the culture of future ages, in the case of the Eastern Church through Neoplatonism, the last effort of paganism to attain a conception of life and of God. In the west, this formulation had to be translated into Latin, for Greek was no longer generally understood in Italy, and thus the juristic trend of Roman thought also became a factor in the exposition of Christian doctrine. This formulation of the Faith was one of the chief legacies the transition centuries passed on to the middle ages. Had classical culture been less formal than it was during the early centuries of Christianity the innate antagonism of the pagan and Christian views of life and character must have been so apparent that the education which prepared for the one could not have been accepted by the other. Thus the pagan ideal of life, especially as it had been developed in the individualistic ethics which had prevailed for more than six centuries as antithetical in essence to that of the Christian Church. The former was essentially an ethics of self reliance and self-control showing itself in moderation and proportion in all expressions of life. An essential feature in such a character was high-mindedness and a self respect which was of the nature of pride. On the contrary, Christian teaching exalted humility as one of the highest virtues, and regarded pride and self-confidence as the deadness of sins. The highest state attainable by man was absorption in loving ecstasy in the mystic contemplation of God. The practical attempt to realize this gave rise to monasticism, with its minutely regulated life expressing unlimited obedience and the renunciation of private will at every moment. The monastic life was regarded as the nearest approach to the ideal which a Christian could make on earth. Naturally, as this conception gathered strength in generations nurtured in it, the value of classical culture became less and less apparent, and by the time of St. Gregory the Great (d. 604) the use of classical literature as a means of education was discouraged.

Of course, during these centuries, the gradual subjugation of the western empire by the barbarians had been powerfully operative in the obscuring of culture. Most of the public schools disappeared, and such light of learning as was kept burning in the monasteries was mainly confined to monks and novices. Though the barbarians absorbed the old culture in various degrees of impenetration, yet the four centuries following the death of Augustine were plunged in intellectual darkness, relieved by transitory gleams of light in Britain and by a more enduring flame in Ireland. The utmost that could be done was to preserve to some extent the heritage of the past. This, indeed, was essentially the work of men such as Boethius, Cassiodorus, Isidore and Bede.

Modification of Latin.—During these same centuries another process had been advancing with accelerating steps. This was the modification of the Latin language. Thus with Christian civilization the modification of the past gradually gave way to the evolution of a new and living Latin which showed itself more and more regardless of classical models. The Christian Latin was a real living instrument of expression, which conformed closely in its structure to the mode of thought and expression of actual life. It is the Latin in which St. Jerome wrote the Vulgate. But with the obscuring of culture during the barbarian invasions this current Latin became more and more oblivious of every such element of form as grammatical inflections and concord.

It was to the reformation of this corrupt Latin by a return to classical models and to the more general spread of culture, especially among clergy and nobles, that the Carolingian revival addressed itself. The movement, essentially practical and conservative, was directed by Alcuin (735-804), who was Charlemagne's educational adviser and chief executive officer in scholastic matters. Its most valuable outcome was the establishment of the palace school, and of bishops' schools and monastic schools throughout the empire. Thus, the educational system north of the Alps was pre-eminently ecclesiastical in its organization and profoundly religious in its aims. For two centuries the new intellectual life was obscured by the troubled times which followed the death of Charlemagne, but the learning which the Carolingian revival had restored was preserved here and there in cathedral and monastic schools, and the sequence of well educated ecclesiastics was never altogether interrupted.

Medieval Curriculum.—The scope of that learning was comprised within the seven liberal arts and philosophy, on the secular side, together with some dogmatic instruction in the doctrines of the church, the early fathers, and the Scriptures. Theology was as yet not organized into a philosophical system that was the great work the middle ages had to perform. The seven liberal arts (divided into the *Trivium*—grammar, dialectic, rhetoric, and the more advanced *Quadrivium*—geometry, arithmetic, music, astronomy) were a legacy from old Roman education through the transition centuries. They appear in the *Disciplinarum libri IX* of Varro in the 2nd century B.C. But they reached the middle ages chiefly through the summaries of writers in the transition centuries, of which the best known were the *De nuptiis Philologiae et Mercurii* of the Neoplatonist Martianus Capella, who wrote probably early in the 5th century, the *De artibus ac disciplinis liberalium litterarum* of the Christian Cassiodorus (c. 490-c. 585), and the *Etymologiarum libri XX* of St. Isidore of Seville (570-636).

The scope of the arts was wider than their names would suggest in modern times. Under grammar was included the study of the content and form of literature, and in practice the teaching varied from a liberal literary culture to a dry and perfunctory study of just enough grammar to give some facility in the use of Latin. Dialectic was mainly formal logic. Rhetoric covered the study of law, as well as composition in prose and verse. Geometry was rather what is now understood by geography and natural history, together with the medicinal properties of plants. Arithmetic, with the cumbersome Roman notation, included little more than the simplest practical calculations required in ordinary life and the computation of the calendar. Music embraced the rules of the plain song of the church, some theory of sound and the connection of harmony and numbers. Astronomy dealt with the courses of the heavenly bodies, and was seldom kept free from astrology. In philosophy the current textbooks were the *De consolatione philosophiae* of Boethius (470-524), an eclectic summary of pagan ethics, and the same writer's adapted translations of the *Categoriae* and *De interpretatione* of Aristotle and of Porphyry's *Introduction to the Categories*.

Scholastic Revival.—In the 11th century Europe had settled down, after centuries of war and invasion, into a condition of comparative political stability, ecclesiastical discipline and social tranquillity. The barbarians had been converted, and civic life had developed in the fortified towns of Italy, raised as defenses against the pressure of Saracens and Hungarian invasions. Soon, communication with the east by trade and in the crusades, and with the highly cultivated Moors in Spain, further stimulated the new burst of intellectual life. Arabic renderings of some of the works of Aristotle and commentaries on them were translated into Latin and exercised a profound influence on the trend of culture. A new translation of Aristotle's *Metaphysics* appeared in 1167, and by the beginning of the 13th century all his physical, metaphysical and ethical treatises were available, and during the next half century the translations from Arabic and other Semitic versions were superseded by renderings direct from the original Greek. It was only when the real Aristotle was known that it was found possible to bring the Peripatetic philosophy into the

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service of theology. There were thus two broad stages in the educational revival commonly known as scholasticism. In the first the controversies were essentially metaphysical, and centred around the question of the nature of universals, the orthodox theological party generally supporting realism, or the doctrine that the universal is the true reality, of which particulars and individuals are only appearances, while the opposite doctrine of nominalism—that universals are “mere sounds” and particulars the only true existences—showed a continual disposition to lapse into heresies on the most fundamental doctrines of the church. The second stage was essentially constructive, the opposition of philosophy to theology was negated, and philosophy gave a systematic form to theology itself. The most characteristic figure of the former period was Abelard (1079–1142), of the latter St Thomas Aquinas (1225–74). The former knew little of Aristotle beyond the translations and adaptations of Boethius, but he was essentially a dialectician who applied his logic to investigating the fundamental doctrines of the church and bringing everything to the bar of reason. This innate rationalism appeared to bring theology under the sway of philosophy, and led to frequent condemnations of his doctrines as heretical. With St Thomas, on the other hand, the essential dogmas of Christianity must be unquestioned. In his *Summa theologiae* he presents all the doctrines of the church systematized in a mould derived from the Aristotelian philosophy.

It is evident, then, that during the period of the scholastic revival men's interests were specially occupied with questions concerning the spiritual and the unseen, and that the great instrument of thought was syllogistic logic, by which consequences were deduced from premises received as unquestionably true. There was a general acceptance of the authority of the church in matters of belief and conduct, and of that of Aristotle, as approved by the church, in all that related to knowledge of this world.

Before the rediscovery of Aristotle exerted such a general influence on the form of education, there was a real revival of classical literary culture at Chartres and a few other schools, and John of Salisbury (d. 1182) in his *Metelogeus* advocated literature as an instrument of education and lamented the barrenness of a training confined to the subtleties of formal logic. But the recrudescence of Aristotle accelerated the movement in favour of dialectic, though at the same time it furnished topics on which logic could be exercised which only a bare materialism can esteem unimportant. The weaknesses of the general educational system which grew up within scholasticism were that haste to begin dialectic led to an undue curtailment of previous liberal culture, and that exclusive attention to philosophical and theological questions caused a neglect of the study of the physical world and a disregard of the critical functions of the intellect. Doubtless there were exceptions, of which perhaps the most striking is the work in physical science done at Oxford by Roger Bacon (1214–94). But Albertus Magnus (1193–1280), the master of St Thomas, was also a student of nature and an authority for his day on both the natural and the physical sciences. And the work of Robert Grosseteste (d. 1253), as chancellor of the University of Oxford, shows that care for a liberal literary culture was by no means unknown. Probably the most striking instance of the stunting effect of this premature specialization may be found in the fact that the encyclopaedists of general information which were in general use during the middle ages show little or no advance in positive knowledge upon the treatment of similar subjects in Isidore of Seville.

Foundation of Universities.—The services of scholasticism to the cause of education, however, cannot well be overestimated. And the content of scholastic studies was in fundamental harmony with the intellectual interests of the time. Above all other benefits owed by future ages to scholasticism is the foundation of the universities of western Europe. (See **UNIVERSITIES**.)

The concentration of higher instruction in universities was not antagonistic to the mediaeval conception of the church as the teacher or moulding. University life was modelled on that of the cloister, though the monastic ideal could not be fully realized, and the scholars not infrequently exhibited considerable licence in life. This was inevitable with the very large numbers of the

scholars and the great variations of age among them. Moreover students and to a less extent teachers passed from university to university, so that the universities of mediaeval Europe formed a free confederacy of learning in close relation to the church but untrammelled by state control. Nevertheless, the introduction of studies derived from the Greeks through the Arabians led to an increased freedom of thought, at first within authorized limits, but prepared, when occasion served, to transcend those limits. The scheme of instruction was arranged on the assumption that special studies should be based on a wide general culture. Thus of the four faculties into which university teaching was organized that of arts with its degrees of *Baccalaureus* and *Magister*, was regarded as preliminary to those of theology, law and medicine. It often included, indeed, quite young boys, for the distinction between grammar school and university was not clearly drawn. Little or no attempt was made to extend the bounds of knowledge, the aim was to pass on a body of acquired knowledge regarded as embracing all that was possible of attainment, and the authority of Aristotle in physics as well as in philosophy, and of Galen and Hippocrates in medicine was absolute. The methods of instruction—by lecture, or commentary on received texts and by disputation, in which the scholars acquired dexterity in the use of the knowledge they had absorbed—were in harmony with this conception and were undoubtedly thoroughly well suited to the requirements of an age in which the ideal of human thought was not discovery but order, and in which knowledge was regarded as a set of established propositions, the work of reason being to harmonize these propositions in subordination to the authoritative doctrines of the church.

Such an extension of the means of higher education as was given by the universities was naturally accompanied by a corresponding increase in schools of lower rank. Not only were there grammar schools at cathedral and collegiate churches, but many others were founded in connection with chantries, and by some of the many guilds into which mediaeval middle class life organized itself. In addition to the grammar schools were writing and song schools of an elementary type, in which instruction was usually in the vernacular. Girls were taught in women's monasteries and in the home, and those of the upper classes, at least, very generally learned to read, write and keep accounts, as well as fine needlework, household duties and management, and such elementary surgery and medicine as served in cases of slight daily accidents and illnesses. Even those boys, and girls who did not receive formal scholastic instruction were instructed orally by the parish priests in the doctrines and duties of the Faith, while the pictures and statues with which the churches were adorned aided the direct teaching of sermons and catechizing in giving a general knowledge of Bible history and of the legends of the saints.

No doubt, in times of spiritual and intellectual lethargy, the practice fell short of the theory, but on the whole it may be concluded that in mediaeval times the provision for higher instruction was adequate to the demand, and that, relatively to the culture of the time, the mass of the people were by no means sunk in brutish ignorance. Indeed, especially when the paucity of books before the invention of printing is borne in mind, the number of people who could read the vernacular, as evidenced by the demand for books in the vulgar tongue as soon as printing made them available, is clear proof that the latter part of the middle ages was by no means a time of general illiteracy.

The education of the masses was by no means confined to the church, and the people received direct instruction in reading and writing, courtly amusements, such as chess and playing the lute, singing

and making verses, the rules and usages of courtesy, and the knightly conception of duty. As a squire he practised more assiduously the knightly exercises of war and peace, and in the man-
agement of large or small bodies of men he attained the capacity of command.

With the unification of existing knowledge and the systematization of theology the constructive work of scholasticism was done. At the same time the growth of national feeling was slowly but surely undermining feudalism. Moreover, deep resentment was accumulating throughout western Europe against the practical abuses which had become prevalent in the church, and especially in the court of Rome and in the prince bishoprics of Germany. In such conditions the customary and traditional education of school and university tended to lose touch more and more completely with the new aspirations and views of life. Had a new cultural movement not begun, the education of Europe threatened to become as arid as the rhetorical education of the last centuries of the Roman empire had been. From this it was saved by the renaissance of classical studies which began in the 14th century.

The Renaissance—Ever since the 11th century the cities of northern Italy had been in advance of Europe beyond the Alps both in culture and in material progress. The old classical spirit and the feeling of Roman citizenship had never quite died out, and the *Divina commedia* of Alighieri Dante (1265-1321) furnishes evidence that the poet of the scholastic philosophical theology was also a keen student and lover of the old Latin poets. But the greatest impulse to the revived study of the classics was given by Petrarch (1304-74) and Giovanni Boccaccio (1313-75). Generally throughout western Europe the 14th century, though full of war and political unrest, was a time of considerable intellectual activity, shown in the increase of schools and universities, as well as in the literary and artistic revival in Italy, in the social and theological movement in England and Bohemia associated with the names of John Wycliffe and John Huss, and in the more or less complete substitution of Roman law everywhere except in England for the law of custom which had hitherto prevailed.

But it was the literary movement which most affected education, and indeed, the whole life of Europe. A decisive step was taken when Manuel Chrysoloras was invited to teach Greek in the University of Florence in 1397. The enthusiasm for classical culture, to which Petrarch had given so great an impetus, gathered force and extended over the whole of Italy, though, of course, felt only by a select few and leaving the mass of the people little, if at all, affected. From Italy it spread gradually to countries north of the Alps. In the old writers men found full expression of the new spirit of self-conscious freedom which was vaguely striving for expression throughout the whole of Christendom. In the free political atmosphere of the Italian communes, with their wealthy and leisured merchant class, that spirit could flourish much more readily than in the feudalized Europe across the Alps. Moreover, the antique spirit was in direct line of ancestry with that of medieval Italy. Thus for a couple of centuries, Italy stood in the van of European culture.

It is the spirit of the new movement which is of interest to the student of education. And that spirit was essentially one of opposition to authority and of assertion of individual liberty, which worked itself out in various forms among peoples of different temperaments. In Italy the form was literary and artistic, and the full development of the Renaissance spirit was seen in a practical paganism which substituted the attractions of art for the claims of religion and morality, and eventuated in deep and widespread immorality, and a contemptuous tolerance or the outward observances of religion without faith in the doctrines they symbolized. The most valuable service of the Italian humanists to Europe was the restoration to man of the heritage of knowledge which he had been allowed to slip from his grasp, and the leading the way to a freer intellectual atmosphere. In Germany the spirit manifested itself in a rebellion against the doctrinal system of the Church as the only effective means of attaining reform of ecclesiastical abuses. The Protestant Reformation of Martin Luther was the real German outcome of the Renaissance. In no other

country of Europe did the movement take so distinctive a form.

The revival of interest in classical studies was, therefore, only a first step. These newly discovered literatures responded to the intellectual and moral cravings which had been blindly gathering force for generations, as they encountered in them the pagan view of life with its assumption of the essential worth and self-reliance of the individual and its frank delight in all the pleasures of existence. It was in just this pagan view of individual worth and the supremacy of the human intellect, that the church gradually realized the supreme danger to herself.

At first the revival of interest in the classical literatures did not show any antagonism to Catholic faith and practice, and its warmest supporters were faithful sons of the church. The view of the relation of classical literature to Christianity adopted by the great humanist schoolmaster Vittorino da Feltre (1378-1446) was broadly that of the early fathers, and in his school at Mantua he showed that culture was not inconsistent with loyalty to the church or with purity of life. With him classical literature was not the end and sum of education, but was a means of implanting ideas, of developing taste and of acquiring knowledge, all as helps and ornaments of a Christian life. The school at Mantua may, indeed, be said to have exhibited in practice a Christianized application of the doctrines of Quintilian and Plutarch.

So was it in the other countries of Christendom. In the Netherlands the Brethren of the Common Life introduced humanistic studies into their schools side by side with definite religious teaching and observances and their work was always dominated by the Christian spirit. The earlier German humanists, such as Nicholas de Cusa, Alexander Hegius, Johannes Agricola and Jakob Wimpfeling, adopted the same attitude, and Erasmus himself, bitterly as he attacked the practical abuses of the church, remained in communion with it, and aimed at harmonizing classical culture with the Christian life. In England the same love of culture combined with devotion to the church was seen in Selling, prior of Christ church, Canterbury, the first real English humanist, in William Grocyne, Thomas Lanacre, Sir Thomas More, John Fisher, John Colet and many others whose enthusiasm for culture was as undoubted as was their loyalty to Catholicism. It seemed, then, at first as if the greatest educational effect of the classical revival would be the deepening of literary culture, and the substitution of real inquiry for dialectic subtleties in the courses of schools and universities, without any break with established religious teaching. It is true that the majority of schools were but little affected, and many of the universities had given but a half-hearted welcome to humanistic studies when the religious revolt in Germany under the leadership of Luther threw the whole of Europe into two hostile camps. But even the conservative University of Paris—the headquarters of scholastic philosophical theology—had permitted the teaching of Greek as early as 1458, and both Oxford and Cambridge had welcomed the new studies.

The Reformation—The immediate effect of the religious controversies of the 16th century on education was disastrous. The secularization of ecclesiastical property too often absorbed the endowments of the schools, so that, both in Germany and in England, the majority of grammar schools either disappeared or continued a starved existence, with diminished funds, the doctrine of salvation by faith alone and the futility of good works dried up the source from which such endowments had flowed, the violent fulminations of the German reformers against the universities as the homes of the hated scholastic theology and philosophy led to wholesale expulsions from those seats of learning, while the theological speculations and quarrels led those few who did resort to the universities to devote their energies to interminable wrangling over controversial points. This decadence in culture was attended by an outbreak of licence and immorality, especially among the young, which called forth violent denunciations from Luther and many of his followers in Germany, and from Hugh Latimer and other reformers in England. Humanism and Protestantism, which had so far diverged that Erasmus (1467-1536) had declared that where Lutheranism flourished learning decayed

were brought together again by Philipp Melancthon (1497-1560), under whose influence universities were founded or reorganized and schools re-established in Protestant German states, and in England the reign of Elizabeth saw the creation of a certain number of new foundations. But this restoration of the means of education was only partial, and the doctrine of the worthlessness of "carnal knowledge," which led the Barebones parliament to propose the suppression of the English universities, was held by many fervent Protestants both in England and in Germany all through the 17th century.

Moreover, the schools continued to ignore the new directions of men's thoughts and the new view of knowledge as something to be enlarged and not merely a deposit to be handed down from generation to generation. The later humanist theories of education which the schools continued to follow generally for more than two centuries, and in many cases for another hundred years after that, were drawn mainly from Erasmus and Melancthon, who found in the classical languages and literatures, and especially in Latin, the only essential instruments of education. General knowledge of natural facts might be desirable to the cultured man as ornaments to his rhetoric but it was to be sought in the writings of antiquity. Even so revolutionary a thinker on education as François Rabelais (1495-1553) with all his demand for an encyclopaedic curriculum, held the writings of the ancients as authoritative on natural phenomena. Melancthon exercised enormous influence both directly and through such disciples as Valentin Troitzendorff and Neander, but especially through his friend John Sturm (1507-1589), whose Latin gymnasium at Strasbourg became the model which the grammar schools of Protestant Europe strove to imitate. In this school nearly the whole of the energies of the boys was given to acquiring a mastery of the Latin language after the model of Cicero.

In Catholic countries the church retained control of education. The practical reformation of abuses by the Council of Trent, and the energy and skill of the Society of Jesus, founded by St Ignatius Loyola in 1534, brought back most of south Germany into the fold of the church. Everywhere Catholic universities were mainly taught by Jesuit fathers, and under their influence, scholasticism, purged from the excretions which had degraded it, was restored. Everywhere the society established schools, which, by their success in teaching and the mildness of their discipline, attracted thousands of pupils who came even from Protestant homes. Their curriculum was purely classical, but it was elaborated with much skill, and the methods of instruction and discipline were made the subject of much thought and of long-continued experiment. All Jesuit fathers being trained, the teachers in Jesuit schools attained a degree of skill in their art which was too generally wanting elsewhere.

Decadence of Schools and Universities.—Richard Mulcaster (1530-1611) pointed out that Latin was not of value to the majority of boys. For them he urged an elementary education in the vernacular, but neither in this nor in his advocacy of the training of teachers was his advice followed. In the 17th century the dislocation between the Latin schools and the needs of life began to be accentuated as Latin gradually ceased to be the language of learning, and, as a consequence, the numbers attending the schools decreased, and the mass of the people sank continually lower in ignorance. In vain Charles Hoole urged the establishment of a universal system of elementary schools giving instruction in the vernacular, Sir William Petty put forth his plan for elementary trade schools, and Abraham Cowley proposed the establishment of a college devoted to research. Ideas of reform were in the air, but the main current of scholastic practice flowed on unaffected by them. Some attention was, indeed, paid to the conservative reforms advocated by the Port Royalists, of which the most important was the inclusion of the vernacular as a branch of instruction, but the cry for more fundamental changes based on the philosophy of Roger Bacon was unheeded. Of these, none was a more active propagandist than Johann Comenius (1592-1670). Unfortunately his *Great Didactic*, in which he set forth his general principles, attracted little attention and won less adherence, though his school books, in which he attempted with very

little success to apply his principles, were widely used in schools. But these were little more than bald summaries of real and supposed facts, stated in Latin and the vernacular in parallel columns. In content they differed from such medieval summaries of knowledge as the well-known work of Bartholomew Anglicus, which had been widely used since the 13th century, chiefly by their greater baldness and aridity of statement.

In the universities, too, the 16th and 17th centuries saw a continuous decadence. The 16th century was not ripe for real intellectual freedom, and Protestantism, having based its revolt on the right of private judgment, soon produced a number of conflicting theological systems, vying with each other in rigidity and narrowness, which, as Friedrich Paulsen says, "nearly stifled the intellectual life of the German people." Further, the idea of national autonomy, which exercised so great an effect on the politics of the time, included the universal adherence of the citizens to the religion of the state. Hence, till the end of the 17th century the universities of Protestant Europe were regarded mainly as instruments for securing adhesion to the national theological system on the part of future clergy and officials, and the state interfered more and more with their organization and work. In Paris, on the other hand, the faculty of theology had decayed through the withdrawal of those preparing for the priesthood into episcopal seminaries, and the higher studies pursued were mainly law and medicine. Thus, generally, the universities were less and less fulfilling the function of providing a general liberal education. Another change, arising from the same causes and making for the same results, was the isolation of universities, often directly fostered by the state governments, which for the universal interchange of mediaeval thought substituted a narrow provincial culture and outlook.

Indeed, from the middle of the 17th century, the main current of intellectual life had drifted away from the orthodox centres of learning. The formation of the Berlin academy in Germany and of the Royal society in England, and the refusal of Gottfried Leibnitz to accept a chair in any German university, were signs of the times. In France, and later in Germany, the education of the noble youth was increasingly carried on apart from the schools, and was really an outgrowth from the education of chivalry. In the 16th century Baldassare Castiglione and Michel de Montaigne had advocated a training directly adapted to prepare for active public life, and Sir Thomas Elyot wrote on similar lines. But the most important movement in this direction was the formation of the courtly academies which flourished in France in the 17th century, and were soon imitated in the *Ritterakademien* of Germany. In these schools of the nobility French was more honoured than classics, and the other subjects were chosen as directly adapted to prepare for the life of a noble at the court or in camp. John Milton in his *Tractate* advocated the foundation of such academies in England. More and more, too, foreign travel had, from the middle of the 16th century, been looked upon as a better mode of finishing the education of a gentleman than a course at a university.

Revival of University Life.—The later years of the 17th century saw a revival of university life in Cambridge, through the work of Sir Isaac Newton and the increasing attention paid to mathematics and the physical sciences, though the number of students continued very small. In Germany, also, a new era opened with the foundation of the Universities of Halle (1693) in 1694 and Göttingen in 1737, which from the first discarded the old conception that the function of a university is to pass on knowledge already complete, and so opened the door of the German universities to the new culture and philosophy. It was soon seen that students could thus be attracted, and the influence spread to the other German universities, which by the end of the 18th century had regained their position as homes of the highest German thought.

At Halle, too, was set the example by August Francke of providing for the education of the children of the poor, and to his disciple, Johann Julius Hecker, Germany owes the first *Realschule*. Simultaneous movements for the education of the poor were made by St. Jean Baptiste de la Salle and the Brothers of the Christian

Schools in France and by the Society for the Promotion of Christian Knowledge in England. Mention should also be made of the Sunday School movement started by Robert Raikes in 1780. But the total results were not great, the mass of the people in every European country remained without schooling throughout the 18th century.

Education in the 18th Century.—The intellectual movements of that century were indeed, essentially aristocratic. Voltaire and the Encyclopedists aimed at the enlightenment of the select few, and Jean Jacques Rousseau declared baldly that the poor need no education. That these movements influenced education profoundly is undoubted. The individualistic and abstract rationalism of Voltaire, derived from the sensational philosophy of John Locke through the more thoroughgoing Étienne de Condillac and finding its logical outcome in the materialistic atheism of Julien de La Mettrie and the refined selfishness of Rochefoucault, infected the more cultured classes. In Lord Chesterfield's *Letters to his Son* is shown its educational outcome—a veneer of superficial culture and artificial politeness covering, but not hiding, the most cold blooded selfishness. Against this fashionable artificiality, as well as against the obvious social and political abuses of the time, Rousseau's call for a return to nature was a needed protest.

Rousseauism, however, was not merely a transitory revolt against a conventionality of life that had become unbearable, it was emphatically the voicing of a view of life and of education which profoundly influenced Europe. In that Rousseau (1712-1778) attempted to look at life as a whole, he was on truer ground than were the intellectualists of the "Enlightenment," especially in his advocacy of the hitherto ignored claims in education of feeling and emotion. His *Émile* may be, in spite of certain crudities, not unfairly described as the charter of childhood. It is, in fact, a declaration of childhood's rights. On the other hand, his overstatement of the efficacy of nature, as shown by his theory that man is born good, and if left to his own instincts cannot fail to achieve happiness, is obviously one-sided.

Against this position the educational teaching of Immanuel Kant (1724-1804), influenced though he was by the *Émile*, is essentially a protest. The most necessary element in education, according to Kant, is constraint, which by the formation of habit prepares the young to receive as principles of conduct the laws at first imposed upon them from without. And the supreme guide of life is the law of duty which is always more or less opposed to the promptings of inclination. The French Revolution—the natural outcome of the teachings of Voltaire and of Rousseau—was the second stage in the movement of which the Reformation was the first. It was essentially the assertion of the natural rights of man, and as a logical sequence, of the right of every child to be properly trained for life. The gradual recognition of this truth, with the necessary corollary of the establishment of a national system of education, is emphatically the characteristic mark of the educational history of all countries in the 19th century.

The 19th Century.—Preached and practised by Johann Pestalozzi (1746-1827) in Switzerland, the general education of the poor was first made a reality by Prussia after the crushing defeat of Jena. In France and England it remained for nearly three quarters of the century the work of the church and other voluntary agencies though aided by the state. Finally a state system of schools was more or less fully set up in every state of Western Europe and in America, and submitted to more or less strict regulation and control. Equally marked was the growing care for the education of girls as well as boys, though only in the U.S. were the two regarded as practically identical in form and content.

Thus the 19th century saw the final working out of the idea that the state should be substituted for the church as the official agent of education. Among the principal causes of such a change was the growing conviction that with the ever widening distribution of political power the state had a right to demand a minimum of knowledge from every citizen, while on the other hand, it is alike to the benefit of the individual and the state that the door of educational opportunity should be thrown as wide open as possible. Equally potent was the idea which had its roots in the

Renaissance conception of the right of man to direct his life apart from theological determinations. The more direct outcome of the same idea was apparent in the absolute liberty with which the presuppositions of knowledge were questioned, and the maxim of René Descartes—to prove everything by the reason and to accept nothing which fails to stand the test—was acted upon. No greater contrast is possible than that between the mediæval student and the modern searcher after truth.

The influence of the same spirit wrought an equally momentous change in the methods of instruction. The impetus given by the doctrine of Rousseau to the view that the nature of the child should determine the means of education, led to more thoroughgoing attempts than had hitherto been made to base educational method on a knowledge of child psychology. Pestalozzi and Friedrich Froebel (1782-1852), by their insistence on the need of educating a child through his own activity, and by their widespread influence, made the new view of method an actuality. The influence of Rousseau thus passed into modern educational practice in a form that, in its essence, was true, though in practice it showed itself apt to run into the same excess of emphasis on impulse and feeling which characterizes his teaching. The influence of Johann Herbart (1776-1841) tended to counteract this. The essence of Herbartianism was that mental life consists of presentations, or reactions of the mind on the environment, and that will springs from the circle of thought thus developed. The emphasis was therefore placed on intellect and instruction, while in Froebelianism it was placed on spontaneous activity and on the arrangement of the environment. Each exaggerated the function of the one factor in concrete experience which it made the centre of interest, and each was tinged with the individualistic conception of life which characterized the 18th and early 19th century. (See also ACADEMIES, CLASSICS, COEDUCATION, EXAMINATIONS, POLYTECHNICS, TECHNICAL EDUCATION, UNIVERSITIES, etc.)

(C Br.)

HISTORY OF NATIONAL SYSTEMS

ENGLAND (19TH AND 20TH CENTURIES)

Elementary Education.—It was the development of industry and the social unrest at the end of the 18th century, following on the French Revolution, which combined to bring home to the public mind the need of a national system of day schools. Unfortunately, just at this moment the revival of Nonconformity as the result of the religious vitality of the Evangelical movement shattered the religious peace of the early Hanoverian period and divided the nation once more into hostile camps, to which class distinctions lent additional bitterness. The famous controversy between Andrew Bell and Joseph Lancaster and their respective followers in the opening years of the 19th century served to define the religious difficulty substantially in the form in which it existed for more than 100 years. Both these remarkable men conceived independently the idea of a national system of popular education upon a voluntary basis. The controversy between them, begun upon personal grounds, resolved itself into a national contest of rival principles of religious teaching. Lancaster as a young Quaker schoolmaster confronted with pupils drawn from a various religious body, planned his religious instruction upon the lines of doctrine common to all the orthodox Christian denominations. Thus he is the father of the undenominational religious teaching which later formed the basis of the Cowper Temple compromise of the 1850 act (see below). But whereas the Cowper Temple clause was purely negative in form and so seemed to point to an undogmatic religion, the Lancasterian teaching was essentially positive and dogmatic within its limits. The church as a whole refused to co-operate in religious teaching upon the basis of a common Christianity and joined issue with Lancaster and his Whig and Nonconformist following not merely upon the question of the exclusion of dogmatic formularies, but also upon the question of the control of whatever religious teaching should be given. In the vital question at this period was whether the clergy of the established church were to control the national education. The religious issue was prominent in connection with the remarkable attempt at legislation made by the Whig statesman Samuel

Whitbread in his Parochial Schools bill of 1807. It was rejected by the lords, mainly on the ground that it did not place education on a religious basis or sufficiently secure control to the minister of the parish.

Early Voluntary Schools—The failure of the liberal proposals of Whitbread, and the strength of the dissenting opposition to any settlement on purely church lines (such as that advocated by Andrew Bell in 1808 for establishing schools under the control of the parochial clergy), rendered recourse to voluntary effort inevitable. In 1808 the Royal Lancasterian society was formed to carry on the work of Lancaster, the name being afterward changed to the British and Foreign School Society. In the following year the National society for promoting the education of the poor in the principles of the established church throughout England and Wales was formed, with Bell as its superintendent. In voluntary effort on a grand scale the church easily outdistanced her opponents, and in 1831 the National society was able to show that there were in all more than 13,000 schools in connection with the church of which 6,470 were both day and Sunday schools, having a total attendance of 409,000.

The rapid development of the voluntary school system was no doubt greatly facilitated by the monitorial plan of teaching, upon which Bell and Lancaster equally relied. This plan never rested upon any educational theory, it was simply a rough and ready expedient for overcoming the practical difficulty caused by the dearth of competent teachers. Historically it is important as the precursor of the pupil teacher system which long formed the exclusive basis of the English elementary system.

Meantime Lord Brougham in 1816 procured the appointment of a general commission of inquiry into endowed charities. The labours of this great inquiry lasted for 20 years and led to the reformation of many cases of abuse or waste of wealthy endowments, and eventually to the establishment of the Charity Commission in 1855. In 1820 Brougham introduced a bill which proposed to require teachers to be members of the Church of England and to be appointed upon a certificate from the parochial clergyman, and on the other hand to prohibit religious formularies and to confine religious instruction to Bible reading without comment. The bill naturally failed through the opposition of the dissenters and served only to accentuate the religious impasse.

Establishment of State Aid—In 1832 the Whig government placed on the estimates a sum of £20,000 for public education, thus initiating the system of the annual grant voted by parliament. The funds thus granted were to be confined to the erection of school buildings, and to be administered only through the National and the British and Foreign School societies. In 1839 Lord Melbourne's government, by means of an order in council, established a Committee of Council on Education, and the sum voted by parliament was increased to £39,000. The original intention of the government was to establish a state normal school or training college as the foundation of a national system of education. Unfortunately this design had to be abandoned in view of the religious difficulty, with the result that the training of elementary teachers was left in private hands. In view of the limited resources placed at its disposal by parliament, the committee of council was at first compelled to confine its assistance to capital grants in aid of the provision of school buildings, but in the distribution of the money three important conditions were at once imposed. In the first place, the continuing right of inspection was required in all cases, secondly, promoters were obliged to conform to a fixed standard of structural efficiency, thirdly, the building must be settled upon trusts permanently securing it to the education of poor children.

By the minute of Aug. 10, 1840, the committee of council concluded what came to be known as the concordat with the church. Under this minute no appointment was to be made of any persons to inspect schools in connection with the Church of England without the concurrence of the archbishop of the province, and what seems still more extraordinary to modern ideas, any such appointment was to be revoked should the archbishop at any time withdraw his concurrence. The altered financial relations, however, between the state and the voluntary managers brought about

by the institution of maintenance grants soon rendered this concordat obsolete.

Among the first acts of the committee of council was the promulgation of a set of model trust deeds. The necessary conditions were the permanent appropriation of the site to purposes of education, and the permanent right of government inspection, a conscience clause was not obligatory, and indeed was only offered in the limited form of exemption from instruction in formularies and attendance at Sunday school or public worship. Special facilities for the conveyance of land for school purposes were afforded to limited owners by the School Sites acts of 1841 and subsequent years. The landed gentry responded with great public spirit to the call thus made upon their generosity by the state, with the result that the vast majority of rural, and many urban parishes were freely endowed with sites for elementary schools.

The Grammar Schools act of 1840 which was passed to deal with the case of the decayed "grammar" (i.e., classical) schools which abounded throughout the country belongs to the history of elementary rather than secondary education. As a result of this act a considerable number of ancient endowments were reorganized so as to afford an improved elementary instead of an inefficient classical education, and the schemes made under the act constituted an early, but not very successful, experiment in the direction of higher elementary schools.

In 1843 the committee of council decided to make grants in aid of the erection of normal schools or training colleges in connection with the National society and the British and Foreign School societies, thus marking the definite abandonment of the system of relying on voluntary effort for the provision of training colleges.

In 1846 an important step forward was taken in the foundation of the pupil teacher system. The regulations of this year inaugurated annual maintenance grants in the form of stipends for apprenticed pupil teachers receiving a prescribed course of instruction under the head teacher, and a lower grade of stipendiary-monitors in schools where such instruction could not be provided. These regulations inaugurated the system of Queen's scholarships to assist pupil-teachers to proceed to a training college, they also established capitation grants for the support of such colleges, and annual grants to elementary schools under government inspection of from £15 to £30 in aid of the salary of every trained teacher employed. Provision was at the same time made for retiring pensions to elementary teachers.

To facilitate the recognition of denominational schools other than Church of England, the committee of council in 1847 issued a minute dispensing schools not connected with the established church from inquiries concerning their religious condition, and in the same year state aid was extended to Wesleyan and Roman Catholic schools. Jewish schools received recognition in 1851 upon condition that the Scriptures of the Old Testament should be daily read in them.

During the middle years of the century various unsuccessful legislative attempts were made to establish a national system of elementary schools upon the basis of rate aid. The only one of these attempts which calls for notice here is the bill introduced by Lord John Russell (called the Borough bill, on account of its being restricted to municipal boroughs) in 1853, and forming part of a comprehensive scheme of legislative and administrative reform of which a portion was actually carried into effect. The bill as a measure for elementary education was supplemented by an administrative system of capitation grants for rural areas. The government scheme also comprised a measure dealing with the administration of charitable trusts (which took shape as the Charitable Trusts act, 1853), the constitution of the department of science and art, and university reform upon the lines recommended by the Oxford and Cambridge commissions.

The failure of the Borough bill did not affect the new system of capitation grants which was introduced by minute of the committee of council dated April 2, 1853. These grants were fixed at a scale varying from 3s to 6s per head, payable upon certain conditions, of which the most important were that the school must be under a certificated teacher, and that three-fourths of the

children must pass a prescribed examination. The capitation grant was, by minute of Jan. 26 1856, extended to urban areas. As in the case of all the early grants, the regulations governing the distribution of the capitation grants were framed upon the principle that subventions of public money must be met by local funds derived from voluntary contributions, endowments and school fees, thus the basis of the denominational system as fostered by the state at this stage was one of financial partnership.

In 1856 a purely administrative bill was passed, establishing the office of vice president of the Committee of Council on Education as a minister responsible to parliament. At the same time, the science and art department was transferred from the board of trade to the committee of council.

The Newcastle Commission—The progress of state aided education during this period may be measured by the increase of the annual parliamentary grant, which rose from £30,000 in 1839 to £100,000 in 1846, £150,000 in 1851, £398,000 in 1855, and £663,400 in 1858. This expansion was viewed with misgiving by the friends of the denominational system and by the strong individualist school of that day, who upon wider grounds clung to the old ideal of voluntary initiative. These sections combined with the advocates of further state intervention to press for a commission of inquiry and a royal commission was appointed in 1858, under the chairmanship of the duke of Newcastle to inquire into the state of popular education in England, and to consider and report what measures, if any, were required for the extension of sound and cheap elementary instruction to all classes of the people. The *Report of the Newcastle Commission* issued in 1861, contained an exhaustive account of the existing condition of elementary education, and with due allowance for the grave defects revealed, and in particular the glaring inefficiency of the numerous little private-venture schools kept by "dames" and others, the graphic picture drawn by the commissioners constituted a striking tribute to the sterling qualities of self help and religious earnestness which were characteristic of the early Victorian period. It was found that in round numbers about 2,500,000 children were attending day schools, the proportion to population being one in seven, as compared with one in nine in France, one in eight in Holland and one in six in Prussia, where education was compulsory. On the other hand, of this number only 1,675,000 were in public schools of all kinds, only 1,100,000 in schools liable to inspection, and 917,000 in schools receiving annual grant. The result was that only one child in every 20 was attending a school whose efficiency could be in any way guaranteed by the state. The commissioners as a body rejected free and compulsory education in view of the religious difficulty and upon general grounds of individualistic principle. In view of the solution adopted in 1902 it is of interest to note that the Newcastle commissioners deliberately rejected the parish as unfit to be taken as the unit of elementary education upon the ground that management by parochial ratepayers must tend to be illiberal and niggardly, and recommended the constitution of county boards with power to levy a rate for the aid of existing voluntary schools.

The one definite achievement of the Newcastle commission was the famous system of payment by results. Impressed by the defects of the existing teaching, the commissioners reported that there was only one way of securing efficiency, and that was to institute a searching examination by competent authority of every child in every school to which grants were to be paid, with the view of ascertaining whether the indispensable elements of knowledge were thoroughly acquired, and to make the prospects and position of the teacher dependent to a considerable extent upon the results of this examination. They recognized that to raise the character of the children, both morally and intellectually, was and must always be the highest aim of education, but they thought that the training in the rudiments of education, which must be the foundation of all teaching, had been lost sight of, and that there was justice in the common complaint that while a fourth of the scholars were really taught, three-fourths after leaving school forgot almost everything they had learned there.

Lowe (Lord Sherbrooke), as vice-president of the committee of council (1859-64), adopted the system of payment by results

in what became famous in history as the Revised code, issued in 1862. The Revised code provided for the payment of a grant of 4s upon the old principle and a further grant of not more than 8s upon the result of examination. Lowe declared of the system in the house of commons that "if it was costly it should at least be efficient, and if it was inefficient it should at least be cheap." In fact, it proved to be cheap, the grant fell from £813,400 in 1861 to £636,800 in 1865. Later, to meet objections, some modifications were introduced in the code under the Conservative government in 1867. The system of paying grant upon the result of individual examination of the scholars was not finally abolished till 1904.

The Act of 1870 and Its Effects—In 1868 the Conservative government brought in, but did not proceed with, an education bill deliberately discarding the principle of rate aid on the ground that it would destroy voluntary contributions and gradually starve out the denominational schools. In 1867 and again in 1868, Henry Austin Bruce (afterward Lord Aberdare), W. E. Forster and Algernon Egerton introduced a bill which formed the basis of the measure of 1870. As redrafted in 1868 the bill of Bruce and his coadjutors proposed a universal system of municipal and parochial rating with liberty for voluntary schools to unite themselves to the rate aided system under their existing management, subject to the acceptance of a conscience clause. The bill also proposed to empower town councils to co-opt outsiders upon their education committees. Thus both in the principle of co-optation and in the extension of rate aid to schools not under public control the bill of these Liberal statesmen in 1868 anticipated certain features of Balfour's Education act of 1902. In the meantime, in the country the Education League, originated at Birmingham, was carrying on a propaganda in favour of free secular schools, while the Education Union, formed to counteract the influence of the league, urged a settlement upon the old lines. As a concession to the popular feeling against secularism, the league proposed to allow Bible reading without doctrinal exposition. Thus opinion was sufficiently focused to enable William Gladstone's administration in 1870 to undertake a comprehensive measure of educational reform.

The Elementary Education act of 1870 bore in every respect the marks of compromise. As Forster explained in introducing the bill, the object of the government was "to complete the voluntary system and to fill up gaps," not to supplant it. To this end the education department was charged with the duty of ascertaining whether or not there was in every parish a deficiency of public school accommodation, and of making provision for the formation of school boards in every school district (i.e., parish or municipal borough) requiring further public school accommodation.

Three important changes were made in the measure during its passage through parliament. (1) In lieu of the rate aid as first suggested, the government proposed an increased grant from the treasury, that is to say, the voluntary schools were left standing as state aided schools under private management, side by side with the new rate supported schools. (2) The character of the religious instruction in the board schools was determined upon an undenominational basis by a provision which became known after the name of its author, as the Cowper-Temple clause (section 14 of the act), directing that "no religious catechism or religious formula which is distinctive of any particular denomination shall be taught in the school." The clause was not intended to exclude doctrinal exposition, and was in fact a compromise not merely between absolutist secularism and denominationalism, but between denominationalism and the view of those who would have the Bible read without note or comment. The Apostles' Creed as a symbol common to all denominations of Christians was held by Forster (at Gladstone's suggestion) not to be excluded under the Cowper Temple clause. The result was the establishment of the schools, upon the lines laid down by Joseph Lancaster at the beginning of the 19th century, of what may be termed the common Protestantism of the English nation. The Cowper Temple compromise, notwithstanding its inherent want of logic, stood the test of experience for more than a generation against the consistent

denominationalists on the one hand and the party of secular education on the other. (3) The third change in the bill was the substitution of the *ad hoc* school board for the municipally appointed board originally proposed. These boards were elected by the system of cumulative voting under which each elector had as many votes as there were candidates to be elected with liberty to give all his votes to one candidate or to distribute them among the candidates as he thought fit. This system was much criticized as being unduly favourable to minorities, whose representation it was devised to secure, it continued, however, until the act of 1902.

School boards were empowered not only to acquire sites for schools under powers of compulsory purchase, but also to take transfers of existing voluntary schools from their managers. The act of 1870 did not introduce either direct compulsory attendance or free education, but it took a distinct step forward in each direction by enabling school boards to frame bylaws rendering attendance compulsory, and also to pay the school fees in the case of poverty of the parent. Building grants were continued temporarily for the benefit of those who applied (as voluntary managers alone could apply) before Dec. 31, 1870. On the other hand, the education department was authorized to refuse parliamentary grants to schools established in school board districts after the passing of the act if they thought such schools were unnecessary.

The following figures are of interest as showing the progress made under the act of 1870. In the year 1870 there was accommodation in inspected day schools for about 2,000,000 children, the average attendance was 1,168,000, and the number on the books about 1,500,000. It was computed, however, that there were, exclusive of the well-to-do classes, at least 1,500,000 children who attended no school at all or schools not under inspection. In 1876 accommodation had been provided for nearly 3,500,000, and of the 1,500,000 new places nearly two thirds were provided by voluntary agencies. "These voluntary agencies," said Sir H. Craik, "had received grants in aid for about one-third of the schools they had built, the grants defraying about one-fifth of the cost of the aided schools." On the other hand, the growth of school boards was rapid and continuous, notwithstanding the permissive character of the act and the strenuous efforts of the voluntarists to keep pace with the new demands. In 1872, 9,700,000 of the population were under school boards, and of these 8,142,000 were under bylaws, in 1876 the numbers were respectively 12,500,000 and 10,400,000. In the same period the annual grants increased from £894,000 in 1870 to £1,600,000 in 1876. The development evidenced by the above figures, and in particular the fact that 52% of the population were subject to bylaws, enabled Benjamin Disraeli's government in 1876 to pass a law introducing universal compulsory attendance, with certain exceptions. In order to complete the machinery for compulsion the act directed that, in every district where there was no school board, a school attendance committee should be appointed by the local authority.

In 1880 Anthony Mundella, as vice-president of the council in Gladstone's administration, passed a short act which made the framing of bylaws compulsory upon school boards and school attendance committees, thus completing the system of universal direct compulsion. Under the acts of 1870 and 1880 the average attendance increased from 2,000,000 in 1876 to 3,500,000 in 1878 and 4,000,000 in 1881. In terms of percentage to population, 18.06% in 1876, 29.60% in 1878, and 30.69% in 1881. In the last-mentioned year the annual grant rose to £2,200,000 having more than doubled in the decade.

In 1887 a royal commission under the presidency of Viscount Cross was appointed to inquire into the working of the education acts. The labours of this commission produced a thorough discussion of the educational problem in all its aspects—political, administrative, scholastic and religious. For any clear recommendations with regard to the reorganization of education generally the moment was not opportune, inasmuch as the commission just preceded the establishment of the new county authorities and the powers with respect to instruction other than elementary which parliament was shortly to confide to them under the Tech-

nical Instruction acts. Nevertheless the report of the majority of the commissioners pointed unmistakably toward the solutions adopted in the act of 1902, and their definite recommendation that voluntary schools should be accorded rate aid without the imposition of the Cowper Temple clause, served as the basis of that legislation.

Of the developments which followed the Cross report, it is convenient to mention in the first place, out of chronological sequence, the practical establishment of free education by the act of 1891, not by the absolute prohibition of school fees but by the device of a special grant payable by parliament in lieu of fees, called the fee grant. The result of this legislation and of subsequent administrative action was to place free education within the reach of every child, fees being retained (with few exceptions) only where some instruction of a higher elementary type was given.

(For provisions of the education act of 1944, see below.)
Secondary and Technical Education.—The establishment of county councils by the Local Government act, 1888, introduced a new factor, destined to exert a determining influence upon subsequent developments of public education. In the first place, it at once rendered possible the partial and experimental provision for higher education attempted by the Technical Instruction acts, which affected secondary education as well as technical education in the proper sense of the term.

In order to understand the state of secondary education at this period it is necessary to refer to the first attempts made at state intervention.

In 1861 the first step was taken by the appointment of a royal commission, presided over by Lord Clarendon, to inquire into the condition of nine of the chief endowed schools in the country, viz., Eton, Winchester, Westminster, Charterhouse, St. Paul's, Merchant Taylors, Harrow, Rugby and Shrewsbury. The report of this commission led to a statute, the Public Schools act of 1864, which introduced certain reforms in the administration of seven of these schools, leaving the two great London day schools, St. Paul's and Merchant Taylors, outside its operation.

The Schools Enquiry Commission.—In 1864 the Schools Enquiry commission was appointed under the presidency of Lord Taunton to inquire into all the schools which had not been included either in the commission of 1861 or the Popular Education commission of 1858. It thoroughly explored the field of secondary education, discussing all the problems, administrative and pedagogic, which the subject presents, and "its luminous and exhaustive report" (to quote the words of Bryce's commission of 1894) was an excellent introduction to the problem of public secondary education in England. The existence of numerous and frequently very wealthy endowments arising from private benefactions and bequests had at all times been a feature in education as in other departments of English social life. At the date of the Schools Enquiry commission the state of the ancient endowments was largely one of abuse. Many endowments intended, for advanced education were applied for instruction of a purely elementary character, and that of an inferior kind, indeed the possession of an endowment in a rural locality not infrequently operated to prevent the establishment of an efficient state school. The Schools Enquiry commission reported that the endowments of the endowed schools act, which conferred upon a special commission (united in 1874 with the Charity commission) very wide and drastic powers of reorganizing ancient endowments. A direction for extending the benefits of endowments to girls did much to assist the movement for the secondary education for girls. Because of their powers in framing schemes for the reorganization of ancient endowed schools the commissioners found

themselves able to treat the majority of cases as undenominational. In such cases the general practice was to direct that instruction should, subject to a strict conscience clause, be given in the principles of the Christian faith, this provision however, did not exclude special doctrinal instruction.

The Schools Enquiry commission also submitted proposals for the general organization of a system of secondary education. They recommended the establishment of three authorities: (1) a central authority, (2) a local or provincial authority, representing the county or a group of counties, and (3) a central council of education charged with examination duties. Further it was proposed to raise the level of proprietary and private schools by offering them inspection and examination and by establishing a system of school registration. Lastly, it was proposed to confer upon towns and parishes powers of rating for the establishment of new schools. For these proposals as a whole the time was not ripe. The bill of 1869 attempted to give effect to the suggested creation of a central council but exigencies of parliamentary time made it necessary to drop this part of the measure, the result was that the plan of the commissioners was only half carried out. Nevertheless the work accomplished was sufficient to exert a considerable influence upon the secondary education of the country. Thus in 1895 Bryce's commission was able to report that schemes under the Endowed Schools acts had been made for 902 endowments in England, excluding Wales and Monmouth, leaving untouched only 546 endowments out of the total of 1,448 endowments in England known to be subject to the Endowed Schools acts. The total income of the endowments known to be subject to the Endowed Schools acts, and therefore available for the purposes of secondary education, according to the estimate of the Secondary Education commission, was in 1895 about £735,000 gross.

The creation by the Local Government act in 1888 of the representative and popular county authorities rendered the municipalization of secondary instruction at last possible. In 1889 the Technical Instruction act (extended in some particulars by an act of 1891) empowered the councils of counties, boroughs and urban districts to levy a rate (not exceeding a penny on the pound) for the support or aid of technical or manual instruction. Comparatively few councils were prepared to resort to their rating powers, but progress under these acts was greatly facilitated by the Local Taxation (Customs and Excise) act of 1890, which mentioned technical instruction as one of the purposes to which the imperial contribution paid to local authorities in respect of the beer and spirit duties might be applied (*See TECHNICAL EDUCATION*). By virtue of the liberal interpretation given to technical instruction by these acts the financial assistance afforded under them was extended to cover the whole field of mathematical and physical science, as well as modern languages.

At the same time the department of science and art (founded in 1853) gradually utilized its grants to encourage literary studies in secondary schools as well as the scientific and mathematical subjects to the promotion of which it was primarily directed. Thus the combined effect of the local resources available under the Technical Instruction act and the imperial grant administered by the department was gradually to develop a national system of secondary education with a marked bias on the side of physical science. But the school's owner had her education left practically considered apart from the big public schools, of endowed grammar schools or proprietary schools established by religious bodies or joint-stock companies. No public body had a right to the right to build a secondary school.

An indisputed stimulus was given to secondary education in the great centres of industry during the last quarter of the 19th century by the rise of the new university colleges, among which must be reckoned those established expressly for women. At the same time (1899) a beginning was made of state aid to these colleges through a committee appointed by the treasury in a minute of July 1 (*See UNIVERSITIES*). Meanwhile with the development of university education, the great school boards found themselves obliged to provide for the further education of their

best pupils in what were known as higher-grade elementary schools. These were really secondary schools of the third grade, and, as the commission on secondary education observed, the school boards simply stepped in to fill the educational void which the Schools Enquiry commissioners had proposed to fill by schools of that name. Their creation was greatly fostered by the upper departments in such schools being recognized for grants by the science and art department. In fact they continued to multiply and prosper till 1901, when the famous judgment in the test case of *Rex v. Cockerton* pronounced them to be illegal. It was at once recognized that the legislature must, without delay, step in to secure the educational work which the undoubtedly correct principles of judicial interpretation had placed in jeopardy.

Secondary Education Commission.—Meanwhile, as far back as 1894, a royal commission had been appointed under the presidency of James Bryce to inquire into secondary education. The principal recommendations of the commission were (1) the unification of the existing central authorities, viz., the department of science and art, the Charity commission (so far as it dealt with educational endowments), and the education department, in one central office, and the establishment of an educational council to advise the minister of education in certain professional matters, (2) the establishment of local authorities, to consist of committees of the county councils with co-opted elements, (3) the formation of a register of teachers with a view to the encouragement of professional training, and a system of school registration upon the basis of inspection and examination. The first of these recommendations was carried out by the Board of Education act, 1899, and under the same act an attempt was made to give some effect to the third named object, which unfortunately fell short of success. The realization of the second, and most important, of the recommendations was deferred till 1902, when it was brought about as part of a wider reorganization of the educational system.

In 1896 an endeavor was made to meet the demands of the voluntary managers of elementary schools by means of a bill introduced by Sir John Gorst. This bill with its provision for a special aid grant to be administered by county education authorities, which were to exist side by side with the school boards, represented a kind of compromise between the system of 1870 and what later developed in 1902. It encountered opposition in all quarters and was withdrawn. In 1897, however, the position of the denominational school was strengthened by the Voluntary Schools act, which provided for a special aid grant of 5s per head of the scholars in average attendance in these schools.

Partial effect was given to the recommendations of the Secondary Education commission by the Board of Education act of 1899, which united the department of science and art with the education department in one central office under the title of the board of education, with a president and parliamentary secretary, and provided for the transfer to this board of the powers of the Charity commissioners in relation to educational endowments, also for a consultative committee, consisting, as to not less than two-thirds, of persons qualified to represent the views of university and other bodies interested in education, for the purpose of (1) forming a register of qualified teachers and (2) advising the board of education upon any matters referred to the committee by the board. In 1902 a tripartite division was adopted to correspond with the three branches of education in which the board of education is concerned viz. elementary, secondary and technological. Mention may also be made here of another important measure, the Elementary Education act of 1899 which dealt for the first time, from the point of view of the state, with mental deficiency (*q*).

Education Act, 1902.—In the sphere of elementary education, this act boldly abolished the school boards and made the one authority for every form of education (below the university), the county or county borough. It thereby recognized authority for technical and to a limited extent, for secondary education. By putting voluntary and ordinary elementary schools on the same footing it practically made the standard of the work in the two identical and eventually built up an almost complete network of well-equipped secondary schools as well as a vigorous system of

technical education Under the impartial administration of the counties the religious question practically ceased to exist. The act was extended to London in 1903. For framing and carrying it through, special credit was due to Arthur (afterward Lord) Balfour and Sir R. Morant. Its principal provisions were as follows:

Part I. Local education authority. The council of every county and of every county borough was the local education authority for higher and elementary education, for the purpose of elementary education autonomous powers were conferred upon boroughs with a population of more than 10,000, and urban districts with a population of more than 20,000.

parishes benefited any expenses incurred in regard to education other than elementary.

Endowments.—The act introduced a new principle into the administration of endowments by directing that their income, so far as necessarily applicable for those purposes of a public elementary school for which the local authority were liable, be paid to that authority for the relief of the parochial rate.

A number of Nonconformist ratepayers refused to pay the education rate on the ground that their consciences forbade their supporting the religious teaching in denominational schools, and their willingness to become subject to distraint and consequent inconveniences rather than pay the rates became the foundation of a widespread political campaign known as "Passive Resistance." In Wales, where in the rural districts the schools were commonly Anglican while the population was Nonconformist, particular difficulties arose in administering the act in consequence of the hostile attitude of the county authorities. Accordingly the government passed the Local Education (Local Authority Default) act, 1904, empowering the board of education, in the case of default by the local authority, to make payments direct to the managers of the school and to deduct the amount from the sums payable to the defaulting authority.

Supplementary Bills.—When the Liberal party came into power again in 1906, Augustine Birrell, as president of the board of education in Sir Henry Campbell Bannerman's administration, introduced a bill to amend the Education acts, 1902-03, with the object of securing full public control of all rate-aided schools and the appointment of teachers without reference to religious belief. The bill encountered strong opposition from Anglicans and Catholics, it passed the house of commons by a large majority, but after unavailing attempts at compromise upon the amendments introduced in the house of lords, the two houses failed to agree and the measure was lost.

Early in the session of 1908, Reginald McKenna introduced a bill containing a scheme for a new system of allocating the parliamentary grant, and proposing to make Cowper Temple teaching compulsory in all aided schools. The bill was remodelled by his successor, Runciman, but in spite of negotiations with the Church party, no compromise was reached, and the bill was ultimately withdrawn by the government when in committee of the house of commons.

The Education (Provision of Meals) act, 1906, enabled local education authorities to aid voluntary agencies in the provision of meals for children attending public elementary schools, and in certain cases with the consent of the board of education to defray the cost of the food themselves.

In 1907 an uncontroversial act entitled the Education (Administrative Provisions) act, besides dealing with various matters of technical and administrative detail, laid upon local education authorities the new duty of providing for the medical inspection of all children attending public elementary schools. In connection with this act the board of education established a medical department to advise and assist them in supervising local education authorities in carrying out their statutory duties in this regard. The whole department was significant of the new sense of the importance of hygiene and physical training.

Other noteworthy developments were the extension in the provision for mentally and physically defective children (see BLIND, TRAINING AND WELFARE OF THE, DEAF AND HARD OF HEARING, EDUCATION OF, MENTAL DEFICIENCY, etc.), and a more definite organization of "after care" work, including the finding of employment for pupils on leaving school. The act of 1902, by placing secular education in public elementary schools under the control of strongly organized local education authorities, enabled the board of education in the code of 1904 to abolish the last traces of the system of payment by results, by setting forth "a properly co-ordinated curriculum suitable to the needs of the children, with an indication of the relation which the various subjects of instruction should bear to each other, in place of the relatively haphazard list of possible branches of knowledge which were formerly presented to the choice of individual schools or authorities." In the new code also the board for the first time endeavoured to state for the guidance of teachers and parents the

them. Assistant teachers and pupil teachers might be appointed in voluntary schools "if it is thought fit" without reference to religious creed and denomination, where there were several candidates for the post of pupil teacher, the appointment was to be made by the L.E.A.

Provision of New Schools.—New schools might be provided either by the L.E.A. or any other persons, subject to the issue of three months' public notice, and to a right of appeal on the part of the managers of any existing school, the L.E.A. (in the case of proposed voluntary schools) or any ten ratepayers of the district, to the board of education on the ground that the proposed school was not required. Any enlargement of a public elementary school which in the opinion of the board of education was such as to amount to the provision of a new school, and any transfer of a school to or from the L.E.A. had to be treated as the provision of a new school. In deciding appeals, the board was to have regard to the interest of secular instruction, the wishes of parents as to the education of children, and the economy of the rates, but existing schools were not to be considered unnecessary if the average attendance was not less than 30.

Aid Grant.—Section 4 provided a new aid grant payable to the L.E.A. for the number of scholars in average attendance in schools maintained by them.

Education Committees.—All councils having powers under the act, except those having concurrent powers as to higher education only, were to establish education committees in accordance with schemes approved by the board of education. All matters relating to the exercise by a council of their powers under the act, except the power of raising a rate or borrowing money, stood referred to the education committee. Every scheme had to provide (1) for the appointment of a majority of the committee by the council, the persons so appointed to be already members of the council unless the council otherwise determine, (2) for the appointment by the council of persons of experience in education, and of persons acquainted with the needs of the various kinds of schools in the area of the council, (3) for the inclusion of women.

Expenses.—All parliamentary grants were made payable to the L.E.A. instead of, as previously, to the managers. The council county was to charge a proportion of all capital expenditure and liabilities, including rent, on account of the provision or improvement of any public elementary school, on the parish or parishes served by the school, such proportion to be not less than one-half or more than three-fourths as the council thought fit. The council county might also charge on the

proper aim of the public elementary school laying stress upon that element of the training of character which the system of payment by results had obscured. The new spirit was strikingly manifested in the volume of *Suggestions for the Consideration of Teachers*, issued by the board of education in 1905. Apprehension of the true aims of elementary education led to a corresponding development of instruction of a practical character, observation lessons and nature study being treated as a necessary element in the curriculum, while handicraft and gardening and domestic subjects (for girls) were encouraged by special grants. Increased attention was bestowed both by the central and local authorities upon the problem of rural instruction (see RURAL EDUCATION).

According to the official returns for 1907-08, the total number of scholars on the registers was as follows: council schools 2,991,741, voluntary schools 2,566,030, total 5,557,771, and the total attendance upon which grant was paid was 4,928,659. The percentage of actual average attendance to average number on the registers was 88.50%. The parliamentary grant (England and Wales) for elementary schools, other than higher elementary, amounted to £11,023,433.

A large number of the old higher grade board schools (declared illegal under the Elementary Education acts by the judgment in the case of *Rev v Cockerton* in 1901 and legalized temporarily by an act passed for the purpose in the same year) were converted into municipal secondary schools under the act of 1902. In the succeeding years provision was made in the code for higher elementary schools of a specialized and technical type intended only for industrial districts. In 1906, as the result of the recommendations of the consultative committee, a new type of higher elementary school was admitted for children over 12, corresponding generally to the French *école primaire supérieure*, and having "for its object the development of the education given in the ordinary public elementary school, and the provision of special instruction bearing on the future occupations of the scholars, whether boys or girls" (For subsequent history, see CENTRAL SCHOOLS).

The total expenditure (exclusive of capital outlay) of the local authorities (1906-07) in England only, upon elementary education, including industrial and special schools, was £19,776,733, of which £10,408,242 was met by the ordinary parliamentary grant, and £8,930,468 was the balance required to be met by rates. The difference being represented by receipts from various sources. The average cost per child of elementary schools in England and Wales (including London) was £5 4s 10d, and the average central grant (excluding grants for special purposes) at 41s, leaving 19s to be raised locally.

Training of Teachers—The training of teachers for the two great branches of public education, elementary and secondary respectively, early became an important part of the general administrative problem. Sir Josiah Fitch pointed out that the full appreciation of the importance of training began at the lower end of the social scale. Shuttleworth and Tunnell in 1846 urged the necessity of special training for the primary teacher, and hoped to establish state training colleges, to supply this want, but the college at Battersea which was founded as an experiment was soon transferred to the National Society (the 'National Society for educating the poor in the principles of the Established Church' founded in 1811). Before this Bell and Lancaster had made arrangements in their model schools for the reception of a few young people to learn the system by practice. The religious bodies in England, notably the established church, proceeded to avail themselves of the failure of the central government and a number of diocesan colleges for men and separate colleges for women were gradually established. In 1851 the British and Foreign School Society (founded 1808) placed their institutes at the Borough Road and Stoke Newington, London, on a collegiate footing, and subsequently founded other colleges at Swansea, Bangor, Darlington and Balfour Walden; the Roman Catholic Church provided two for women and one for men, and the Wesleyans two one for each sex. The new provincial colleges of university rank were invited by the educational department to attach normal classes to their ordinary course and to make provision for special training and suitable

practice in schools for those students who desired to become teachers. Thus the residential colleges of the old type and the day colleges attached to institutions of university rank, were both subsidized by grants from the treasury, and regularly inspected. As the need of special training for teachers became further recognized by the consideration of the same question in regard to teachers in higher and intermediate schools (Cambridge instituting in 1879 examinations for a teacher's diploma, and other universities providing courses for secondary as well as primary teachers and establishing professorships of education) the attitude of the board of education toward the problem gradually became more and more a subject of controversy and of public interest, as indicated by the clause in the act of 1899 providing for a public registration of qualified teachers and for the gradual elimination from the profession of those who were unqualified. And meanwhile the increased solidarity of the National Union of Teachers (founded in 1870), the trade union of the teachers, brought an important body of professional opinion to bear on the discussion of their own interests.

The question of preliminary education of elementary teachers reached a critical stage in 1909. The history of pupil-teachership as a method of concurrent instruction and employment showed that it was, in its inception, something in the nature of a makeshift, the ideal placed before local education authorities in the regulations of the board was the alternative system whereby with the aid of national bursaries (instituted in 1907) "the general education of future teachers may be continued in secondary schools until the age of 17 or 18, and all attempts to obtain a practical experience of elementary school work may be deferred until the training college is entered, or at least until an examination making a natural break in that general education and qualifying for an admission to a training college has been passed." Under the revised pupil teacher system established by the regulations of 1903, provision was made for the instruction of pupil-teachers in centres which as far as possible were attached to secondary schools receiving grants from the board of education under the regulations for secondary schools. Accordingly, the result was to modify the old system in two ways, first by providing the alternative of a full course of secondary education, secondly by associating pupil-teachership itself as far as possible with part-time attendance at a secondary school (See TEACHERS, TRAINING OF).

One of the principal difficulties which confronted the state and the local authorities in their task of organizing an improved system of public education under the act of 1902 lay in the deficiency of training colleges in view of the increased number of teachers. Moreover there was a widespread feeling that the provision of training colleges should be undertaken by the state as a matter of national concern. Accordingly a new system of building grants in aid of the establishment of training colleges was instituted in 1905. In 1906 these grants were raised from 25% to 75% of the capital expenditure, but were limited to colleges provided by local authorities. A further difficulty in view of the municipalization of education arose from the fact that the majority of the residential colleges were in the hands of denominational trusts which did not admit a conscience clause. Under the presidency of McKenna (1907), the board of education in regulations which excited much controversy, "with a view to throwing open as far as possible the advantages of a course of training in colleges supported mainly by public funds to all students who are qualified to profit by it, irrespective of religious creed or social status," laid down that the appointment of a candidate might in no circumstances be rejected on any religious ground, nor on the ground of social antecedents or the like. The same regulations provided that no new training colleges would be recognized except on terms of compliance with certain conditions as to freedom from denominational restrictions or requirements. The obligation as to religious exemptions was limited to 20% of the admissions.

Training facilities for secondary teachers entrusted at Cambridge as far back as 1890, and the other universities later followed suit. None the less, progress was far slower than in the elementary sphere, especially in regard to the men. Many headmasters, especially in the public schools still believed that the best

way was for the young master to play himself in. With the head mistresses, on the other hand, training was more and more regarded as a *sine qua non*. It is only fair to add however, that even with the men the pace accelerated.

The fear that a considerable part of the national expenditure upon elementary education was wasted for want of an effective system of continuative instruction to be given out of working hours to adolescents engaged in industrial employment led to an inquiry by the consultative committee of the board of education whose report (1909) recommended a reduction in the size of classes in elementary schools by the new staffing regulations of that year, an increase in handwork with a view to rendering the curriculum less bookish and more efficient as a training for industrial and agricultural life, and legislation to reform the system of half time attendance and raise the age of compulsory attendance to 13 and ultimately 14. They further recommended a super structure of continuative schools or classes at which attendance would be compulsory up to 17 under various adoptive locally at the option of the local education authorities. In 1906-07 about 21 per thousand of the population of England and Wales attended evening schools and classes inspected by the board of education, and grants amounting to £361,596 were paid for 440,718 regular attendants (See CONTINUATION SCHOOLS).

The general progress in elementary education, great as it was in the years following the act of 1902, had been outstripped by that made in secondary education. During that period there had been built up a liberal system of local scholarships and free places, amounting after 1907 to 25% or more of the pupils actually in the schools, providing a ladder from the elementary school to the secondary and thence to the university, including, as it has been shown the majority of future elementary teachers. In addition scales of salaries had been introduced by many local authorities, the curriculum rendered far more flexible by the abolition of regulations, the school life lengthened, and an imposing, though still incomplete, network of schools developed throughout the country. By 1910 there were on the board of education's grant list, 841 secondary schools with 141,149 pupils, while in addition 87 schools were recognized as efficient, but received no grant.

1910-14.—The period of 1910-14 was one of steady progress in education even if somewhat uneventful from the parliamentary point of view. One noticeable matter in that sphere was the Elementary Education act of 1914 which renewed the act of 1899 (Defective and Epileptic Children) in a more drastic form. Another landmark was the board's circular on physical exercises in secondary schools, in which Swedish exercises were definitely laid down as the official form of physical training, similar recognition having already taken place in elementary schools and training colleges. But, in view of subsequent history, perhaps the most important event was in the realm of university education when in 1913 the report of the royal commission on London university (qv), presided over by Lord Haldane, was issued, the commission having been appointed in 1907. One part of the report seriously threatened the existence of the external degree, a danger later averted, but a still more important part of it dealt with the revision of the organization and government of the university, which formed the groundwork of a subsequent commission and parliamentary action.

World War I.—During the period of World War I all grades of work suffered. The elementary schools lost many of their teachers, who were called on for military service. The men's training colleges were seriously depleted, and several were closed or amalgamated, while in the later stages of the war, the boys' secondary schools lost practically all their pupils at the age of 18. A large amount of the teaching was done by women who occupied positions usually held by men teachers. Nevertheless, there was progress to chronicle. In 1917 the board, which in 1914 had abolished all examinations for lower and middle forms in secondary schools, established the secondary schools council for co-ordinating the standards of the remaining examinations in these schools, multiplicity of examinations, with considerable variety in standard, having been in the past a serious flaw in English education (See EXAMINATIONS).

Education Acts 1918 and 1921.—The men who returned from the front on the conclusion of the war had realized the need of education as a *sine qua non* to promotion from the ranks. At the same time there had been forming at home a strong body of opinion in favour of insuring, as far as possible against the inevitable aftermath of postwar unemployment. This opinion may be said to have focused around the report of the departmental committee on juvenile education in relation to unemployment which, appointed in 1916 reported in 1917, many of its suggestions being embodied in the bill of 1918.

The Education act of 1918, which was carried through by H. A. L. Fisher, and which was re-enacted, with most of the earlier acts, in consolidated form by the Education act of 1921, made a determined attempt to improve the state of things in England and Wales. It aimed at the establishment of "a national system of public education available for all persons capable of profiting thereby," and the local authorities were called on to prepare schemes setting out the provision which they had made and proposed to make to this end. The act effected important changes in regard to elementary education (see ELEMENTARY EDUCATION), including the power to establish nursery schools (qv) for children between two and five years of age. It raised the compulsory school age from 12 to 14 with power to the local authority to extend that age to 15. It abolished part-time attendance, made provision for central schools for the older and more intelligent children in the elementary schools, and laid emphasis on physical training, enlarged facilities for recreation of all kinds and the social side of education. The local authorities were to co-operate in providing for the preparation of children for further education in schools other than elementary, and for their transfer at suitable ages to such schools. The act also dealt with the supply and training of teachers, and extended the duties and powers of the local authorities with reference to medical inspection and mental deficiency and treatment, to secondary and continuation schools. It removed the limit imposed on rating powers for education other than elementary.

But perhaps the most novel feature of the statute was that which instituted a compulsory system of part time education after the close of the elementary school period. Young persons, between the ages of 14 and 18, were required to attend a continuation school for 320 hr. in the year, unless able to claim exemption under the act. (See CONTINUATION SCHOOLS.) Other movements that grew out of this legislation, or received an added momentum from its presence on the statute book, were the Workers' Education association and the movement for adult education (qv).

In 1920, for the first time in the history of English education, a national scheme of salaries for elementary and secondary teachers (see SECONDARY EDUCATION) was established under the chairmanship of Lord Burnham, known thereafter as the Burnham scale. Slight modifications were subsequently made in both pension and salary schemes, but the general result of these reforms was to place the position of the teacher on a satisfactory footing, one direct outcome being the rapid growth of members on the teachers' register that followed, largely through the efforts of the National Union of Teachers. In 1920, also, the board started state scholarships to enable the talented children of parents with limited means to proceed to the university. Dropped during 1922-23, they were revived in 1924, and the maximum number offered in 1927 was 200. Moreover, during the same period (1918-22), the board published four reports of committees on modern languages, science, classics and English. In 1922 the board issued a valuable circular on the possibility of co-ordinating the recommendations made in these reports with the claims of other subjects.

After 1922 education went through a period of slowing down and consolidation, while at the same time a large amount of official investigation and research took place. The financial uneasiness may be said to have started with the seventh report of the Select Committee on National Expenditure in 1920 which specially dealt with national education. But the actual financial stress did not make itself felt until 1922 when, with almost dramatic suddenness, unemployment, hitherto at an insignificant figure, bounded

up in less than six months to an abnormal height. Among educational developments the scheme for universal day continuation schools (1917) was the first to suffer. Unfortunately conceived as the prolongation of general education they became speedily unpopular with the pupils, parents and the general public. Practically the only schools that survived were the London ones. A certain number of these were saved by being placed on a voluntary basis with a voluntary levy and as such became increasingly popular.

In spite of the financial crisis elementary schools, secondary schools, universities and technical institutes of all kinds held their ground and even progressed though in elementary education, because of the falling off in the juvenile population from war causes (the number of pupils showed a considerable decrease). In secondary schools the numbers did not decline and there was a substantial increase in the number of pupils over 16 and in those doing advanced work. The Burnham scale was extended to technical institutes. (For the history of English universities during this period see *UNIVERSITIES*.) (C. Br., X.)

Developments Preceding and During World War II—The Education Act, 1936, provided for the raising of the age of compulsory education from 14 to 15 years, though with exemption at 14 for "beneficial employment." The reorganization of the public elementary school into separate primary (5-11 years) and senior (11-14) divisions was given fresh impetus by this act and some fine senior schools were built or projected. A national campaign for physical education brought to a climax by the Physical Training and Recreation Act, 1938, is in full swing. A national development of technical education involving a capital expenditure of 14,000,000 is being planned.

Despite these signs of progress, the teachers were uneasy and apprehensive. The buildings in which many had to work were out of date and not infrequently in bad repair. Their pay was poor and their status in society unequal. Thousands of classes were far too large. The secondary school curriculum had in the endeavour to meet modern requirements become a congested mass of unrelated subjects. The clauses in the 1936 act exempting children from attendance at school after 14 if they found "beneficial employment" were felt to be a retrograde step.

These and other complaints gave rise to a feeling largely unarticulate that nothing less than a complete reorganization of the statutory system of education was necessary. The publication in Dec. 1938 of the report of the consultative committee of the board of education on *Secondary Education, with Special Reference to Grammar Schools and Technical High Schools* (the Spens report) gave considerable impetus to this feeling. This, like the committee's earlier report on *The Education of the Adolescent* (the Hadow report, 1926), recommended that all varieties of post-primary education should be regarded as secondary education, and suggested, more controversially, that this education should be conducted in three main types of secondary school: grammar, technical and modern—thus opening a wide dispute.

But by early 1939 reform projects were overshadowed by the gathering threat of war. School children were doing gas mask and evacuation drill; administrators preparing estimates for air raid shelter. On Sept. 1, 1939—the day the school leaving age was to have been raised to 15—the Germans invaded Poland and Britain began to evacuate children from her 140 large centres of population. With in 11 days, 750,000 school children and many thousands of younger ones were transported into "war" districts. As no bombing occurred, great numbers quickly returned home, but Christmas, more than a day was being. During these months the public system of education was gravely disorganized and by the great efforts of administrators, teachers and voluntary helpers order was restored. When heavy bombing began in Sept. 1940 the educational services were generally so well prepared that they could stand up or improvise successfully at a moment's notice.

While the authorities were coming to terms with the chaos caused by evacuation, three movements of profound social significance had their birth. In Nov. 1939 the govt. earnestly launched the service of youth by calling into partnership the local education authorities and the national voluntary youth organizations and offering

generous money grants in aid of their joint efforts to provide educational social and recreative facilities for young people by means of compulsory school age. Within three years an organized network of provision had covered the country and the youth service thus created by the end of World War II had become an integral part of the public system of education.

A complex of discontents brought to the surface mainly by evacuation and including significantly, widespread anxiety on the part of parents about their children gave rise early in the war to a demand—which spread rapidly—for radical and far-reaching reforms in the public system of education. The board of education was not slow to take cognizance of this and in 1941 circulated to interested bodies a comprehensive questionnaire. During the following 18 months or so it received in answer more than 100 detailed memorandums. Most of these were published in pamphlet form or noted in the press, and public interest was further aroused and focused by numerous public meetings held all over the country notably by the Council for Educational Advance formed in 1942 by the Trades Union Congress, the National Union of Teachers, the Workers' Educational Association and the Co-operative society.

Education Act 1944—R. A. Butler who had become president of the board of education in July 1941, immediately entered into discussions with the numerous interests concerned with public education in England and Wales and exactly two years later, after prolonged negotiations conducted by him, presented to parliament the government's policy for postwar reform in a White Paper entitled *Educational Reconstruction*. In Dec. 1943 he introduced into parliament a bill to reform the law relating to education in England and Wales and on Aug. 4, 1944, this became law as the Education Act 1944.

This great act the bulk of which came into operation on April 1, 1945, remodelled the public system of education by abolishing the previous division into elementary and higher education and organizing it in three progressive stages: primary (to age 12), secondary (12-18) and further, from the end of compulsory full-time education onward, and by making it the statutory duty of the local education authorities to secure the provision of efficient education throughout the three stages (previously the provision of elementary education only was a duty). The president of the board of education who could only "superintend" was made a minister with power to direct and control the authorities. The act raised the age of compulsory full-time education, first from 14 to 15, and later to 16, as soon as practicable. It established a system of compulsory part-time education (one day a week) up to age 18 for all not in full-time education.

Tuition fees were abolished in primary and secondary schools maintained by the public authorities. All private schools were to be registered and reported. (H. C. D., X.)

There was also some supply and required extra accommodation (H. C. D., X.)

SCOTLAND

The Education (Scotland) act of 1872 set up elective school boards and vested in them the existing parish and burgh schools. A conscience clause, allowing exemption from religious instruction, did little more than confirm existing usage. The school boards were left full liberty as to the religious instruction to be given in their schools, and in practice school boards universally adopted the Shorter Catechism, which was acceptable to all denominations of Presbyterians. The act made the school boards responsible for the supply of school accommodation, and introduced compulsory attendance. By the act of 1901 the age of

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compulsory attendance was raised to 14, with provision for exemption after 12.

A notable feature, historically, in Scottish education was the extent to which the parish schools supplied their best pupils with higher education. Administrative changes under the code of 1903 and later codes led to a remarkable development of higher-grade schools and departments, organized upon the lines of the higher primary schools of France. "To continue a stage further," said the report of the Scottish education department, "the general education of that considerable body of pupils who, under new conditions, may be expected to remain at school till 15 or 16."

There was a gradual abandonment of individual examination as the basis for the payment of grants. Elementary education was generally rendered free by the fee grants under the parliamentary vote, and by the sums accruing under the Local Taxation (Customs and Excise) act of 1890 and the Education and Local Taxation (Scotland) act of 1892.

The Act of 1908—Certain additional powers were conferred upon school boards by the Education (Scotland) act of 1908, including powers to provide school meals, in outlying parts to provide means of conveyance, or pay travelling expenses of pupils or teachers, or defray the cost of lodging pupils in convenient proximity to a school, to provide for medical inspection, and in the case of children neglected by reason of ill health or poverty of the parent, to supply food, clothing and personal attention. Perhaps the most noteworthy provision of the act of 1908 was that which enabled (not obliged) school boards to make bylaws requiring attendance at continuation classes up to the age of 17. It laid upon the school boards the duty of making suitable provision of continuation classes in the crafts and industries practised in the district.

The Scottish Education act of 1872 distinguished certain burgh and parish schools as "higher class public" or secondary schools. The act of 1908 dealt in some detail with secondary education. Secondary schools were distinguished from intermediate, the former being defined as providing at least a five-year course, the latter as providing at least a three-year course for pupils who had reached a certain standard of attainment in elementary subjects. Intermediate schools were later abandoned and a three-year advanced course from the ages of 12 to 15 was provided at primary schools, leading to the higher day school certificate. A two-year advanced course led to the lower day school certificate. The teaching in these advanced courses was partly practical, but included also morals and citizenship, music, drawing, English, science, mathematics and physical exercises. It was the aim of the authorities to staff the advanced divisions with teachers as highly qualified as those in secondary schools. A qualifying test at the age of 11 or 12 decided whether a child was to enter an advanced course or proceed to the secondary school. But there were facilities for changing over at a later stage.

The Act of 1918—By the Education (Scotland) act of 1918 the machinery of the system of education was reorganized, with a large increase of expenditure, both national and local, which was partly due to the transfer of voluntary schools to the public authorities. A scale of minimum salaries for teachers was drawn up in 1919. In 1920 the education department urged rigid economy, and there followed a reduction in salaries and staffs and an increase in the size of classes. In 1924 the restrictions were relaxed and there was a noticeable increase in educational activity, but in 1925 the surge for economy was again dominant.

The 1918 act swept away the system of parochial school boards. Five large burghs, Edinburgh, Glasgow, Aberdeen, Dundee and Leith, remained separate educational areas (the number was reduced to four by the amalgamation of Leith with Edinburgh in 1920), elsewhere the area is the county, including the burghs within its bounds. Electors to the education authorities were registered local government electors, and voting was conducted on the principle of proportional representation. School management committees, composed of representatives of the education authorities, parents, teachers, and others nominated by local bodies, had limited powers under the education authorities.

Education authorities were required to provide free primary,

intermediate and secondary education in all districts, but they could maintain a limited number of fee-paying schools and make grants to others. No pupil, however, could be debarred from continued education by inability to pay fees, and each education authority has a bursary scheme. They were also empowered to spend money on the provision of food and books for the children, and to give assistance to qualified persons attending the university or training college.

Nearly all the voluntary or denominational schools were transferred to the education authorities in accordance with the act, the teachers in such schools were appointed by the education authority after being approved, with regard to character and religious belief, by the denomination concerned. No child whose parents objected to his receiving religious instruction was thereby to lose any other advantage of the school. Voluntary schools not transferred to the education authority ceased to be eligible for grant from the education fund. A national committee for the training of teachers, established in 1920 and elected by the education authorities, controlled the former denominational training colleges.

The Act of 1945—The Education (Scotland) act, 1945, generally applied to Scotland the provisions of the English Education act of 1944 (see above). (M G G, X)

UNITED STATES

Religious Origin of Schools—Schools of America, as with the older European countries from which the early American settlers came, arose as children of the church. From instruments of religion they gradually changed into instruments of the state. The first schools in America were clearly the fruits of the Protestant revolts in Europe, and were set up by dissenters who had come to America to obtain a freedom in religion which they could not enjoy in their own lands. The reformers had insisted upon the necessity of a knowledge of the Gospels as a means to personal salvation, and the ultimate outcome was the creation of schools to teach children to read. The early settlers in New England brought these ideas with them, and one of their first interests, after they had built their homes and churches and settled the civil government, was the creation of schools and a college to advance learning in the new land and to provide a supply of literate ministers. With practically all the early religious groups that settled in the central and northern colonies the education of the young for membership in the church, and the perpetuation of a learned ministry for the congregations, elicited serious attention. Only in the Anglican colonies of Virginia and southward was this early interest in education largely lacking.

Three Attitudes—From the European background of the early colonists three attitudes toward education were established in the American Colonies. These are of importance because they materially affected the development of education in the states during the early national period. The first was the compulsory-maintenance attitude of the Puritans of the New England colonies, who set up a combined religious and civil form of town government and by colony legislation in 1642 and 1647 established schools and ordered children to be taught to read and to be given instruction in religion. Still earlier (1635) the beginnings of an English type of Latin grammar school had been made at Boston, and the year following (1636) an English type college (Harvard) had been established by the same people at Cambridge, Mass. The laws of 1642 and 1647 are important, in part because for the first time in the English-speaking world a legislative body representing the state made education compulsory, and also because what the Calvinistic Puritans of Massachusetts established in practice was later generally adopted by the different American states. This distinctively Calvinistic contribution to the new-world life was one of large future importance.

The second attitude was what became known as the parochial-school attitude, and was best represented in Pennsylvania. Unlike New England, no sect was in the majority in Pennsylvania, and church control by each denomination rather than general colonial action resulted. There was no appeal to the state. Instead, parochial schools were established in connection with the churches

and private day schools were opened in the larger towns. Under the primitive conditions of the time the interest even in religious instruction often declined almost to the vanishing point, and Pennsylvania and the other middle colonies finally settled down to the policy of leaving education to such private and parochial schools as cared to undertake it, a policy that was overcome later only after long and stubborn resistance.

The third attitude was what was known as the pauper school nonstate interference attitude, and was best exemplified by Virginia and the southern colonies. Unlike New England these had been settled by English who had come to America for gain rather than for religious freedom, and the lack of any strong religious motive for education naturally led to the continuation of English practices rather than development on distinctively colonial lines. The tutor in the home education in small private and select day schools, or education in the mother country for the sons of the well-to-do planters, with apprenticeship training and a few pauper schools for the children of the poorer classes consequently came to be the prevailing system, and as in the mother country education was not considered the business of the state, nor did the church give any special attention to it. As a result in Virginia, and the colonies which followed its example, the English charity school idea came to dominate such general education as was provided, with the apprenticing of orphans as a prominent feature.

The 17th century was a period of the transplanting of European ideas as to government, religion and education to the new American Colonies and by the 18th century the three attitudes toward educational responsibility had been clearly established on American soil deeply influencing subsequent American educational development. In time the first or New England Calvinistic attitude came to be the accepted American conception, and the other two types were subordinated or eliminated. Almost all the early 19th-century struggles to establish education in the states were battles between the upholders of these different attitudes.

Change in Character—During the 17th century little or no attempt at adaptation or change in English ideas transplanted to the colonies was made. With the coming of the 18th century there was a waning of the old religious interest, a tendency to create native institutions instead of copying those of the mother country, the rise of a civil as opposed to a religious form of government, new interests in trade and shipping, a breakdown in the old aristocratic traditions and customs, and a dawning individualism—all of which tended to weaken the hold of the old religious influences and in turn the interest in the old type of schools and learning. By 1750 the change in religious thinking had become quite marked, the New England religious town had begun to disintegrate, and a native type of district school and academy had arisen to threaten the very existence of the town grammar school. By 1750, too, it was clearly evident that European traditions and ways, manners and social customs, and types of schools no longer satisfied. To the north this expressed itself in a tendency to modify all established educational institutions to make them conform more closely to American thinking, to the south in a tendency to discard schools altogether. There were many evidences, in education as in government, that the end of the colonial period was near at hand and the Revolutionary War came as the culmination of a process of evolution which had been taking place for some time.

Effect of the American Revolution—With the outbreak of the war education everywhere suffered seriously. Most of the rural and parochial schools closed or continued a more or less intermittent existence. In some of the cities and towns the private and charity schools continued to operate, but in others they were closed entirely, for the war engrossed the energies and resources of the people of the different colonies. In New York city then the second-largest city in the country practically all schools closed with British occupancy and remained closed until after the end of the war. The Latin grammar schools and academies often closed from lack of pupils, while the colleges were almost deserted, Harvard and Kings, in particular, suffered grievously, and sacrificed much for the cause of liberty. The period from the revolution to the beginning of the national government (1775-89) was

a time of rapid decline in educational advantages and increasing illiteracy among the people. Meagre as had been the opportunities for schooling before 1775, by 1790, except in a few cities and in the New England districts, they had shrunk almost to the vanishing point.

A Half century of Transition—The first half century of America's national life may be regarded as a period of transition from the church control idea of education to the idea of education under the control and support of the state. It required time to make this change. Up to the period of the beginnings of national development education had almost everywhere been regarded as an affair of the church, somewhat akin to baptism, marriage, the administration of the sacraments and the burial of the dead. Even in New England, which formed an exception, the evolution of the civic school from the church school was not yet complete. A number of new forces—philanthropic, political, social, economic—now combined to produce conditions which made state rather than church control and support of education seem both desirable and feasible. The rise of a new national government based on the two new principles of political equality and religious freedom together with the rise of new economic conditions which made some education for all seem necessary for economic as well as for political ends, changed this age old situation.

For long the churches made an effort to keep up, as they were loath to relinquish their former hold on the training of the young. The churches, however, were not interested in the problem except in the old way, and this was not what the new democracy wanted. The result was that, with the coming of nationality and the slow but gradual growth of a national consciousness, national pride, national needs, and the gradual development of national resources in the shape of taxable property, all alike combined to make secular instead of religious schools seem both desirable and possible to a constantly increasing number of citizens. This change in attitude was facilitated by the work of a number of semiprivate philanthropic agencies, the most important of which were (1) the Sunday school movement, (2) the growth of city school societies, (3) the Lancasterian movement, and (4) the coming of the infant school societies.

Of these the Lancasterian movement was by far the most important because it, for the first time, made general education for all seem financially possible. All at once, comparatively, a new system of teaching had been evolved which not only improved but at the same time tremendously cheapened education. The new Lancasterian schools materially hastened the coming of the free school system in all the northern states by awakening thought, provoking discussion and accustoming the people to bearing the necessary costs which public education entail. The city school societies, privately organized associations to provide educational facilities in the cities, formed a connecting link between the Lancasterian schools and the publicly organized schools which followed.

Creation of the U S State School—By the close of the first quarter of the 19th century a great struggle for the creation of a series of tax-supported, publicly controlled and directed, and non-sectarian common schools was in progress, and the second quarter of the century may be said to have witnessed the successful conclusion of the battle. In 1825, always excepting certain portions of New England where the free school system had become thoroughly established such schools were only the distant hope of state men and reformers, in 1850 they were becoming an actuality in every northern state. The 25 years intervening marked a period of public agitation and educational propaganda, of many hard legislative fights, of a struggle to secure desired legislation and then to hold what had been secured, of many bitter contests with church and private-school interests, which felt that their vested rights were being taken from them, and of occasional referendums in which the people were asked, by vote at the polls, to advise the legislature as to what to do. Excepting the battle for the abolition of slavery, perhaps no question had ever been before the U S people for settlement which caused so much feeling or aroused such bitter antagonisms.

To meet the arguments of the objectors, and to change the opin-

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ions of a thinking few into the common opinion of the many, to overcome prejudice, and to awaken the public conscience to the public need for free and common schools was the work of a generation. It was likewise the work of a generation to convince the masses that the scheme of state schools was not only practicable but also the best and the most economical means of giving their children the benefits of an education, to persuade property citizens that taxation for education was in the interest of both public and private welfare, to show legislators that it was safe to vote for school bills, and to overcome the general opposition caused by apathy, sectarian jealousy and private interests. In time, however, the desirability of common free tax supported nonsectarian state controlled schools came to be evident to a majority of the citizens of the different U. S. states, and as it did so, the American state school free and equally open to all, was finally evolved and took its place as the most important influence in the national life working for the perpetuation of U. S. democracy and the advance ment of the public welfare.

The Struggle for Public Schools—The problem confronting those interested in establishing state controlled schools was not the same in any two states though the struggle in many states possessed common elements, and hence was somewhat similar in character. There were six strategic points in the struggle, which may be described briefly, as follows:

1 **The Battle for Tax Support**—Land endowments, lotteries, licence taxes, and rate bills were the favourite early means for raising money for school support. The land endowments made by the early states and by the federal government to the new western states were looked upon as having large potential values. The early idea was that the income from such sources would in time entirely support the necessary schools. Later this idea had to be abandoned when it was seen how little yearly income these sources produced, and how rapidly the population of the country was increasing. By 1825 it was evident to the leaders that the only safe reliance of a system of state schools lay in the general and direct taxation of all property. The cry that "the wealth of the state must educate the children of the state" now became a watchword, and by 1825 to 1830 the battle for direct taxation for education was joined in all the northern states except the four in New England where the principle had long been established. The struggle was a prolonged and bitter one. "Campaigns of education" had to be prepared for and carried through. Often those in favour of taxation were fiercely assailed and even at times threatened with personal violence. Indiana and New York were the critical battlegrounds, and referendums were taken. In Kentucky a long fight was waged to prevent misappropriation of the school fund and to secure a two mill (one fifth of a cent in U. S. currency) tax. The right of the state to tax for education and to compel the duplication of state aid by local taxation was seen to be the key to the whole problem of the creation of a state school system of public instruction. When this key position had been won, as it had been generally in the north by 1850, the process of evolving an adequate state school system became merely that of the further education of public opinion to cover the new educational needs. The development followed different lines in different states, and probably no two states stood at the same point in the evolution of a system of school support. Everywhere, though, the New England idea of state support was accepted, and the New England co-operative-maintenance attitude was established as the common practice of the different states. New England Puritanism here made one of its greatest contributions to American life.

2 **The Battle to Eliminate the Pauper-School Idea**—The home of the pauper school idea was in the old central and southern states. It made no headway in the north and the middle western states would not tolerate it. Its roots were found in one of the oldest and most conservative classes, the active taxpayers, the supporters of church schools, and the proprietors of private schools. Large numbers of them were for whom the pauper schools were intended would not brand themselves as pauper by sending their children to them, and those who accepted the divinely ordered law for the sake of their children, despised the pauper schools. Finally the

battle to eliminate the pauper school idea began in Pennsylvania in 1834 and in New Jersey in 1838, and in each state a victory was won and a state system of schools created only after bitter fights in the legislature and at the polls. The idea continued some time longer in Maryland, Virginia and Georgia, and at places in other southern states but finally disappeared in the south with the establishment of state taxation and with the educational reorganizations following the American Civil War. The rate bill, a per pupil charge levied on parents to supplement the public funds, lingered a little longer, the cities did away with it first, and by 1871 it had disappeared from every northern state and the schools of the nation were tax supported and entirely freed from the pauper taint.

3 **The Establishment of Supervision**—The battle for taxation for education was also indirectly a battle to establish some form of state oversight for the hundreds of systems which had grown up in each of the states. The acceptance of state aid inevitably meant a small but gradually increasing state control. To exercise this control found the states creating a series of school officers to represent the state, the enactment of laws extending state control, and a struggle to integrate, subordinate and reduce to some semblance of a state school system the great numbers of small community school systems. The pivotal states in this struggle were Massachusetts, Connecticut, New York, Ohio and Michigan, and the pivotal point in the struggle was the attempt to control the local systems of school organization which had developed and spread with time. In most states the district system had run rampant, and an exaggerated idea as to district rights, distinct importance and distinct perfection had become common. In Massachusetts, New York and Indiana, in particular, such systems had almost destroyed the schools. The Massachusetts law of 1826, requiring each town to appoint a town school committee to control the schools, the establishment in 1834 of the state school fund, and the creation in 1837 of the celebrated Massachusetts state board of education with an appointed secretary—a position held by Horace Mann for 12 years—marked the culmination of the struggle in that state. Connecticut provided for a somewhat similar board in 1839, and Henry Barnard became the first secretary. Michigan and Ohio provided for a state superintendent of public instruction in 1837, and the other states soon followed these examples. From then on state supervision came to be regarded as an established principle, the work of the future being largely an elaboration of the work of Mann in Massachusetts and Barnard in Connecticut—two men who may be said to have created state supervision in the United States.

4 **The Elimination of Sectarianism**—As long as there was little intercourse and migration, and the people of a community remained fairly homogeneous, it was perfectly natural that the common religious faith of the people should enter into the instruction of the school. With the coming of foreign immigration, which began to be marked after about 1825, and the intermingling of peoples in the cities, religious uniformity ceased to exist. As necessity compelled the state to provide education for the children, sectarian differences made it increasingly evident that the education provided must be nonsectarian in character. The secularization of education in the United States thus came about as an unavoidable incident in the development of government among a people, and not as either a deliberate or wanton violation of the rights of the church. The change to nonsectarian schools came gradually. Beginning early in U. S. national history and in a way a sequel to a waning interest in religion, it was not until the 1840s that the question became at all acute. Then the fight was precipitated in both New York and Massachusetts at about the same time, and with about the same results. Finally, to settle the question, state after state amended its constitution to forbid any division or diversion of the public school fund, and each new state when admitted made similar provision.

5 **The Establishment of the High School**—The schools established by the early states were almost entirely elementary, or the so called common schools. The next struggle came in an attempt to extend the public school system upward so as to provide a more complete education than the common schools afforded.

The academy development, beginning about the middle of the 18th century (see **SECONDARY EDUCATION**) had created a new type of secondary school that was semipublic in control and more democratic in character than the town Latin grammar schools had been, and the development of the academy was marked during the first half of the 19th century. In particular, this institution offered a much broader course of study than did the Latin grammar schools, often was open to girls as well as boys, and aimed to prepare for practical life and for teaching instead of merely for college. One result of this development was a demand that the cities should establish free higher schools of a somewhat similar nature. In 1821 Boston created what is regarded as the first U.S. high school, and in 1827 Massachusetts enacted a law requiring a high school in every town of 500 or more families, in which certain specified modern studies should be taught. In 1835 smaller towns also were permitted to establish such a school. This law marked the real beginning of the U.S. high school as a distinct institution, formed the basis of all subsequent legislation in Massachusetts, and deeply influenced development in other states.

Up to 1840 about a dozen high schools had been established in Massachusetts, and a similar number in other states. The democratic west soon adopted the idea and established high schools as cities developed and the needs of the population warranted their creation. The struggle to establish and maintain these schools which New York and Massachusetts had undergone was repeated in every new state east of the Mississippi river and north of the Ohio. One of the most important of these conflicts came in the city of Kalamazoo, Mich. This case finally reached the state supreme court of Michigan which, in 1874, handed down a decision which deeply influenced all subsequent development. It confirmed the high school as an integral part of the common school system and affirmed that the voters might provide for the support of any kind of public instruction authorized by the laws of the state. This decision ranks with the Massachusetts law of 1827 as one of the important milestones in the creation of the U.S. public high school.

6 The State University—During the colonial period of American history nine colleges had been established. Harvard in 1636, William and Mary in 1693, Yale in 1701, Princeton in 1746, Pennsylvania academy and college in 1753-55, Kings (Columbia) in 1754, Brown in 1764, Rutgers in 1766 and Dartmouth in 1769. The religious purpose had been dominant in the founding of each institution, though there was a gradual shading off in denominational control and insistence upon religious conformity after about 1750. Fifteen additional colleges were founded before 1810, though the two dozen colleges then existing did not have, all told, more than 100 professors and instructors, and not more than \$2,000,000 worth of property. All were small. No one of the 24 admitted women in any way to its privileges. Fourteen more colleges were added before 1820, after which a great period of denominational effort in the founding of new colleges began, and during the next 40 years 106 new colleges were founded in the United States. Though the federal government, beginning with Ohio in 1803, had given land to each of the new states to help endow a seminary of higher learning within the state, of the 246 colleges in existence by 1860 only 17 were state institutions.

In 1816 the legislature of New Hampshire attempted to take over Dartmouth college and make of it a state university, but was stopped from so doing, in 1819, by a decision of the U.S. supreme court which held that the charter of a college was a contract the obligations of which a legislature could not impair. The effect of this decision was to give a new impetus to the state to extend their public school system upward and to crown it with a state university. It was some time, however, before such institutions became either numerous or important. For long they remained much like the denominational colleges about them—small, poorly supported, and afflicted with denominational and political controversies. Michigan was the first of the state universities to throw off the yoke of political and denominational control. Opened in 1817 at Ann Arbor, Mich. in 1832 it had a faculty of only six, 72 students and a single course of study, but by 1860 it

had enrolled 519 students and its remarkable development as a state university had begun. During the next two or three decades most other state institutions followed its example.

The Land grant Colleges (qv)—In 1862 congress provided (Morrill act) for a grant of public land to each state to found a college of agriculture and mechanic arts. The grant was accepted and such an institution was created in every state, 18 states added the land-grant to their existing state universities and combined the two institutions, three of the older states (originally five) gave the grant to private institutions already established within the state, and the remainder established separate agricultural and mechanical colleges.

The financial returns from the land grants were disappointing but the educational returns were very large. Probably no aid given by the national government to the states proved so fruitful as did these grants of land, and subsequently of money, for in instruction in agriculture and the mechanic arts. New and vigorous colleges were created (Cornell, Purdue and the state universities of Ohio and Illinois were examples), small and feeble state universities were awakened into new life (Vermont and Wisconsin), agriculture and engineering were developed as new learned professions, and the states were stimulated to make larger and rapidly increasing appropriations for their universities, until the state universities largely overshadowed all but the best endowed of the old denominational colleges.

The Free Public School System—By the close of the second quarter of the 19th century, certainly by 1860, the U.S. public school system was fully established, in principle at least, in all the northern states. Much yet remained to be done to carry it into full effect but everywhere democracy had won its fight, and the American public school, supported by general taxation, freed from the pauper-school taint, free and equally open to all, under the direction of representatives of the people, free from all sectarian control, and complete from the primary school through the high school, and in the western states through the university as well, may be considered as a permanency in U.S. public policy and, with the state university, represented the crowning achievements of those who worked for a state supported educational system fitted to the needs of great democratic states. Probably no other influences had done more to unify the American people, reconcile diverse points of view, eliminate state jealousies, set ideals for the people, and train leaders for the service of the states and the nation than had the academies, high schools and colleges scattered over the land. They educated only a small percentage of the population, to be sure, but they trained most of the leaders who guided the U.S. democracy.

New Influences—Up to the close of the first third of the 19th century U.S. educational development was largely native, predicated from time to time during the colonial period by new ideas brought over from England and new plans as to organization from France. The revolution put an end to English influences, and the schools evolving afterward were those adapted to the needs of a new nation on a new continent. They were distinctly of a home-born variety. It was not until the decade of the 1820s that educational journalism in America had its beginnings, and not until a decade later that it may be said to have got under way. The first real contact with what Europe had been doing came in 1819 through the publication in America of John Galsworthy's *A Year in Europe*, in which he described the schools of a number of European countries, and especially the schools and work of Pestalozzi. A few other travellers published their descriptions, and in 1835 a translation of Victor Cousin's *Report on public instruction in Prussia* was printed in New York. The influence of this volume on the new constitution of Michigan, then being formulated, was of great importance. Both Calvin Stowe's *Report on Elementary Instruction in Europe*, made to the legislature of Ohio in 1837, and Alexander Bache's *Report on Education in Europe* (1839), awakened wide interest. In 1843 Horace Mann spent some months in visiting European schools, and on his return reported at length on what he had seen.

The general results of these various observations by travellers and official Reports, extending over nearly a quarter of a century,

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and the work of the newer educational journals, particularly the work of Henry Barnard, were to give U.S. educators some knowledge of school organizations elsewhere. They especially gave strong support to the movement, already in progress, to organize the many local school systems into state school systems, subjecting them to state oversight and control; they further stimulated the movement, already well begun, to grade and classify the schools in a more satisfactory manner; they helped to inaugurate a movement for the introduction of Pestalozzian methods to replace the wasteful individual and the mechanical Lancasterian plans which had for so long been in use, and they gave material assistance to the few leaders in Massachusetts and New York who were urging the establishment by the state of professional training for teachers for the educational service.

The training of teachers had been begun in the Lancasterian model schools about 1810, but the first regular teacher training school in America was established privately in 1823 at Concord, Vt., by the Rev. Samuel R. Hall, as an adjunct to his work as a minister. In 1827 New York state, at the instance of Gov. De Witt Clinton, provided for teacher training in connection with a few of the academies of the state. The training offered in all these institutions was entirely academic, as there was in America at that time no body of professional knowledge to teach. Practice in the work was obtained by teaching during the winter in the rural schools. Hall, however, tried to tell his pupils how to organize and manage a school, and finally wrote out his ideas in a series of *Lectures on Schoolkeeping* (1829), a little volume that constituted the first professional book on teaching to appear in America in the English language. In 1835, a Dr. Julius, of Hamburg, Ger., visited America and described to the Massachusetts legislature the Prussian system of elementary education and teacher training. A state wide agitation for state training of teachers followed, culminating in the opening of the first state normal school at Lexington, Mass., in 1839, followed by another at Barre the same year, and a third at Bridgewater in 1840. New York state followed with a similar school in 1844, and Connecticut and Michigan in 1849. By 1860, 12 normal schools in nine states and 6 private normal schools had been organized for the training of teachers (see **TEACHERS, TRAINING OF**).

About 1860, largely through Edward A. Sheldon, of Oswego, N. Y., the introduction of the new Pestalozzian procedures began. Within a few years visitors from near and far came to Oswego to see the work of Sheldon and his teachers. The "Oswego movement," which he inaugurated, during the two decades following almost completely reshaped elementary instruction in the better schools of the U.S. The normal school came into its own, and teacher training by Oswego methods was generally adopted by educationists. Between 1850 and 1880 new subjects of study were introduced in elementary education, the teaching of the older ones was revolutionized, and a new technique—a methodology—for instruction in each subject was worked out. Where before the ability to organize and discipline a school had constituted the chief art of instruction, now the ability to teach scientifically took its place as the prime professional requisite. A new conception of the child as a slowly developing personality, demanding subject matter and method suited to his stage of progress, also replaced the earlier conception of the school. With the addition of new ideas as to the teaching of history and literature, which came in with the Herbartian theories in the 1880s, and manual training and home economics instruction, which began about the same time, the most important foreign contributions to the elementary school were made. The kindergarten (*q.v.*), which reached the U.S. in the '70s and became well established by the '90s, also should be mentioned among the material contributions from foreign sources.

By 1900 the centre of gravity had been shifted from the subject matter of instruction to the child to be taught. The school, as consequence, had begun to change from a place where children prepare for life by learning certain traditional things to a place where children live life and are daily brought into contact with such industrial, social, community and real life experiences as will best prepare them for the harder problems of living which lie just ahead. These changes in character and purpose were largely

due to the teachings of John Dewey.

Expansion of the High School.—Though dating from 1821, the public high school up to about 1860 had made little headway except in regions where New England people had gone. The Civil War checked development for two decades, but after about 1885 a rapid growth took place. The old academies were replaced and the high school became the accepted U.S. secondary school. Along with this rapid development—in number of schools, teachers and students—a marked change in the high school itself took place. The course of study, up to about 1860 essentially a uniform book-study course of three years, after about 1880 was expanded so rapidly by the introduction of new subjects that it was soon lengthened to four years and subdivided into numerous parallel courses. Entirely new types of high schools too, were created such as commercial, agricultural and manual arts, and out of this evolution came the so called cosmopolitan high school offering instruction in many different types of general and special training. With the enactment by congress of the Smith-Hughes Vocational Education bill (1917), giving aid to the states for agricultural, home economics and industrial education, a vast system of vocational education, secondary and local in character but national in scope and purpose, began to be developed. Thus the American high school, as the result of a century of progress and evolution, developed into a comprehensive system of secondary education which an increasingly large proportion of the youth of the land, of both sexes, attended. Day schools, night schools and continuation schools all formed a part of this secondary school system.

University Expansion.—Accompanying the expansion of the high school came a similar development of college and university training. From about 1885, when the state universities began to turn their attention to serving and advancing the welfare of the state, both university attendance and university revenues advanced by leaps and bounds. During the same period a number of new and important endowed university creations also made their influence felt. Coincident with the rapid increase in students, faculty, schools and courses, came the greatest number and amount of gifts of money ever made to aid higher education in any land. The states, too, put millions of dollars into the equipment and maintenance of these higher institutions, believing in them as the creators of advanced public opinion and as training schools for the future leaders of the state. (See also **UNIVERSITIES**.)

Educational Reorganization.—Beginning about 1910 an important reorganization of the upper years of the public school systems in the United States took place. Instead of an educational organization consisting of eight years of elementary school and four years of secondary school, there was evolved a six-year elementary school dealing with the fundamental tools and skills, a three-year junior high school with a greatly enriched course of study designed to meet the special biological and psychological and social needs of young people in their teens, and a three-year senior high school planned for later adolescents. This substituted a 6-3-3 type of educational organization for the former 8-4 type. Few fundamental changes in educational organization were accepted more rapidly than this.

Another administrative reorganization was the extension upward of the public school system to include the 13th and 14th years of school life—the freshman and sophomore years of the traditional college. A number of U.S. cities added these years to their public school system by organizing what came to be known as a junior college, thus making their public school system a 6-3-3-2 school system.

Lateral Expansion of the School.—Along with the vertical expansion of the public school system there was also a vast lateral expansion of the school. Especially from about 1900 was this a marked feature of U.S. educational work. Pedagogical and intelligence testing revealed the need for differentiated instruction, and this was met by the institution of flexible plans for grading and promotion and the organization of ungraded and special-type classes to meet many varying needs. Classes were organized for overage, non English speaking, deaf, blind, crippled,

tubercular, anæmic, speech defective, subnormal and other types of children in need of special attention and care. The handling of disciplinary cases also called for the organization of the ungraded room, the opportunity school and the parental school. Industrial classes, trade schools and special vocational and home-making schools were instituted for other children who could not profit by the bookwork of the ordinary school. Adult instruction experienced a marked development. Another aspect of the lateral expansion of the school was the attention given to problems of health, physical welfare, playground work, nutrition, abnormalities, child care, preventive hygiene and parental guidance and infant welfare. The school physician, the school nurse, the visiting teacher and the compulsory attendance officer all combined in service to the child not making proper progress in the regular school. The school guidance counsellor was also added to help guide boys and girls into their tasks, and other advisers (deans) to help the youth of both sexes in handling their personal problems. Education in America thus took on many new functions of a personal and public welfare character. (E. P. C. U. S.)

Federal Aid.—The temporary dislocation of the U. S. educational system during the depression of the 1930s and the pressing need of trained civilian manpower led to increased financial aid from the federal government and to the assumption of extensive educational functions by almost every department of government. This development was particularly marked in connection with the emergency programs which began in 1933.

Funds amounting to a total of about \$22,000,000 were provided to keep schools open in many areas. The Federal Emergency Administration of Public Works (PWA) made grants for the construction and repair of educational buildings which up to 1937 had amounted to a total of \$263,000,000, supplemented by loans of \$83,000,000. Under the Works Progress (later Work Projects) Administration (WPA) \$250,000,000 was spent for the repair of old buildings and the construction of new buildings for educational and community recreational activities. The same administration under its emergency education program hired about 44,000 unemployed teachers to give various types of part-time education which enrolled more than 1,700,000 persons. In the schools books were repaired, libraries maintained and lunches provided in addition to numerous other useful activities. A notable contribution was also made by WPA in the support given for the establishment of nearly 1,500 nursery schools during the depression years and an increasing number during World War II to take care of children of working mothers in defense areas.

In 1934 a program of student aid was begun under the Works Progress Administration and transferred in 1935 to the National Youth Administration (NYA). Aid was given under this program to students who otherwise could not remain in high school or college in return for part-time employment in the school or on the campus or on work of value to the community. A year before the student aid program was adopted the Civilian Conservation Corps (CCC) was established as a form of work relief which combined work with other forms of educational experiences at the elementary, secondary and even college levels. At the same time other activities of the federal government in education were continued with increased grants for instruction and research in land grant colleges, agricultural and home economics extension work in rural areas and for vocational education and vocational rehabilitation.

World War II imposed new responsibilities, the major burden of which was assumed by the federal government to promote education for defense. In addition to the training of army and navy personnel in colleges, an extensive program for the training of workers in industry and agriculture was undertaken in 1940 under the first title of the U. S. office of education and continued until June 1945. During this period provision was made for the training of 13,000,000 students in high schools, special courses, colleges and universities. Of this number, 1,500,000 men and women were trained in colleges and universities, some under the Engineering Science and Management War Training programs (ESMWT), some in special courses, others in co-operation with industrial concerns. Training for industry was provided for 8,000,000 students

in 2,500 schools and for food production for 2,500,000 in 15,000 farm communities. Under the Lanham act, 1941-45, child care centres were established for children of mothers engaged in war industries. Funds were also provided by the federal government for maternal and child health, for welfare services for dependent and delinquent children and for medical care for crippled and handicapped children.

Despite the fact that the federal government during the depression and the years of World War II embarked on an extensive educational program in addition to the continuing program of supporting education proposals for the development of a policy of federal aid to correct inequalities in the provision of educational opportunity continued to meet with resistance. The opposition came in the main from groups which insisted on the tradition of states' rights and feared that federal aid might be followed by federal control in education. While some of the funds were channelled through the state and local educational agencies to be administered by them under federal supervision of a general nature, others were administered directly by federal bureaus and agencies.

The crisis came to a head in 1941 with mounting criticism of the tendency on the part of federal agencies to administer directly the educational services provided under the programs for the Civilian Conservation Corps and the National Youth Administration. As a consequence of this criticism, and also because of the entrance of the country into World War II, which demanded other methods for training youth, the CCC was discontinued in 1942 and the NYA in 1943.

Secondary Education.—In no branch of education did greater uncertainty and unrest prevail in the second quarter of the 20th century than at the secondary level. The problems represented the accumulation of difficulties which had begun to manifest themselves at the beginning of the century. An education devoted primarily, but in U. S. history not wholly, to preparation for college entrance and based on an academic curriculum became the object of criticism and attack with the rapid increase in the number of boys and girls in the high schools for whom the academic subjects appeared to be unsuitable. The enrolments in public high schools rose from 2,494,676 in 1920 to 4,799,867 in 1930, by 1935 they had increased to 5,974,537 and five years later to 7,113,282. By 1942-43 the enrolments had dropped by nearly 1,000,000 to 6,122,066, partly because of war conditions and partly because of the reduced birth rate during the depression years. They dropped further to 5,553,500 in 1944 but increased later, however, to about 6,000,000 in the early 1950s.

The curriculum was broadened but mainly by the addition of new subjects more practical in character and without a general and integrated reorganization of the program. The social and economic changes which took place in the period between World Wars I and II, the increasing unemployability and unemployment of youth, the shortage of teachers and the demands of the war years tended to focus attention on education and particularly on secondary education. The NYA brought out the importance of providing aid to students if they were to be enabled to continue their education while both the NYA and the CCC experiments emphasized the value of work experience in the preparation of youth for adult life.

From another point of view the demands of the war revealed certain defects in the quality of high school and college education. Difficulties were encountered in recruiting military or civilian personnel in addition to mastery of the languages which were included in the curriculum of both high schools and colleges. Before the entrance of the country into the war, Adm. Chester W. Nimitz drew attention to the fact that, owing to the lack of candidates for the naval officers' training corps and for commissions who were suitably prepared in mathematics, the passing mark in the examination had to be lowered. Finally, the results of a test on U. S. history given by the *New York Times* to 7,000 students in 36 colleges and universities indicated that there was not only a lack of knowledge, but widespread misinformation about the subject. Although considerable controversy was aroused about the validity of the test, there were many who showed concern about the results of the investigation. Several states—Illinois and New

Jersey for example—enacted laws requiring the teaching of U S history in all publicly supported institutions or for a specific number of years in high schools

The criticisms of the work of the high schools from the point of view of the organization of subject matter were, however, either discounted or ignored, and the trend was set in another direction. In 1940 the American Youth commission appointed a special committee to report on needed changes in the curriculum of secondary schools. The committee in its report based its recommendations on the change in the character of the high school population, the different social origins and occupational interests of the students, the need of a program to meet the interests of the large majority and the fact that only a minority would continue education beyond the high school. It pointed out that many pupils in high schools had reading ability of the fifth or even the fourth grade level, that many who were slow learners lacked either interest in subjects found in the prevalent programs or proper motivation for study. The committee concluded that the high school curriculum was generally inappropriate, that the conventional subjects—English, mathematics, natural sciences and foreign languages—needed to be re-examined, with less emphasis on the traditionally academic, and better adaptation to the interests and abilities of the students. It was recommended that the program of secondary education should concentrate on English, social studies and work experience.

This report was followed in 1944 by a more extensive report on *Education for All American Youth*, prepared and published by the Educational Policies commission of the National Education association. Purporting to be a description of secondary education as it might be conceived to be 20 years later, the report was based on the assumption that the prewar pattern of education was "shattered beyond repair," that "the end of the war was the end of an epoch to which there could be no return in education or in any other aspect of life," and that the tremendous pressure of the traditional educational program stood in the way of reform. The types of programs that should be developed were illustrated by accounts of two hypothetical experiments—one in a rural and one in an urban high school, in courses extended by two years to include community institutes or junior colleges as a normal part of the reorganized system of education. The traditional arrangement of the program by subjects would be replaced by "curriculum areas." Thus, in the urban high school the curriculum areas would consist of "common learnings" ("to help students grow in competence as citizens of the community and the nation, in understanding of economic processes and of their roles as producers and consumers, in co operative living in family, school and community, in appreciation of literature and the arts, and in the use of the English language"), health and physical education, science, emphasizing methods, principles and facts needed by all students, vocational preparation including also preparation for college entrance, and the development of individual interests—vocational, cultural or intellectual. Corresponding programs would be developed for rural high schools. The conventional subjects would appear in the new courses insofar as they would be needed to meet the common needs of youth, but they would be found "in unaccustomed settings" among the "common learnings."

Higher Education during World War II—The crises of World War II seriously affected the status and progress of higher education in the United States. In 1936 there had been a slight increase over the previous year of 6% in the enrolments in colleges and universities and of 9% in junior colleges. This increase was maintained until the outbreak of World War II. A more serious problem than that of enrolments, however, was the reduction in the income from investments of endowments and in the number of gifts. The increased enrolments were due largely to the grant of student aid under the National Youth administration. The shrinkage of income meant, on the one hand, curtailment of staffs, particularly among the younger members, despite the larger number of graduate students and Ph D's available, and on the other, made it impossible to increase salaries and in many institutions compelled a reduction. These conditions led to proposals for federal aid, without leading, however, to definite action.

The outbreak of the war in Europe had an immediate effect on enrolments in institutions of higher education as a result of uncertainty in the political situation, the increased opportunities for employment and expectation of the draft. Enrolments in 1940 were practically the same as in 1939, in 1941-42 there was a definite decrease of nearly 9% as compared with 1940-41, the heaviest losses took place in tax supported institutions and in independent teachers colleges. The distribution of students in the various fields of study showed a marked difference, the medical schools had the largest enrolments on record and engineering schools and scientific departments generally were attended by larger numbers, law schools were the worst hit by reduction in enrolments. In 1943-44 total enrolments were 1,120,300 or 18% less than in 1939.

The uncertainty as to the future of U S higher education which had begun during the depression years became still more aggravated after Pearl Harbor. For nearly a year there was no clear statement of policy from the government either on the status of students of draft age or on the use that might be made of colleges and universities for the war effort. The leadership in higher education was assumed by the American Council on Education, established during World War I to serve as a co ordinating agency in this field. Two weeks after Pearl Harbor the Planning and Executive board of the council recommended the adoption of accelerated programs by colleges and universities and emphasized the importance of continued education for able students to meet the future demands for physicians, dentists, engineers and other professional workers.

The situation became clearer in 1943, then the war and navy departments entered into contracts with 479 institutions to give instruction in some designated branch of the armed services—engineering, aviation cadets, WACs, basic training, personnel psychology, language training, premedical studies, meteorology, chemical warfare, basic medical sciences and medical, dental and veterinary training. The candidates for the army specialized training programs (ASTP) were enlisted men selected by classification and personnel officers. The basic program included English, history, mathematics, physics and chemistry in addition to specialized studies. On completing the courses students were recommended for admission to officer candidate schools or were assigned for immediate service. A similar system was established by the navy in the V 12 courses. At the same time a more liberal Selective Service policy was adopted for students in preprofessional and professional courses, such as agriculture, forestry, pharmacy, optometry and in internships, provided they received certificates of competence from the institution attended and showed promise of completing their studies successfully by July 1, 1945. In Feb 1944 the war department announced that the ASTP would be partially discontinued, only 35,000 out of 145,000 students were retained in medicine, dentistry and engineering, and more than 300 institutions were affected. (See also **UNIVERSITIES**.)

(I L K, X)

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FRANCE

Early Stages of Public Education—No historical sketch of French education can ignore the great Catholic religious educator of the 18th century, Jean Baptiste de la Salle, the founder of *Les Frères de la doctrine chrétienne*, commonly known as the "Christian Brothers." The brothers were not merely pioneers of elementary education, they may also be regarded as the originators of higher primary instruction. Under the restoration they upheld the method of simultaneous teaching against the partisans of the mutual (or monitorial) method, successfully demonstrating the superiority of the trained teacher.

The Revolution—The constitution of 1791 decreed that primary instruction should be compulsory and gratuitous. In this as in much else the Revolution was powerless to do more than enunciate general principles which it left for later generations, in

the present instance after the lapse of nearly a century, to carry into effect. True to its theories of individualistic liberty, the Revolution admitted liberty to teaching. Napoleon on the other hand by the law of 1806 centralized all forms of education in one official teaching body under the name of the Imperial university, thus securing a monopoly of teaching to the state.

Under the Restoration education fell inevitably under the control of the church but under the Liberal monarchy François Guizot in 1833 passed a law which laid the foundations of modern primary instruction, obliging the communes to maintain schools and pay the teachers. It is also to the credit of Guizot as an educational reformer that he perceived the necessity for the higher primary as distinct from the secondary school. The higher primary schools which he founded were unfortunately suppressed by the *Los Falloux*, their restoration constituted one of the great positive services rendered by the third republic to the cause of popular education.

Loi Falloux—The *Los Falloux* of 1850, passed by the second republic under the influence of the prince president, is chiefly memorable for its restoration of the liberty of teaching, which in a Catholic country means in effect free scope for priestly schools. This law also made provision for separate communal schools for girls, for adult classes, and for the technical instruction of apprentices. In 1854 France was divided for purposes of educational administration into 16 académies, each administered by a rector with an academy inspector under him for each department.

The ministry of the well known educationist, M. Duruy (1859-69) corresponding to the period of the Liberal empire, rendered primary schools for girls obligatory in communes of more than 500 inhabitants. Duruy also provided for the introduction of gratuitous instruction at the option of the commune.

Organization by the State—The task of educational reform imposed itself upon the republic by a twofold necessity. The wars of 1866 and 1870 were victories for the Prussian schoolmaster and aroused western Europe to the national importance of popular education. For France the reform of popular education was an essential part of the work of national restoration. For the republic, too, menaced by older and hostile traditions, the creation of a national system of education inspired by its own spirit was an essential condition of the permanence and security of its government and the social ideals of which that government was the expression. Hence the energy with which the republican state addressed itself to the organization of primary instruction, "obligatory gratuitous, secular."

By the law of June 1, 1878, there was imposed upon the communes the obligation of acquiring their school buildings, and as a grant in aid a sum of £2,400,000 was set aside for this purpose by the state. In 1879 a law was passed compelling every department to maintain a training college for male and female teachers respectively. The two higher normal schools of Fontenay and St Cloud were also founded to supply the training colleges with professors. During the same period, among other certificates or professional diplomas, there were established the *certificat d'aptitude pédagogique*, which qualified probationer-teachers (stagiaires) for appointment as teachers in full standing (titulaires), and the *certificat d'aptitude* for primary inspectors and heads of normal schools. The law of June 16, 1881, rendered obligatory for all teachers whether public or private the *breve de capacité*. It was not, however, impracticable to carry this law into immediate effect though conditions had improved.

The laws making primary education gratuitous compulsory and secular are indissolubly associated with the name of Jules Ferry. The law of June 16, 1881, abolished fees in all primary schools and training colleges, the law of 1882 established compulsory attendance, and finally the law of Oct. 30, 1886, enacted that none but lay persons should teach in the public schools, and abolished in those schools all distinctly religious teaching. In the boys' schools members of religious communities were to be displaced within five years but in girls' schools the religious might remain till death or resignation. The law of Aug. 9, 1936, made education compulsory to the age of 14.

Moral Instruction—Religious teaching was replaced in the

state schools under the Ferry law by moral instruction according to official curricula. In regard to the character of this instruction it would seem to have shifted from a Kantian mainly to a sociological basis. Roman Catholic opinion was at least not unanimous in regarding the "lay" or neutral school as essentially or necessarily antireligious, and plainly there was no inherent reason why the neutrality should not be a real neutrality, but with the relations between the Catholic Church and modern thought in France the influence of the nominalist teachers was in fact to be antireligious and moreover no system of independent moral doctrine, whether based upon a *a priori* or inductive reasoning could be acceptable to the Roman Catholic Church. In whatever degree the blame might be rightly apportioned between church and state, the fact is that the two found themselves in acute conflict. It may be that the mischief would have been mitigated had more moderate counsels prevailed at the time of the Ferry law, and had the church been willing to accept (as the republic might have been willing to concede) right of entry for the clergy into the schools. In the meantime the religious difficulty in the schools divided the nation into two hostile camps (*les deux Frances*, as a Swiss Protestant writer put it) in the shape of the state secular schools on the one side and the private religious schools on the other.

Secondary Education—In proceeding to sketch the French system of higher primary and secondary schools, it may be observed that European systems of higher education were generally framed upon the view that secondary education is a training complete in itself from the preparatory stage to the university, with aims and ideals of general culture which differentiate it radically and at the very outset from education of the elementary type. On the other hand, in the United States, the view prevailed that the secondary school must be complementary to the elementary school, in which even the elite must receive their preparatory or elementary training. At any rate, down to the reform of 1902, which will presently be explained, the French system could be regarded as a typical and even extreme example of the European theory, little consistent as this might seem to be with the broader principles of democracy. A further breach was made in the theory by an augmentation in the number of scholarships following World War I and by an experiment to amalgamate in country districts small secondary day and higher finishing schools.

Higher Primary Schools—The aim of the *écoles primaires supérieures* was to fill the void which must otherwise exist for those needing a higher education than the primary school could give. Throughout the organization of primary education the French kept steadily in view the danger of creating an intellectual proletariat. *Notus poursuivons la culture générale du caractère et de l'esprit, mais nous cherchons en même temps à orienter l'enfant vers la vie pratique*, says an official report. The aim of the higher primary school was to continue education in this spirit up to the age of 16 so as to prepare the scholar to take an honourable place in the higher ranks of skilled industry. In 1942 the *écoles primaires supérieures* were replaced by the *collèges modernes* (modern schools).

Lycees, Classical Schools and Modern Schools—French secondary education for boys is given in the *lycées*, which are first grade schools maintained and controlled by the state, in the so-called classical schools maintained by the municipalities, and in the *collèges modernes* mentioned above.

Secondary Education for Girls—The foundation of secondary schools for girls was in its way one of the most notable achievements of the third republic. It was inaugurated by the law of Dec. 22, 1890, called after its author, *La Loi Camille Sée*. At first the curricula were different from those of the boys, and the course of study was only five years. There were no ancient languages and mathematics were not carried to so high a pitch as in the boys' lycées. After 1942 there were three types of establishments the same as for boys (see above).

Private Secondary Schools—Until the passing of the Waldeck-Rousseau law prohibiting religious associations, the number of pupils in the state secondary schools and the private secondary schools were approximately equal the great majority of the latter schools being in the hands of the religious orders. The Waldeck-

Rousseau Act was passed on July 1, 1801, and in 1804, under M Combes, the religious schools were suppressed by law. Some man aged none the less to maintain their ground. Under the heading of the private secondary schools should be mentioned Honors causa, l'école des Roches founded by M Demolins (author of *Quoi tient la supériorité des Anglo-Saxons*) and Le Collège de Normandie, founded by M Duhamel, a former French master at Harrow school, England. The Waldeck Rousseau act also caused a temporary decrease in the number of pupils in the religious elementary schools.

Secondary School Curriculum.—In 1802 reforms were made in the curriculum. Article 1 of the decree of May 31, 1802, coordinated with primary education so as to constitute a continuation of a course of primary studies of a normal duration of four years. The decree went on to provide for a full course of secondary studies of seven years' duration, divided into two cycles of four and three years respectively. In the first cycle the scholar had two options. In section 1 Latin was obligatory and Greek optional from the beginning of the third year (*classe IV*). In section 2 there was no Latin. At the end of the first cycle the state granted a *certificat d'études secondaires du premier degré*. In the second cycle one of four courses might be taken: section 1 with Latin and Greek continued the old classical education, section 2 with Latin and modern languages corresponded to the German *Realgymnasium*, section 3 with Latin and science, and section 4 with modern languages and science to the *Oberrealschule*. The *baccalauréat*, or secondary school-leaving examination, conducted by the university, was adapted to all the courses on the principle that courses of study of equal length, whether classical or modern, literary or scientific, were entitled to equal advantages.

In 1803 the minister of public instruction, M Léon Bérard, decided to abolish the four alternative sections and make Latin compulsory for four years and Greek for two, for all secondary pupils. The course in science was to be the same for all pupils, and it was only in the year before the *baccalauréat* that the pupil could choose between classics and a modern course. The Bérard reforms considerably lightened the timetable by cutting down, above all, the mathematics, and simplified the overelaborate course of studies, but the proposal of classics for all roused the most violent opposition. A change of government made it easy for M Herriot—the new minister of public instruction—to re-establish the modern Latinless course, but the others were not revived. Henceforth the pupils had a choice between classics and a modern course, but whichever they chose, for two-thirds of the timetable in such subjects as French, history, geography, etc., they were taken together, though the system met with a good deal of criticism.

Technical Schools.—A certain number of technical schools, formerly under the ministry of commerce, were brought under dependence of the ministry of public instruction. They included six national professional schools, six *écoles nationales d'arts et métiers*, higher schools of commerce and *écoles pratiques de commerce et d'industrie*, as well as commercial and technical courses. There was also a network of institutions and schools run by the ministry of agriculture, from the national agricultural institute of Paris, and the national schools of agriculture at Montpellier and Rennes, down to the *fermes-écoles* and the *écoles pratiques d'agriculture*. (C Br, X)

GERMANY

Latin Schools.—Martin Luther's famous letter to the German municipalities in 1524 urged upon them the duty of providing schools and upon parents the duty of sending their children to school. An attempt to carry this into effect was made by the electoral government of Saxony which issued in 1528 an ordinance, drawn up by Melancthon, providing for the establishment in every town and village of Latin schools, for the Protestant reformers were solidly in favour of classical education. It is, therefore, all the more remarkable that the ordinance issued by the elector of Württemberg in 1559 represented the first systematic attempt to provide both elementary and higher education directing the establishment of elementary schools throughout the country and of Latin schools (or *Particularschulen*) in every con-

siderable centre of population. These promising beginnings were, however, brought to nought in the troublous times of the Thirty Years' War, and by the desolation and national decadence which that calamity brought in its train. The permanent and positive value of Luther's pronouncement of 1524 lies not so much in its direct effects as in the hallowed associations which it established for Protestant Germany between the national religion and the educational duties of the individual and the state. Thus, doubtless, was created that healthy public opinion which rendered the principle of compulsory school attendance easy of acceptance in Prussia at a much earlier date than in England. State interference in education was almost coincident with the rise of the Prussian state. In 1717 Frederick William I ordered all children to attend school where schools existed. This was followed in 1736 by edicts for the establishment of schools in certain provinces and by a royal grant of 50,000 thalers for that purpose in the following year. In 1763 the *Landschulreglement* of Frederick the Great laid down the broad lines upon which the Prussian state thereafter proceeded, asserting the principle of compulsory school attendance.

Karl Wilhelm von Humboldt.—It was not until after the disaster of Jena (1806) that any effective reorganization of the educational system was carried out. One of the first acts of the minister Baron vom Stein in 1807 was to abolish the semiclerical *Oberschulkollegium*, and to place education under the ministry of the interior with Karl Wilhelm von Humboldt (*q v*) at the head of a special section. Humboldt's policy in secondary education was a compromise between the narrow philological pedantry of the old Latin schools and the large demands of the new humanism of the period. The measure introduced by Humboldt in 1810 for the state examination and certification of teachers checked the then common practice of permitting unqualified theological students to teach in the schools, and at once raised the teaching profession to a high level of dignity and efficiency which of itself sufficed to place Prussia in the forefront of educational progress. It was due also to the initiative of Humboldt that the methods of Pestalozzi were introduced into the teachers' seminaries, through them to vitalize the elementary schools. To the period of the national struggle belong the revival, 1812, of the *Abiturientenexamen* (the school-leaving examination) which had fallen into abeyance, and the institution about the same time of the local authorities called *Schulvorstände* for the country and *Schuldeputierten* for the towns.

Though the period which succeeded the peace of 1815 was one of political reaction, the work of administrative organization was carried on by defining the duties of the *Provinzial-Schul-Kollegium* and the *Regierung*. In 1834 an important development was given to secondary education by making it necessary for candidates for the learned professions, as well as for the civil service and for university studies, to pass the leaving examination of the *Gymnasien*. Thus through the leaving examination the state held the key to the liberal careers, and was thereby able to impose its own standard upon all secondary schools.

Administrative Machinery.—In connection with the *Kulturkampf*, or struggle between the state and the Roman Catholic Church, the *Schulaufsichtsgesetz* of 1872 reasserted the absolute right of the state alone to the supervision of the schools. Nevertheless the Prussian system remained both for Catholics and Protestants essentially denominational. All schools, whether elementary or secondary, were Evangelical, Catholic, Jewish or mixed. In the elementary sphere, in particular, recourse was only had to the mixed school (*Simultanschule* or *parteiliche Schule*), where the deeds were so intermingled that a confessional school was impracticable. In all cases the teachers were appointed with reference to religious faith, religious instruction was given in school hours and inspected by the clergy. Under the ministerium in Berlin stood the *Provinzial-Schul-Kollegium*, the chairman of which was the *Ober-Präsident* of the province, composed of four or five *Räte* or councillors, generally selected from the directors of *Gymnasien*. This body was concerned mainly with higher education.

Each province was divided for purposes of general administration into two *Regierungen* or governments, and in each gov-

ernment there was a section consisting of three or four *Schulräte*, which controlled the elementary schools. This council was usually recruited from the ranks of directors of training colleges and from the inspectors. The *Regierung* was divided into *Kreise* or districts, and in each district an administrative officer, called the *Landrat*, represented the government. The *Landrat* was concerned with the provision and repair of elementary school buildings, for internal organization, the elementary schools were under the *Kreisschulinspektor*.

In the Protestant districts the inspectors often were Evangelical clergymen, but later inspectors with pedagogical qualifications and the status of full government officials were appointed. For every school there was a local inspector (*Ortschulinspektor*), usually the clergyman of the parish, who discharged the duties of local manager and correspondent.

The official classification or grading according to the type of curriculum of secondary schools in Prussia (and throughout Germany) was very precise. The following were the officially recognized types of the period: (I) Classical schools: (a) *Gymnasium*, with nine years' course, (2) *Progymnasium* with six years' course (II) Modern schools: (1) with Latin (semiclassical)—(a) *Realgymnasium* (nine years' course), (b) *Realprogymnasium* (six years' course), (2) without Latin (nonclassical)—(a) *Oberrealschule* (nine years' course), (b) *Realschule* (six years' course).

The differentiation between the types was the result of a natural educational development corresponding with the economic changes which transformed Prussia from an agricultural to an industrial state. The classical schools long retained their social prestige and a definite educational advantage in that their pupils were alone admissible to the universities. From the foundation of the empire (1871) the history of secondary education was largely concerned with a struggle for a wider recognition of the work of the newer schools. The movement received a considerable impetus by the action of the emperor, who summoned a school conference in 1890, at which he criticized the *Gymnasien* as lacking a natural basis. "It is our duty to educate young men to become young Germans and not young Greeks or Romans." New timetables were framed in which the hours devoted to Latin were considerably reduced and no pupil could obtain a leaving certificate without a satisfactory mark in the mother tongue. The results satisfied neither party and the reform listed only a single school generation. In 1900, after a second conference, equality of privileges was granted to three types of schools, subject to certain reservations—the theological faculties continued to admit only students from classical schools, the pupils of the *Oberrealschule* were excluded by their lack of Latin from the medical faculties, but in so far as Latin was required for other studies, such as law or history, it could be acquired at the university itself.

Although the official programs were binding on the schools, their rigidity was not absolute, experiments were possible, but they were carefully supervised. It was thus that the modifications of the classical school program known as the Frankfurter system came into being, after a similar experiment had been tried at Altona. The chief innovation—and there the two schemes agreed—was the postponement of the beginning of Latin to *Untertertia* and the introduction of French as the first foreign language. This enabled parents to defer their decision as to the form of their son's education until he was about 12 years of age.

A further factor of the willingness of the authorities to sanction reasonable changes was seen in the permission accorded to certain schools to vary the course of study, in the top classes, as a preparation for the freedom of choice of the university.

Girls' Schools.—In Prussia, as elsewhere, the higher education of girls lagged far behind that of boys and received little attention from the state or municipality except so far as the services of women teachers were needed in the elementary schools. Thus it came about that in Prussia secondary schools for girls were dealt with administratively as part of the elementary school system. After the establishment of the empire a conference of directors and teachers of these schools was held at Weimar and put forth a reasoned plea for better organization and improved status. The advocates of reform, however, were not at unity in their aims,

some wished to lay stress on ethical, literary and aesthetic training, others on intellectual development, and claimed an equal share in all the culture of the age. But even in the schools the women fought an unequal battle, for all the heads and a large part of the staff were men usually academically trained. The women continually demanded a larger share of the work, and this was secured by the establishment of a new higher examination for women teachers. University study though not prescribed was in fact essential and yet the women had not the right of access to the university in Germany. They were allowed to take the *Abiturientenexamen*, for which private institutions prepared them, but their admission to the university rested with the professor.

Economic necessity and the growing strength of the women's movement at last brought the desired change. New programs were issued in 1908, organizing the girls' schools in two degrees: the *Lyceum*, a ten class institution for girls from 6 to 16, and an *Oberlyceum* of three classes of varying types, one of which might be a training department for teachers, another for home life. But apart from these normal courses, opportunity was given to girls to follow from their 12th or 13th year courses similar to those of the higher schools for boys. The form generally preferred was that of the *Realgymnasium*. At the same time a ministerial decree opened the German universities to women on the same terms as men.

Elementary Schools.—In no sphere of public activity did the revolution of 1918 cause more far reaching changes in Germany than in that of education. The ultimate aims which these innovations envisaged were clearly stated in the Weimar constitution, and led to a single system of national education. It was recognized that this goal could only be reached by gradual steps and the responsibility for educational administration was left with the federated states. The state ministers, however, had to observe the principles enunciated in the constitution and to conform to the federal laws enacted to secure the realization of the republic's ideals.

The elementary school, which under the old regime was a class-school, became a national institution, serving all and used by all. It had no rivals and private elementary schools were forbidden in those early years for which the common school exists. The *Einheitschule*, which the popular parties had demanded before World War I, became an accomplished fact, as far as the first four years of the course were concerned. As a concession, reluctantly granted, specially gifted children were allowed to complete the course in three years.

When the *Grundschule* (basic school) had been passed the child might be transferred to a secondary school, organized to lead on to the university, or he might go to the *Mittelschule*, if he wished to enter commerce or industry about the age of 16, or he might remain at the elementary school, if he had to enter on employment at the earliest possible age.

New Types of Secondary Schools.—After 1918 the interests of poor but gifted boys were well served. Two new types of schools catered to their particular needs. There was first the *Deutsche Oberschule*, in which, in harmony with the sentiment of the Weimar constitution, the emphasis was laid on the training of a national spirit, and German history, literature and art were all studied from this national standpoint, though foreign languages were not excluded. These schools related, to a large extent, the old institutions which prepared former elementary school pupils for admission to the training colleges for teachers of primary schools.

The other new type was the *Aufbauschule* ("built-on" or supplementary school). Its place in the educational scheme resembled the high school of the United States in that it only received pupils who had completed the primary school course.

(A. E. Tw., X.)

The Third Reich and After.—Under Adolf Hitler the formal organization of the elementary and secondary systems was not changed radically, but the content of education underwent a vast transformation to make it conform with national socialist ideology. Youth labor camps were established in which the educational keynote was nationalistic and utilitarian. Personnel of the schools

was transformed, studies were wrested from their proper position as independent forms of truth and knowledge, and indoctrination permeated the whole educational system. Wherever German influence extended prior to and during World War II, anti-Semitism followed, resulting in the expulsion of Jewish teachers. The traditional nine year course was reduced to eight, and potential nazi "leaders" were sent to *Adolf Hitler schools*. The system introduced during the Weimar republic which placed teacher preparation on a university basis was discarded and replaced by one which was to recruit candidates at the age of 14 from a new type of higher primary school (*Hauptschule*) and train them in small institutions for five years. This represented a return to a system against which German teachers had been protesting for a century.

After World War II the German system again underwent a thorough overhauling in every *Land*, designed primarily to "denazify" the curricula and the teaching personnel. In soviet occupied east Germany, however, the system was naturally made to conform with Communist educational ideals (X)

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EDUCATION, THE UNITED STATES OFFICE OF, established by congress in 1867 as an independent department of the government, officially changed in 1869 to an office in the department of the interior, in 1939 transferred by executive order to the Federal Security agency, is the principal agency of the United States government for educational research, statistics, surveys, investigations and demonstrations and for the promotion of the cause of education throughout the country. It has no administrative authority over the various state systems of education although it exercises some administrative functions in the disbursement of financial grants-in-aid appropriated by congress for colleges of agriculture and mechanic arts and for vocational education of less than college grade in agricultural, homemaking, trade and industrial, and distributive business occupations in the states, territories and the District of Columbia. The influence of the U.S. office of education upon school systems and school practices in the United States is chiefly brought about by publication of numerous monographs reporting results of statistical and other studies, by the convening of national and other conferences, and by consultative services rendered by its professional staff and field agents.

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EDUCATIONAL ASSOCIATIONS Many educational and professional associations were formed after the middle of the 19th century, these did much to co-ordinate methods of education and to improve the professional standards of teachers.

UNITED STATES

Educational associations to advance the status of the profession and improve educational practices were formed in the middle of the 19th century under the leadership of such men as Horace Mann and Henry Barnard.

The federal government has no authority to require standard courses of study, teacher training, management, methods or finance as in those countries where education is directed by the central government, yet a U.S. system has grown up through the zeal of teachers who have overstepped state boundaries to join with their coworkers in conference and in educational investigation. The result has been that educational methods and standards, materials, processes and attitudes have become nearly uniform

throughout the states and territories of the union.

Educational organizations in the United States are local, state and national in scope. They may also be classified as general and special, according to their aims and purposes. There is scarcely a county of the United States which has not its organization and every city has from one to several. Each state and territory is organized. Local associations function in the solution of problems which concern their members in their local relationship. Their programs vary widely, but professional improvement, teacher welfare, social betterment and community service are common objectives. Most local associations are affiliated with the state associations.

The activities of state associations include conventions, publications, legislation, research, field service, public relations, teacher welfare, membership promotion, and co-operation with the national organization. All state associations and Alaska, the District of Columbia, Hawaii and Puerto Rico are affiliated with the National Education Association. In this connection the states co-operate in national projects, lend counsel on national policies, assist in the enlistment of members of the national association, and send official delegates to the national conventions.

The most influential educational organization in the United States, the National Education Association, was organized at Philadelphia, Pa., in 1857, under the name, The National Teachers' Association. The name was changed in 1870 to the National Educational Association, and in 1907, by act of the U.S. congress, the new charter was adopted designating the organization as the National Education Association of the United States. Its general purposes may be considered the objectives of many educational associations in America. "The purpose and object of the incorporation shall be to elevate the character, to advance the interests of the profession of teaching and to promote the cause of education in the United States." It includes the National Council of Education and the following departments: administrative women, adult education, art education, business education, classroom teachers, deans of women, educational research, elementary school principals, exceptional children, garden education, health, physical education and recreation, higher education, home economics, industrial arts, journalism directors, kindergarten primary education, lip reading, music educators, rural education, school administrators, science teachers, secondary school principals, secondary teachers, social studies, speech teachers, supervision and curriculum development, teachers colleges, visual instruction, vocational education. New departments may be created and old ones discontinued or reorganized.

The representative assembly was created in 1921. In it state and local educational associations may be represented according to the number of their members who belong to the national body. The representatives take part in business sessions and in establishing the general policy. Under this reorganization, the association undertook to carry its influence and support to every teacher in the United States. The membership was extended from 8,557 in 1918 to more than 450,000 by the early 1950s.

The National Education Association is concerned with promoting teacher welfare, through the establishment of retirement systems for teachers, the assurance of tenure of position, and increased salaries. It stimulates beneficial legislation, research, and the general advancement of learning and culture. It has sponsored many forward movements in education and its publications give wide distribution to advances in educational procedure. It called the first World Conference on Education in San Francisco, Calif., in 1923, which resulted in the organization of the World Federation of Education associations.

There are many national organizations usually representing special interests. The American Council on Education, supported by associations, universities, secondary schools, state and local school systems, promotes many phases of U.S. education through co-operative action by institutions and it undertakes activities which will contribute to that end. The American Education Fellowship, formerly known as the Progressive Education Association, with a membership of about 9,000, publishes information about progressive educational principles and promotes experi-

and technical schools, the National Association of Head Teachers and the National Federation of Class Teachers. The two latter organizations include a large number of teachers in primary and central schools who are employed mainly in the principal urban centres of the country and are usually members of the union. Both bodies hold annual conferences at which educational and professional policies are formulated generally in harmony with those proposed by the National Union of Teachers. Most of these bodies make provision to co-operate with one another, and relations between teacher groups and local education authorities are on a very friendly basis, the change in attitude dating from the establishment of national committees to settle the question of scales of salaries for teachers. (T W G N.)

EDUCATIONAL PSYCHOLOGY *see* PSYCHOLOGY

EDUCATION IN ANIMALS concerns special influences which guide or control learning. Such influences may arise from ordinary experiences in the characteristic environment, from experiences with other animals, or through human guidance.

Education through ordinary experience is typified by the manner in which many young vertebrate animals modify their inborn snapping responses to small moving objects. At first the young chick pecks at both edible and inedible objects in motion, but after certain kinds of objects, e.g., hairy caterpillars, have been rejected repeatedly in response to their harsh effect in the mouth, these may be avoided in advance while others of different visual appearance are snapped up.

Education through the activities of other animals may occur incidentally, or through individual relationships meriting the term "tutoring." Often young mammals are weaned forcibly and thereby stimulated to acquire adult feeding habits, evidently more because physiological changes in the mother cause her to reject her advances than because she has a "teaching" attitude. In birds, parental behaviour frequently influences the appearance of adult behaviour in the young, as when fledgling birds of prey are at first given pieces of flesh and finally intact prey which they must handle independently, or when early flight is stimulated by pulling or forcing the young from the nest. In the higher mammals, situations in which one individual directly stimulates and guides learning in another are not uncommon. For example, a mother

monkey may release herself and back away from her infant thereby impelling it to follow independently. As another instance, in laboratory experiments one chimpanzee in a joint rope-pulling test retrouses its lagging partner by means of an identifiable gesture—a series of gentle taps with one hand. It must be remembered that an untrained animal profits only in a very general way from seeing another perform, unless the essential parts of the act have been learned previously. An untrained dog which sees another open a door by twisting the knob with his paws is not thereby enabled to duplicate the act, although when tested alone he may be more persistent in his attacks on the door and perhaps work more around the knob than would otherwise be the case.

Education through human guidance in its simplest form, the "conditioned response," requires as basis a response which the animal makes at the outset to some definite excitatory stimulus. For example, to teach a dog to lie down on command one begins by using the hands gently to force lying down, each time presenting the new stimulus ("lie down") until after many repetitions the words alone are sufficient. Similarly in circus training the basic responses (e.g., sitting still) essential for complicated training are fixed to particular stimulus cues through a conditioned response procedure. However, for highly skilled acts a complex routine of special training is necessary, a process in which appropriate techniques are used to emphasize each step of the serial act and to exclude undesired acts. This holds both for the training of domestic animals and for less ordinary processes such as educating elephants to dance or dogs to lead the blind.

Obviously, the critical limits of animal educability vary in different animal forms particularly in dependence upon the elaboration of cerebral cortex in the brain. The cortex of a rodent such as the rat is inferior to that of a carnivore such as the dog, and the rat is found correspondingly inferior in learning complex tasks. Furthermore, brain operations reducing the amount of cerebral cortex lower the educability of given individuals. Once the potentialities and capacities of the given animal for new behaviour are known, established principles of learning may be utilized to devise a suitable training program. (*See* PSYCHOLOGY, COMPARATIVE) (T C S.)

